The Contribution of Social Media on Heritage Experience: A Case Study of Samchuk Community and Old Market District, Suphanburi

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Abstract: Alongside with their traditional roles in collecting, preserving and showcasing tangible and intangible cultures, heritage sites play a crucial role in both formal and informal education. Learning in heritage sites is often described as free-choice, informal and lifelong. Social media has significantly impacted cultural education due to its popularity and ability in engaging learners. It supports constructivist learning by promoting reciprocal learning by bringing together different people regardless of their background and their social skills. Also, the representation of the destination on the social media can potentially shape visitors' perceptions before visiting and influence their on site experience. This paper aims to investigate the current roles of social media in supporting constructivist-based museum learning by focusing on the pre-trip perception. Samchuk Community and Old Market District in Suphanburi, a historic Sino-Thai community that has been transformed into a nostalgia-themed attraction is used as a case study. In so doing, user-generated content (UGC) on the major social platforms were reviewed to investigate how social media can construct pre-trip knowledge by analysing the presentation style and the content. The contributions of the research are as follows. The paper marks an early attempt to understand social media as a tool for promoting constructivist learning experience in Thai cultural tourism. This is an understudied issue, despite Thailand being among the world's largest internet user community and the most visited destinations. Also, the suggestions provided in the paper can be insightful for practitioners to use social media as a tool to enhance museum learning experience.

Keywords: social media, heritage tourism, constructivist learning, museum learning, user-generated content

1. Introduction

This paper examines the contribution of social media on the constructivist learning in Thailand's heritage sites by focusing on Samchuk Market, a historic trade community which is now promoted as a living museum and nostalgia-themed food market. Constructivist-based learning adheres that learning does not only take place at the point of knowledge transmission or acquisition but also occurs when learners form their proper understanding of the world by synthesizing new knowledge and experience with their existing knowledge.

Museums are often regarded as free choice and informal learning (Falk and Dierkning, 1994). These days, museums do not only exist to showcase and preserve artifacts, but also help diffuse knowledge to the public. The emergence of living museums, also known as living history museum (Naumova, 2015; Worldatlas, 2019) or ethnographic cultural museum (Hitchcock, Standley and Siu, 2005) enhances the significance and of intangible heritage, defined by the Convention for the Safeguarding of the Intangible Cultural Heritage (UNESCO, 2003) as the 'practices, representations, expressions, knowledge, skills'. Storytelling has become the key enables us to understand the past. According to Kongpoonpin (2014), living museums enable people to understand history, society and its culture through spatial narration.

Samchuk is now a district in Suphanburi, central Thailand. It is a historic community whose existence can be traced back to 19th century. In addition to a large farming area, Samchuk was previously known as an important commercial hub because it is located near Tachin River. The community's economic prosperity attracted Chinese migrants to settle down into the community. They lived harmoniously with the Thais and were gradually assimilated with the locals. The community started to decline in the 1950s due to the government's modernization policy. The community was gradually isolated because road construction diverted commercial activities away from the community. In early 2000s, attempts to demolish old community buildings enticed a group of residents in Samchuk Community to revive the historic significance of this community. To date, Samchuk Community is recognized as successful community-based attraction. The presence of traditional lives in the community has made Samchuk to become a living museum, where visitors can learn about local lives through old-fashioned buildings, monuments and local family business that are still in operation (Lunchaprasith, 2016). According to the research conducted by Below the Line (2012), visitors spend 2-6 hours at the destination and they usually buy goodies, eat and walk along the community. The research project also concludes that the presence of ancient architecture, local lives and diversity of food and drink items are the markets' strengths in terms of tourism potential.

The academic contribution of this research paper is as follows. In spite of the myriad research paper discussing the case study of Samchuk Market (to name but a few Jampanil, 2007; Kamonsakdavikul *et al.*, 2013; Nakasiri, 2013), this is the first attempt where Samchuk is discussed in terms of the role of social media in enhancing the learning experience. This paper offers possibilities to incorporate social media technology in enhancing public perception of communal heritage. The findings and discussion in this paper can also provide useful insights for practitioners in the GLAM (galleries, libraries, archives, and museums) sector when considering incorporating social media to engage public to cultural establishments.

2. Constructivism in education

In the realm of education, constructivism emphasizes the role of experience in knowledge formulation. This instructional approach is derived from Piaget's psychological explanation of constructivism where people acquire knowledge through interacting with the environment and others (Scott, 2014). Knowledge is accumulated from the synthetization between prior knowledge and newly acquired information (Jeffery-Clay, 1998; Bada, 2015). The constructivist-based learning approach focuses on the subjective nature of knowledge. The truth is not absolute but rather derived to individuals' interpretation of the world around them. (Driscoll, 2000; Hein 2001).

Constructivism is regarded as a learning approach that gradually supersedes the traditional learning method, in other words, rote or objectivist learning, where knowledge is acquired through memorization. Bada (2015) contrasts constructivist learning approach with traditional learning, which can be described as passive learning and repetition. Rote learning has been much criticized for being a superficial learning approach. Nevertheless, a number of research reveals that rote learning leads to successful learning achievement. According to Kember (2016), role learning in enhancing the performance of Chinese students in learning. Also, Mitchell and Martin (1997) points out that rote learning can be effectively integrated with constructive learning approach in language classes.

The relationship between constructivism and education can be viewed from both the learners' and instructors' perspectives. From the learners' point of view, the constructivist approach is related to mind-brain mechanism. Bada (2015) relates constructivist education to the brain's ability to process, and organize information (including thoughts, emotions and cultural knowledge). For instructors, the constructivist learning refers to the instructional methodology that take into account the reciprocity between teachers and learners. Education is not about single-directional knowledge transmission but rather mutual learning between teachers and students (Tam, 2000). Constructivist-based learning is described in conjunction with learner-centred education, where active learning is central to the creation and development of knowledge (Tam, 2000). People's perception and reflection is essential for constructivist learning (Driscoll, 2000; Barviskar, Hartle and Whitney, 2009; Schrader, 2015). Bereiter (1994) pinpoints that knowledge is based on personal learning. Therefore, teachers will need to be aware of learners' voices and ability in order to provide an appropriate education for them (Honebein, 1996). The self-directed nature of constructivist instructional methods indicates that teachers are not leaders but rather facilitators assisting students learning (Tam, 2000).

In the context of museum, constructivism denotes the presence of social and individual subjectivity in visit experiences. Gradually, the museum's mission shifts from the storage and preservation of objects to message communication (Hein, 1998). The museum is known as an institution projecting cultural meanings to the society (Macdonald and Fyfe, 1996). In addition, constructivism also is reflected in the subjective nature of experience creation and consumption. Some tourism literature, such as Iwashita (2003) and Guachalla (2016), regards the cultural experience as constructive reality, which is subject to change according to social circumstances.

The constructive nature of museum experience increasingly gain momentum in museum learning. Individuals' and community's voice increasingly plays an important role in the museum content (Russo, Watkins and Groundwater-Smith, 2009). Jeffery-Clay (1998) suggests how constructivist-led educational methods can be applied in museum learning where social interaction, critical ability, knowledge background and learners' attitudes and expectations are the keys.

3. Social media in cultural heritage tourism

Scott (2014) describes social media as a 'networked platform' used for socialization, which is based on data sharing and exchange among users. Social media platforms are not content producers, but rather store contents generated by users. Contents in the platforms appear in various formats, including but not limited to text, image, audio and video (Thevenot, 2007), and also online-based interactive activities such as discussion forums and games.

To date, social media is regarded as an effective marketing tool due to its cost and time effective as well as its ability to reach a wide public (Kirtis and Karahan, 2011). Social media is a helpful tool in the tourism industry. According to Leung *et al.* (2013), social media is beneficial for tourists when preparing their trip. As reported by Huang, Basu and Hsu (2010), user-generated content (UGC) in the social media is among the primary source trusted by visitors when searching for travel-related information. Some travel-related UGC circulated within the social media platforms are often described as detailed, experiential and non-commercial driven (Litvin, Goldsmith and Pan, 2008), others offer a more comprehensive guide for travelers (Yoo and Gretzel, 2011). Also, social media is also used by tourism developers to market the destination. It can engage visitors with the attractions. Social media generates the word of mouth that spreads at a wide distance (Yoo and Gretzel, 2010). Besides stimulating awareness of the attraction, social media can support constructivist-based learning in the context of cultural tourism. Learners can use social platforms as diverse and rich sources for gaining prior knowledge. Multimedia technologies available on the platforms (e.g. image, VDO, and game formats) also enable content creators to simplify complex information and attract more audiences. Russo and et al. (2007) suggests that museums should act as a trusted social network and distribute their community knowledge. Moreover, social media enables learners to interact with others. Social network platforms are web 2.0 tools that are used to promote communication and collaboration (Enonbun, 2010). They enable learners to reach a larger number of collaborators and construct diverse knowledge through online interaction. Social media also encourages more engagement and actions than reality. In virtual communities, all participants are treated equally and there is no less spoken, shy, less popular user (Schrader, 2015).

The above literature review discusses the principles of the constructivist approach to education, where constructivism is related to the scientific explanation of the cognitive function and the instructional methodology that places value of the individual learners and interactions between instructor and learner. The relationship between social media and constructivist-based education is discussed in tandem with the role of social media in enhancing cultural experiences. It can be concluded from the literature review that social media potentially contributes to the educative purpose of heritage attractions by providing constructivist learning experience. UGC on social media does not only influence the public perception of heritage attractions but may also influence the way visitors experience them. The findings from Samchuk Community and old market, community-based living museums, will be used to elucidate this point.

4. Research methods

20 digital contents were selected and reviewed in order to satisfy the main research aim to investigate the current roles of social media in supporting constructivist-based museum learning. The UGC was sourced in a similar way that that Thai travellers use to acquire travel information.

Table 1: Sampling details

No.	Content Type	Platform	Qty.	Sample code	Selection Criteria
1	Travel Blogs (News Websites)	News websites	5	B1, B2, B3, B4, B5	Keyword used: visit Samchuk (Search on Google) Content presented is specific on Samchuk Market. They have to be In the first three pages of Google. The five most viewed contents
2	Forums	Pantip	5	P1, P2, P3, P4, P5	Keyword used: visit Samchuk Pantip (Search on Google) Content presented is specific on Samchuk Market First five ranked on Google
3	Video Clip appear in google search	Youtube	10	YG1, YG2, YG3, YG4, YG5, YV1, YV2, YV3, YV4, YV5	Search query used: visit Samchuk (search on Youtube) Content presented is specific on Samchuk Market 5 most viewed and 5 most relevant contents

According to Table 1, items can be categorised into three groups, based on social platforms. Google has been employed to acquire contents in group one and two as it is a search engine that frequently used as a tool for trip planning (*see* Section 3). Incognito mode was also utilized to prevent bias from user's browsing history. Visit Samchuk (Thai: เที่ยวสามชุก) was used as a main keyword to search for the UGC. Pantip was selected as it is one of the most popular and oldest social media forum in Thailand. The word 'Pantip' appeared in 'Google related searches', where users can find the recommendation search queries (*see* Figure 1).

Figure 1: Suggested keywords from Google related searches

Secondly, ten videoclips were selected from Youtube. Five most-viewed VDOs were selected and the other five were the most relevant ranked by the youtube filter. Coding and clustering method was employed to analyse the collected data. According to Robson (2002), this method is helpful to elicit meanings from phases. Verbal and written texts were placed in the data sheets and then were sorted through the coding system (example is shown in Table 2).

Table 2: Example of hierarchical coding system used in the study

Level	Code (Abbrev.)	Explanation
1	ATT	Attraction
2	ATT-BUI	Attraction - Build Environment
2	ATT-GAS	Attraction - Gastronomy
3	ATT-GAS-LOC	Attraction - Gastronomy - Local
3	ATT-GAS-OLD	Attraction - Gastronomy - Old-Fashioned

5. Classification of UGC

According to the empirical study, the social media contents on Samchuk Market can be classified according to the presentation style (*see* Table 3).

Table 3: Classification of UGC

	Presentation style	Example Quote	Sampling Code
1	**Informative Guide: general information**	B4-website contents on 1-day trip at Samchuk market B5-website contents containing overview information of Samchuk Market	YG4, B2, B3, B4, B5, P1
	Informative Guide: Gastronomic	YV3- TV show focusing on food products at Samchuk Market YV4- TV documentary focusing on the interview with historic food traders YV5- motion pictures of giant meatball sold in Samchuk	YV1, YV3, YV4 YV5, B1, P3, P4
2	**Documentary**	YG2-TV show about Samchuk Market where historical narratives of the market is presented	YG2, YG3
3	**Personal Travel Memories**	YG1- moving pictures of Samchuk Market's atmosphere P2- forum post where ex-visitors narrate the history of Samchuk. P3- forum post where ex-visitors narrate the history of Samchuk.	YG1, YG5, YV2, P2, P5

5.1 Informative guide

This category provides brief information that helps travellers plan. UGC in informative guide can be classified into two groups based on the content. The first group is the general information guide, including direction (*see* Figure 2), recommended attractions, restaurants and other essential information.

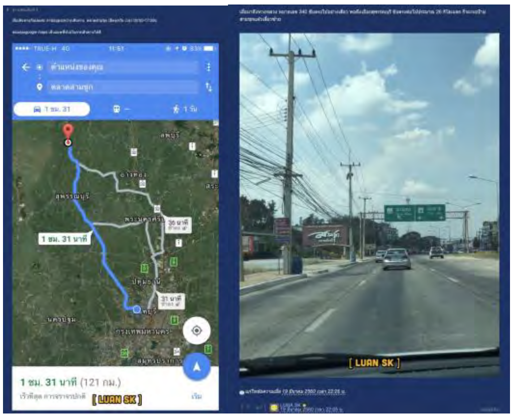

Figure 2: The direction to Samchuk is illustrated through Google Map and street view (P1)

The second group is gastronomy, providing information on recommended restaurants and food shops. The majority of informative guide UGC (7 out of 13) is gastronomy related. For example, the creator of YV1 video is a well-known food blogger who presents restaurants, hawker stores available in the old market for the whole 30 minutes.

Apart from general information and gastronomy, some pieces of UGC also provides photography guide, where food, architecture and landscape photography is included (*see* Figure 3).

Figure 3: A popular photography corner in Samchuk Market, overlooking Tachin river (B2)

5.2 Documentary

Documentary is defined as 'a movie or television programme that tells the facts about actual people and events' (Webster, 2019). UGC items belonging to this group focus on presenting contents related to historical sites, cultures and local people. For example, YG2 item focuses on the storytelling of Khun-Jamnong-Jeenarak, the first tax collector of Samchuk community.

All of the samples in this group were produced by professional production companies who have also broadcast their content in offline channels. Along with the detail information, the historical content is narrated by a professional guide, local residents, committee members of the old market. This is exemplified by YG2, which comprises of interviews with a committee member of Samchuk Market.

> *'Samchuk market already existed when Rattanakosin Kingdom was founded. There are boats that stop at Samchuk temple for trade' (YG2).*

This type of content is suitable for heritage education due to content reliability. However, very few pieces of UGC reach wide audience. Only two out of twenty UGC meet the popularity criteria set in this research paper. When compared to other pieces of UGC, the impression of these two video clips are also low. YG2 and YG3 have achieved only 1852 and 6859 views respectively.

5.3 Personal memory

Besides sharing information publicly, social media is used to record personal experience (Wang, Lee and Hou 2017). While, UGC in Section 5.2 aim to deliver historical information that is accurate, representation of the past, created from different perspectives. The personal memory group includes content that is created by a single perspective of creator (Roediger and Abel, 2015). According to the findings, some travellers have utilized social media as (1) a personal diary and (2) photo and video albums. Firstly, digital media (including images and video clips) and descriptions are used to tell travellers' stories, the content in this UGC is more related to personal activities. In P2 item, information related to heritage is subjectively presented according to the worldview of the creator.

> *'I came to Samchuk because I was craving for Pla Ma (scientific name: Boesemania microlepis). I can think of a district of Bang Pla Ma, Suphanburi. The district would not be called as such if there are not many Pla Ma. I have googled and found that the fish are available in Samchuk Market, which is not located Pla Ma district' (P2).*

Secondly, some travellers use social platforms as storage for their digital files. 5 from 20 content only provide digital media in a form of visual and do not include any explanation. For example, P5 forum only post 35 images on the forum. YG2 and YG5 only upload the footage that they have walked through the market.

The identity of the creator also influence the way cultural contents are presented. Contents produced by corporates, e.g. TV channels and websites, are more informative (facts are more focused), and neutral than those produced by individual users, where the social media platform do not have ownership or take the responsibility of the circulating data. It should be noted many contents produced on the websites represent the organization. According to the findings, gastronomy guide seems to be the most popular content. Four out of five most-viewed video clips were categorised in this group and only focus on foods. The YV1, YV3, YV4, and YV5 videos has achieved 511K, 32K, 27K and 25K views. Although the rest contents were not directly categorised in this classification, most of them are also included food related content.

6. Tourism information provided by UGC

This section shows the information and knowledge that travellers can acquire before their visit. It can be mainly divided into General information (6.1) and Heritage attraction (6.2).

6.1 General information

'General Information' is an overview information of Samchuk market. It generates destination awareness as well as providing essential information for prospective visitors. This includes the accessibility information (6.1.1) and cultural and historical background (6.1.2).

6.1.1 Accessibility

UGC indicates accessibility information, including the market's opening hours, driving direction to the attraction, direction to specific spots. The format and content is shaped by the type of social media platform. Accessibility information on the Youtube videos tends to be brief More detailed accessibility information can be found on blogs and Pantip forum, where written information indicating opening hours and driving directions were presented together with google maps. Example is shown below:

> *'...From Bangkok take the highway way towards Bangbuathong, Nonthaburi and exit at Suphanburi town Centre, which is 107 km. Then drive towards Amphoe Sri Prachan- 20 km away from downtown...' (B4).*

Also, the narration strategy of UGC influence on how accessibility information is presented. Many UGC items are personal travel account where information is subjected to creator's experience. The purpose of the social media content also influence how directions are presented in UGC. A number of gastronomic-related UGC itself focuses on giving directions to food shops and attractions.

6.1.2 Historical information

In terms of cultural and historical background, many UGC items mention the history of Samchuk Community. This includes Samchuk Market's history- the foundation of Samchuk Community, the settlement of different ethnic groups (e.g. Mon, and Chinese), gastronomic history, archeological history (gingerbread style house).

Also, UGC items inform the viewers on how Samchuk community is turned into a touristic destination- the rebranding process of Samchuk Market as touristic market, the recognition awards received by other organizations (including the UNESCO Asia–Pacific Heritage Awards for Culture Heritage Conservation in 2009).

6.2 Heritage attractions

It is found that UGC also gives information on a specific attraction within Samchuk Market. Attractions mentioned in Samchuk Market-related UGC can be mainly categorized into built environment (6.2.1) and gastronomy (6.2.2).

6.2.1 Built environment

Built environment includes signs, including Samchuk Market entrance with Chinese language (*see* Figure 4) and the atmosphere (depicted in P1, P3, YG1), which are presented in the form of pictures and moving images. In particular, the functional building are more emphasized. This includes shops (YG1) and historic buildings (YG1, YG2, B4, B5, P3).

Figure 4: Market entrance with Chinese language (B3)

To be noted, the presentation of the built environment depends on the type of UGC. For example, the YG2 content, as a documentary TV show, gives detailed historical data on Khun-Jamnong-Jeeranak Museum, the Chino-Thai governor of Samchuk community. UGC items categorized under the informative guide and the personal memories category tend to focus less on the historical aspect of the attraction but more on essential information, for example the entrance fee of the attraction (B4). This historical data is mainly drawn from the worldview of creators.

In item B3, which is a personal travel blog, the creator's personal opinion has an influence over the represented image of historic environment. the The content creators describe the atmosphere of the historic community by giving a brief description of each historic buildings.

Laan Samaggi' was previously the district hall but now turned into all purpose venue where students perform Thai music' (B3).

6.2.2 Gastronomy

Gastronomic-related attractions are present in the majority of UGC items related to Samchuk Market. Many are specifically dedicated to the community's gastronomy. Gastronomic attractions include food items that present historical connection with the local community (YV4, B4, B5, P3). To exemplify, the YV4 content presents the story of food items (dried pork and spiced poultry), whose recipe can be traced back to the Chinese settlement in Samchuk community.

Gastronomic attractions also cover the old-fashioned food items, forming the majority of the attraction (YG2, YG1, YV3, P3), which highlights on the traditional quality and the rarity in the contemporary time. Example is shown in the quote below:

> *'Kanom Kai Pla is rare in today's time. It requires a complicated preparation process. You will need to use toddy palm, otherwise it will not taste good because it is not aromatic. In old times, the dessert will need to be steamed before soaked in syrup and sprinkled with salted shredded coconut. (B1)'*

A number of contemporary food items are also form a part of the market's speciality (YG1, YV3, YV5, B4, B5, P1, P2, P3). This includes innovative food items such as giant meatballs (*see* Figure 5) and food that are commonly found in Thailand's central region.

Figure 5: Giant meatballs, a gastronomic items presented in many UGC items (B1)

7. Discussion

From the findings, UGC on social media can support constructivist learning in many ways. Firstly, it enables visitors to gain appropriate cultural capital for participating in heritage attractions. Information in UGC can unconsciously formulate the visitors' background knowledge on the attraction before visiting. Travellers usually rely on the information on UGC when planning trips (*see* Section 3). The findings show that the heritage information in UGC is divided into small pieces so as not to overload viewers with too much information. Historical knowledge on UGC is also helpful for visitors in developing cultural appreciation when on the site. A variety of heritage-related information is presented in the UGC.

Secondly, UGC can be customized to various groups of audiences. Each group of learners have their own preferences and background knowledge (*see* Section 2). Although all of the content tell a story of Samchuk, each story was told differently, depending on presentation style and interest of each creator. Such variety leads to a better performance in learning heritage since each group of audience has different needs and background knowledge. Using learning materials that match learners' abilities and preferences can improve learners' engagement at both the cognitive and the affective domains (Pasupa and Pasupa, 2017).

Although social media can be an effective tool to motivate visitors culturally or stimulate their cultural perception of the location prior to visiting, UGC may not provide specific historical and cultural facts (Iwashita, 2003). Many cultural objects are presented in terms of non-modern quality, rather than connection with the locality. As for gastronomic products, some of them are depicted in terms of the historical connection with Samchuk community, others are traditional Thai elements that were commonly found in the wider public.

It should be noted that the historical and cultural content in UGC has a subjective nature, reflecting the creator's cultural capital, previous experience and aesthetic judgement. Not only the nature of the social platform that shapes the cultural representation of the attraction on UGC but also the background and identity of content creators. In this regard, content creator is not only those who influence visitors' destination choices or tourists' experience at the destination but also act as cultural gatekeepers, who mediate the cultural image of the attraction- prioritizing some cultural elements or ignoring others. As reported from the findings, Samchuk Market are mainly presented on social media as historic community that are now known as food market where both traditional food and non-local food is available from food sellers. However, very few contents UGC items mention the community's history and the old commercial houses that were turned into living museums. It is possible that content creators influence visitors' cultural experience and historical education while at the attraction

8. Conclusion

This research paper examines how social media plays a part in heritage tourism by using living museum as a case study. Based on the analysis of UGC items in numerous social media platforms, social media can be a constructivist pedagogical tool in supporting cultural experience of visitors during the visit by stimulating the interest of visitors with cultural uniqueness of the attraction as well as formulating visitors. Since artistic and cultural appreciation is largely attributed by proper education (Bourdieu, 1984), pre-visit cultural education can potentially improve visitors' cultural experience on the site. The cultural content posted on social media does not only guide them on activities enabling them to experience culture but also shape how they formulate cultural meanings of the attraction.

The limited ability of social media in presenting historical and cultural facts, though regarded as failure by certain groups of people (e.g. historical fanatics or cultural enthusiasts) does not always reduce the ability of social media as constructivist learning supporting tool. Media only play a subordinate part to individual critical thinking knowledge, being formulated by synthesization of knowledge, individual worldview and previous experiences.

It should also be noted that the cultural meaning is by its nature subject to socio-cultural circumstances (Bruner, 1994; Salamone, 1997) or exist in diverse forms given individual interpretations of the space. Cultural meaning of the attraction is not static but altered in accordance to space and time (Chhabra, Healy and Sills, 2003).

Given the potential of social media in promoting accessibility and stimulate public attention towards the attraction, social media can be used to enhance visitors' cultural education prior to visit. Of all the reviewed UGC items, cultural content is proportionally less than non-cultural content. With the exception of the documentary type of UGC explored, the cultural explanation of objects in the attraction is brief. UGC or content on social media can be utilized as a learning materials for heritage education. Presenting story by relying on visitors' point of interest can enhance their impression and engagement. In terms of Samchuk Market, the historical information could be better perceived through gastronomy.

This case study research provides a useful account on the educative dimension of social media contents in heritage attractions. However, limitations of this research paper can be listed as follows. This is the first stage of research on the contribution of social media in supporting constructivist learning, where constructivist learning on the pre-departure stage is focused. Meanings produced by ex-visitors were discerned to understand the cultural image that visitors might have on the attraction prior to visit. Subsequent studies on the interaction between involving agents, be it content creators-users or users, users or studies on the process of cultural meanings generation during and after the visits can make this research paper completed.

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Strategic use of Social Media in e-Learning

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Abstract: The problem of using social media in e-learning has been widely discussed in the literature. Undoubtedly, they are now an integral part of e-learning courses, thus each course must incorporate them into their curriculum. These platforms allow communication between participants of the course and are mainly used for this purpose. Their role in the transfer of knowledge, however, seems to be a more important aspect. In this respect, their potential is often not fully exploited. To change this, a strategic approach should be incorporated. It requires determining appropriate goals and tools that will determine the types, scope and ways of using social media in a given e-learning course. It is necessary to develop a specific model illustrating various stages of planning, operation and control of the effectiveness of using social media in e-learning. As a result, these media can expand knowledge of the course participants, shape their skills and social competences, which can contribute to the educational goals of individual e-learning courses. The aim of the article is to present the strategic model of using social media in e-learning. As a research method the author used a survey addressed to students of the Pedagogical University of Krakow, who were participants in e-learning courses.

Keywords: social media, e-learning, social media strategy, social media in e-learning, new technologies in e-learning

1. Introduction

Young people spend many hours browsing through social media every day. These platforms strongly engage students. Therefore it is important to fully tap into the potential of these media to achieve the objectives of e-learning courses. However, there should be a strategic approach implemented that will make it possible to utilize the opportunities offered by social media in education to the greatest extent.

The aim of the article is to present the strategic model of using social media in e-learning. The main hypothesis was assumed that social media have enormous potential in e-learning courses, which is not used to a sufficient degree, especially in the field of knowledge transfer and cooperation. As a research method the author used a survey addressed to students of the Pedagogical University of Krakow, who were participants in e-learning courses.

The article consists of four parts. The first is a literature review of the subject. The second part of the article introduces the research methodology. The last two parts are the presentation of research results and conclusions.

2. Literature review

The problem of using social media in e-learning is widely discussed in the literature. There are many types of platforms that enable online/social bookmarking, blogging or microblogging (e.g. Twitter). Many platforms enable the creation of collaborative workspaces (wiki). Many allow to share tools (e.g. YouTube), enable social networking sites (e.g. Facebook, LinkedIn), assist in social networking and enable document and calendar sharing as well as editing among other things (like Google Apps) (Dabbagh & Kitsantas, 2012). In 2009, Bosch wrote about using Facebook for teaching and learning at the University of Cape Town (Bosch, 2009). However the impact of new technologies on knowledge management has already been investigated by Alavi & Leidner (2001). Kaplan & Michael (2010), among others, wrote on the use of social media in this process in the context of enterprises. An interesting study on this topic was also conducted by Zhang et al (2015). They pointed out the great potential in the use of social media in knowledge management. These and other studies show that social media can extensively support the e-learning process. At the same time, however, they pose challenges for universities, teachers and students, which were noted, among others by Selwyn (2012). The author claimed as follows: „social media tools and applications present a challenge to the concept of the formal educational establishment as it currently exists. In this sense, social media are also significant in terms of their implications for the nature and form of higher education provision. Social media in any form sit uncomfortably with some of the central tenets of the formal provision of education. The use of social media implies, for example, that learners should be 'active co-producers' of knowledge rather than 'passive consumers' of content, and that learning should be a 'participatory, social process' supporting personal life goals and needs (Lee and McLoughlin, 2010)".

Popescu (2014) described the problem of providing collaborative learning support with social media in an integrated environment. Also Tay & Allen (2011) explored how social media might be used effectively in higher education. One should also note that Silius et al (2010) drew attention to the problem of student motivation for social media enhanced studying and learning. These issues will also be addressed in this article.

3. Methodology

The aim of the research was to investigate the use of social media in e-learning and create a strategic model of using social media in e-learning. The following sub-objectives have been set:

- specification of the types of social media used in e-learning courses,
- presenting the purposes of using social media in e-learning courses,
- presenting students' attitudes towards the use of social media in e-learning courses,
- determining incentives that can effectively motivate students to use social media in e-learning courses.

The main hypothesis was assumed that social media have enormous potential in e-learning courses, which is not used to a sufficient extent, especially in the field of knowledge transfer and cooperation.

The following specific hypotheses were formulated:

> *H1: Chats and forums are mainly used in e-learning courses. The potential of other social media, which can also support the transfer of knowledge and shape hard and soft skills, have not been exploited.*
>
> *H2: Social media in e-learning courses are mainly used for communication purposes and less frequently for the exchange of knowledge and cooperation between course participants.*
>
> *H3: Social media should be used to transfer knowledge and experience in a greater scope.*
>
> *H4: Social media adds value to the e-learning course to a significant extent.*
>
> *H5: Teachers should motivate students to use social media to greater lengths during an e-learning course using positive incentives (e.g. extra points).*
>
> *H6: Students expect to increase the use of social media in e-learning courses.*

The survey was used to verify the hypotheses. The questionnaire consisted of 13 questions regarding the attitude of respondents to the use of social media in e-learning. In addition, the questionnaire contained three metrics questions about gender and age of the respondents. The questionnaire was sent in electronic form to students of the Pedagogical University of Krakow (Poland). The research sample included 92 people. Respondents were mainly women (79%). Men constituted a clear minority (21%). The respondents were mainly aged 18-25 (96%). They were students of law (59%) and administration (41%). The research was carried out in June 2019.

4. Findings

To verify the hypotheses, the author needed information about the use of social media in e-learning courses in which the surveyed students have participated. First, they were asked what social media they use and how often they use it (Figure 1).

Among the surveyed students, the most popular was Messenger (99% of respondents use it daily) and Facebook (91%). In addition, the majority of respondents use Instagram (65%), YouTube (60%) and Snapchat (51%) on a daily basis. Students are also willing to use Wikipedia (49% of respondents do it several times a month) or blogs (34% read them several times a week). Most students have never used LinkedIn (73%), SlideShare (73%), Wykop (63%) or WhatsApp (53%). As one might suppose, students use many social media on a daily basis. They constitute a natural environment for them allowing them to experience comfort and happiness.

The surveyed students mostly participated in four or more e-learning courses (64%) (Figure 2). Therefore, they have relatively good background in this area.

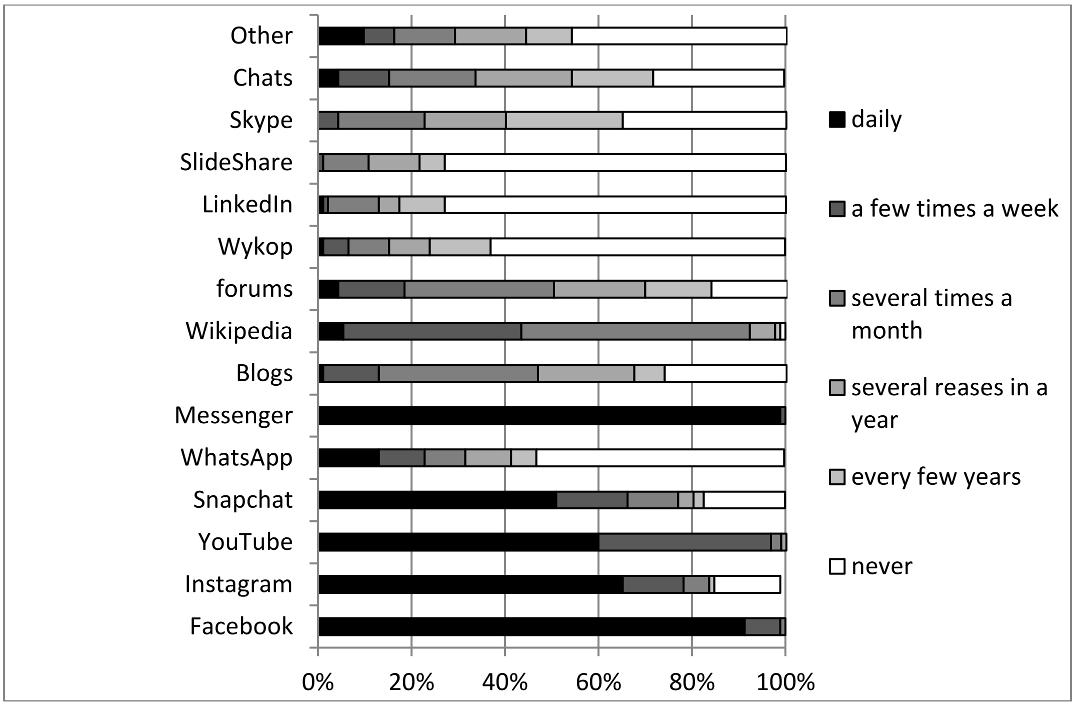

Figure 1: Frequency of using social media by the surveyed students (N=92)

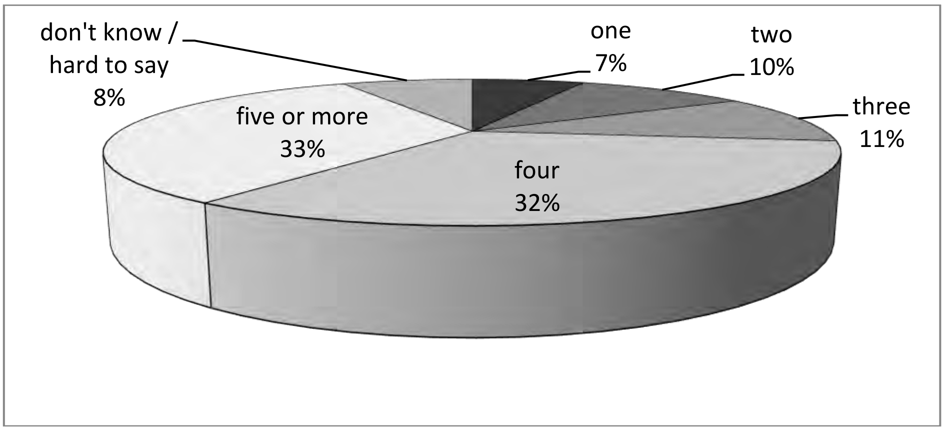

Figure 2: Number of completed e-learning courses studied by students (N=92)

It turns out that in the e-learning courses, in which the respondents participated, forums (65%), chats (64%) and YouTube (47%) were the social media used most often. They have also frequented Facebook (36%), and the other social media were visited rarely (Figure 3).

Meanwhile, students expect other social media to be used in e-learning courses (see Figure 4). They use Messenger and Facebook every day, therefore they would be inclined to use it during e-learning courses as well (58% - Messenger, 50% - Facebook). In addition, chat rooms (46%), forums (41%) and YouTube (40%) are also useful in e-learning according to the surveyed students.

As one can see, the H1 hypothesis was proven as chats and forums are in fact mainly used in e-learning courses. The potential of other social media, which can also support the transfer of knowledge and shape hard and soft skills have not been exploited.

In general, social media in e-learning courses are used to contact the teacher (40%) or other course participants (39%). They also play an important role in the current transmission of information and reference to current events (38%). Another use involves the transfer of knowledge and exchange of experience (35%), as well as sharing of resources (e.g. notes) (27%). To a lesser extent they are used for publication (presentation) of their opinions (19%), co-creation of content and cooperation (17%), or communication and discussion with the remaining participants of the course (15%) (Figure 5).

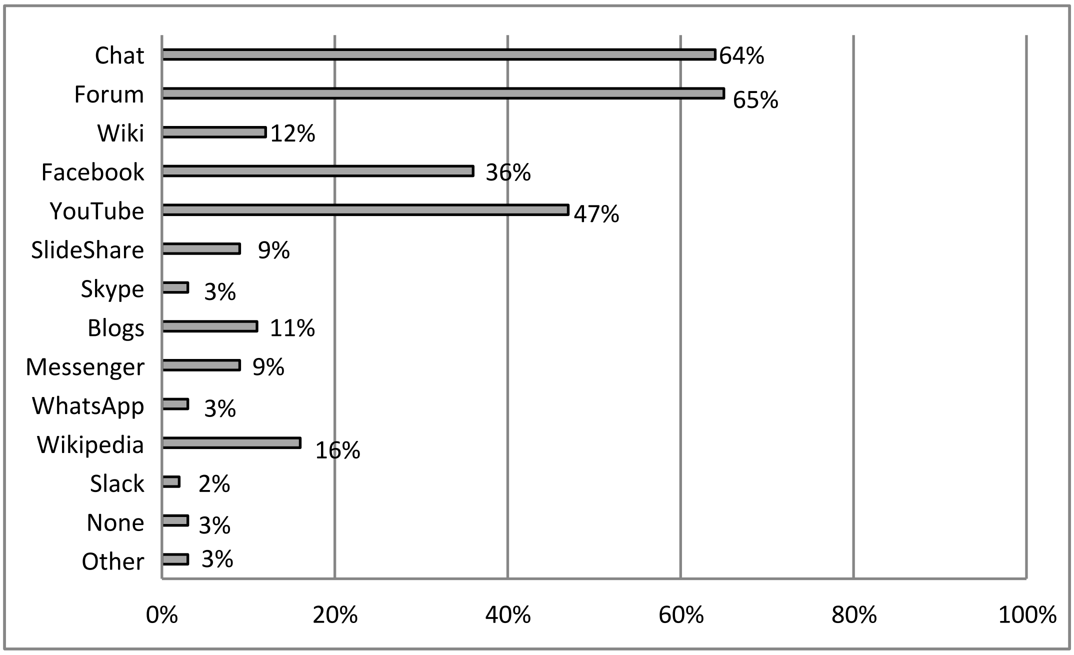

Figure 3: Types of social media used in e-learning courses in which the surveyed students participated (N=92)

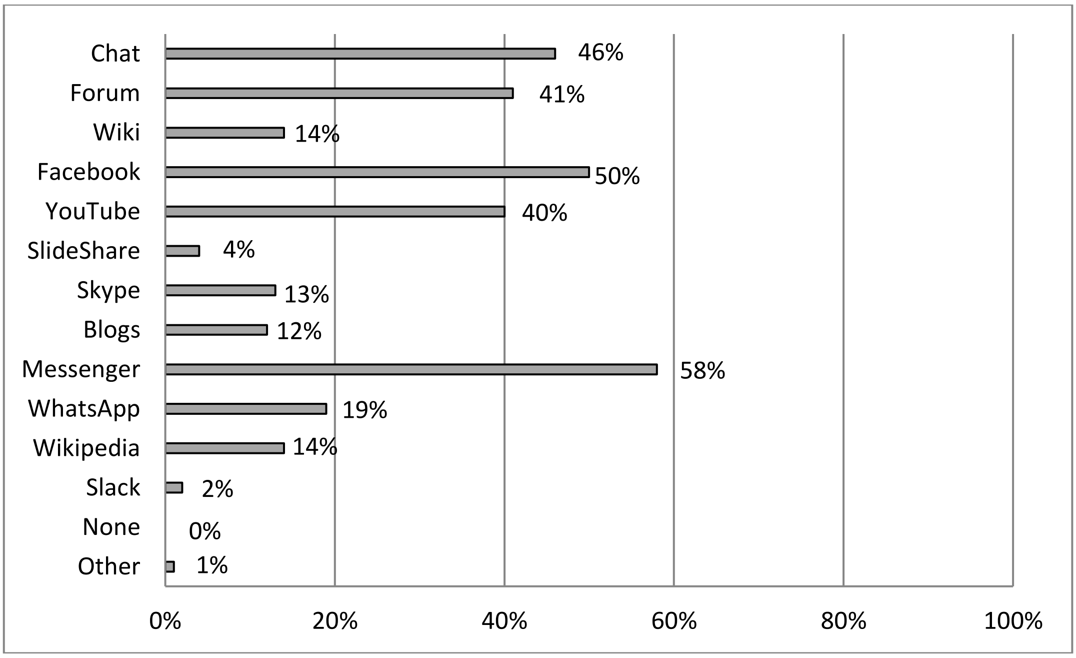

Figure 4: Expectations of the surveyed students regarding the types of social media that should be used in e-learning courses to increase their effectiveness (N=92)

Meanwhile, most students notice the important role of social media in establishing contact with the teacher (73%) and other course participants (75%), but would also use the media in the exchange of knowledge and experience (71%), sharing resources (59%), whether presenting their opinions (47%) and co-creating content or cooperation (35%) (see Figure 6).

It seems that - with some caution - one can accept the H2 and H3 hypotheses, according to which social media in e-learning courses are mainly used for communication purposes and less frequently for the exchange of knowledge and cooperation between course participants. Social media should be used to transfer knowledge and experience to a greater extent.

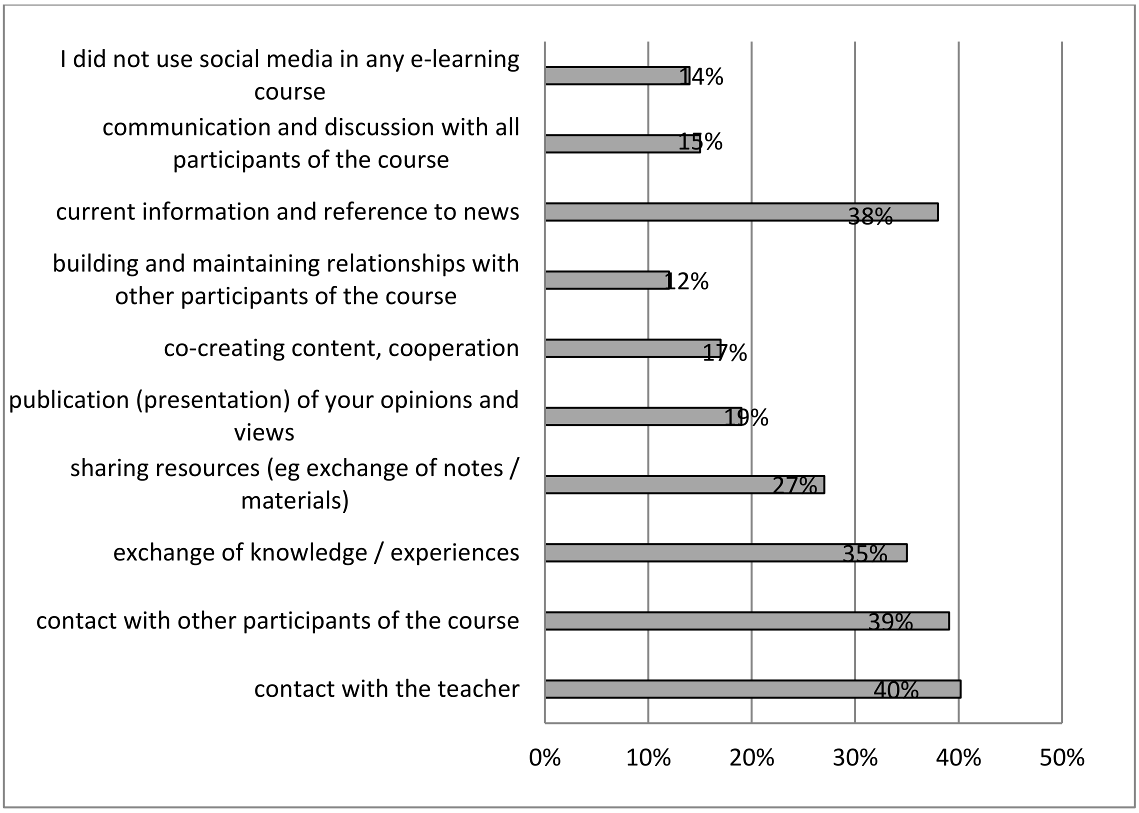

Figure 5: The goals of using social media in e-learning courses by the surveyed students (N=92)

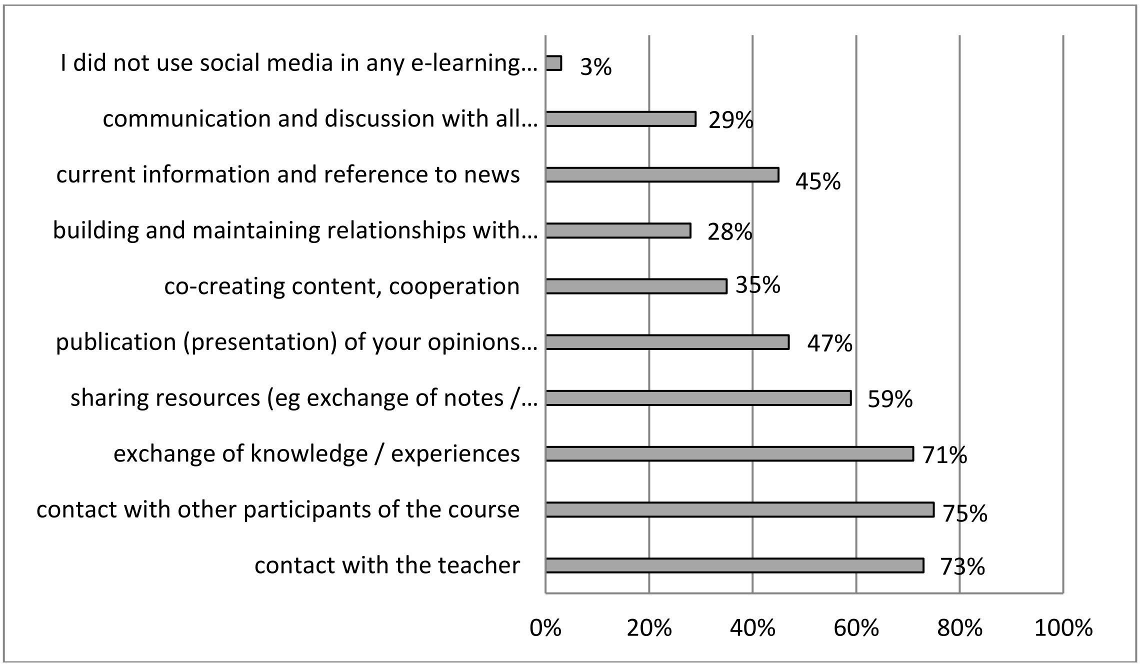

Figure 6: The goals to which social media should be used in e-learning courses, according to the surveyed students (N=92)

Students agree that social media enhance the versatility of an e-learning course (92%), increase the appeal of the course (86%), broaden the knowledge of the course participants (82%), have great potential in e-learning (80%), as well as further integrate the course participants (79%). In addition, 68% of respondents agree that they are not used enough in e-learning (Figure 7). These results allow to accept the H4 hypothesis that social media adds value to the e-learning course to a significant extent.

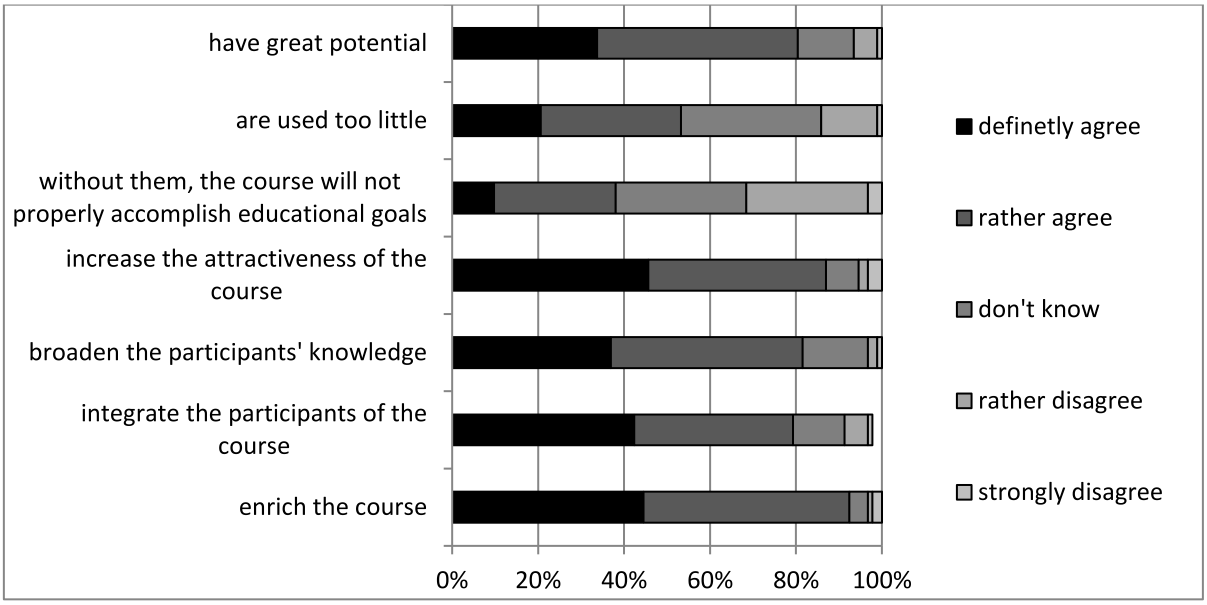

Figure 7: The importance of social media in e-learning courses, according to the surveyed students (N=92)

At the same time, students were asked about how often they use social media in e-learning courses, they answered that they only used it sometimes (30%). Moreover, many of them indicated that they use them rarely (19%) (see Figure 8).

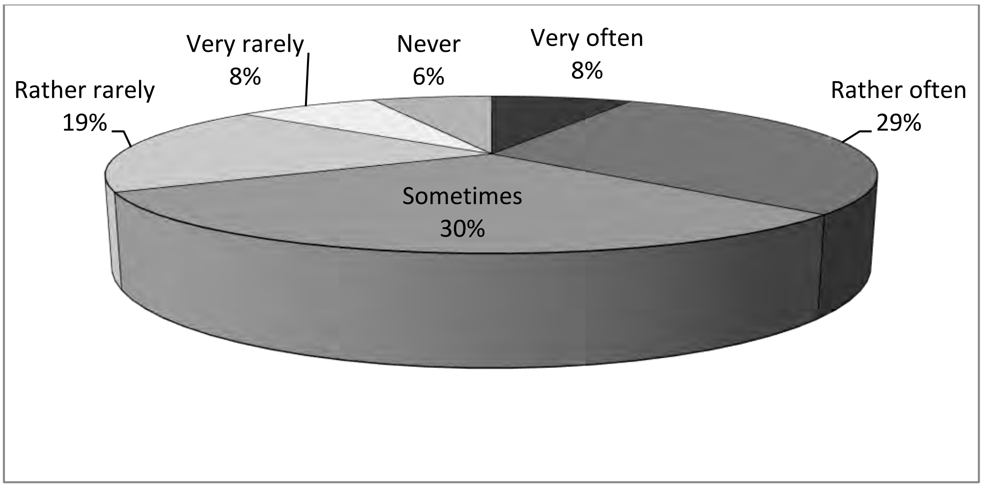

Figure 8: Frequency of using social media in e-learning courses by the surveyed students (N=92)

Therefore, there is a need to motivate students to be more active in these media. The data presented in Figure 9 shows methods of implementing the latter.

The following incentives should be considered to motivate students to use social media in e-learning courses to a greater extent: extra points for activity in social media (13%), brain teasers and puzzles in social media (11%), additional tasks for additional points (10%), social gaming (9%), help in solving tasks (9%), organizing interesting debates (9%) and additional materials to help in tasks (8%). The following tools may also help: chat consultation (6%), releasing individual tasks for activity in social media (6%), organising social media content in a playful and fun way (5%) or performing surveys in social media (5%).

The above research results allow us to accept the H5 hypothesis that teachers should motivate students to use social media to a greater extent during the e-learning course using positive incentives (e.g. extra points).

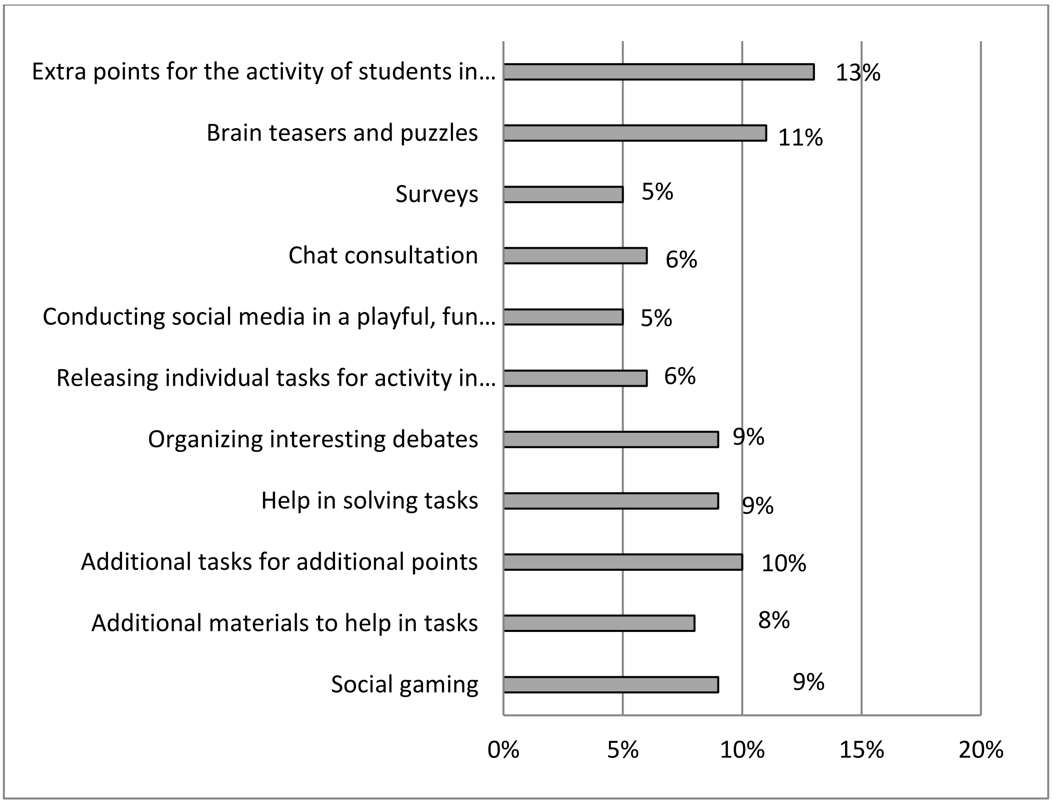

Figure 9: Factors motivating students to use social media during e-learning courses (N=92)

Students notice the potential of social media in e-learning courses. The vast majority are of the opinion that the use of these media in e-learning courses should increase (90%) (Figure 10). Sample opinions of respondents are as follows:

> *"I think it is a very good idea to increase the use of social media in e-learning courses, because everyone uses all the benefits of social media every day, and thanks to their use, courses would become more attractive for students."*
>
> *"I think it is a very good idea because it will increase the attractiveness of the course and, above all, its mobility."*
>
> *"I think that a more convenient form would be e.g. Messenger, which is now widely available, mobile and easy to use."*
>
> *"In an era where many screens disperse us, it's worth thinking about engaging forms in e-learning. It's worth implementing" community networking in such courses".*
>
> *"I believe that the use of social media in courses should be increased because it is an interesting form of conducting courses, it allows making contact with other participants of the course, and to express their opinion on various topics and exchange knowledge with other course participants and easy and quick contact with the teacher."*
>
> *"It is certainly a very good idea, because young people spend many hours every day in social media, so if they are so involved, why would they not be able to participate in such courses?".*

In summary, according to respondents, social media increase the attractiveness of e-learning courses and engage participants to a greater extent. This is due to the fact that students know the social media environment well and feel good in it. Thus, the H6 hypothesis has been proven.

All the stated hypotheses have been proven, and therefore the main hypothesis should be adopted that social media have enormous, and so far unused to a sufficient degree, potential in e-learning courses, especially in the field of knowledge transfer and cooperation.

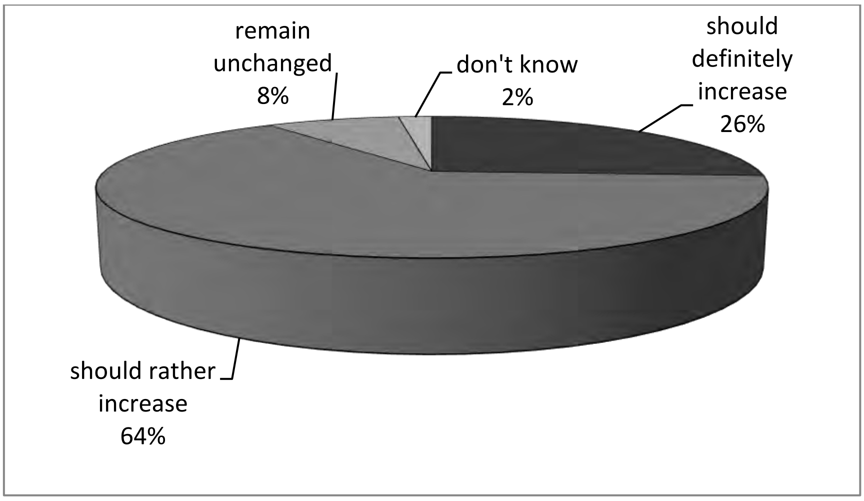

Figure 10: The extent to which social media should be used in e-learning in the future, according to students (N=92)

A strategic approach is proposed to change these circumstances. The teachers are expected to take the following steps (Figure 11):

- Defining the objectives to be achieved through the use of social media in the e-learning course (e.g. increasing cooperation between students, increasing knowledge transfer, greater integration, etc.).
- Selection of a social media mix - selection of social channels that will make it possible to achieve goals in the best possible way; here, the diversity of social media and their various uses should be emphasized (see Kaplan & Haenlein 2010), for example: to increase cooperation it is proposed to use Wiki tools for sharing resources or, for example, Slack, which helps in organizing teamwork. Conversely, Messenger would be more helpful in terms of integration.
- Selection of motivational tools for students that will make them more eager to use social media in an e-learning course - there may be additional points for activity, interesting puzzles, social games, etc. In order for tools to be effective and attractive, they should contain as many elements of a game as possible (extra points, riddles, discretionary awards, etc.). For example, the teacher can promise important information in chat rooms, which will make students more willing to enter it and start a discussion. One can also publish interesting student statements and, in this way, reward them. Effective motivational tools should also encourage students to express their own opinions. As a result, they will feel more involved.
- Defining rules - all motivational tools should be well-planned, and the rules of using them should be formulated in a clear way, understandable for all participants of the course.
- Control of the effects - it should be checked on an ongoing basis, to what extent individual social media accomplish the set goals and what is the attitude of students towards the use of social media. Depending on the results, some modifications should be introduced if the situation requires it.

Tay & Allen (2011) came to the conclusion that “ultimately, success with social media in higher education probably depends on exploring and validating students’ choices of the tools to hand, with which they are comfortable and familiar and that make sense for the task”. The author's research confirms these conclusions and allows to state that in the case of students of the Pedagogical University of Krakow, social media (like Messenger, Facebook, YouTube, chats) will be an excellent tool to support e-learning courses. Students are very familiar with these media. They believe that using them increases the attractiveness and effectiveness of such courses. However, it is important to use a strategic approach.

5. Conclusions

The obtained research results have achieved the purpose of the article, which was the presentation of the strategic model of using social media in e-learning. As a research method the author used a survey addressed to students of the Pedagogical University of Krakow, who were participants in e-learning courses. The research proved the main hypothesis that social media have enormous potential in e-learning courses, which is not used to a sufficient degree, especially in the field of knowledge transfer and cooperation.

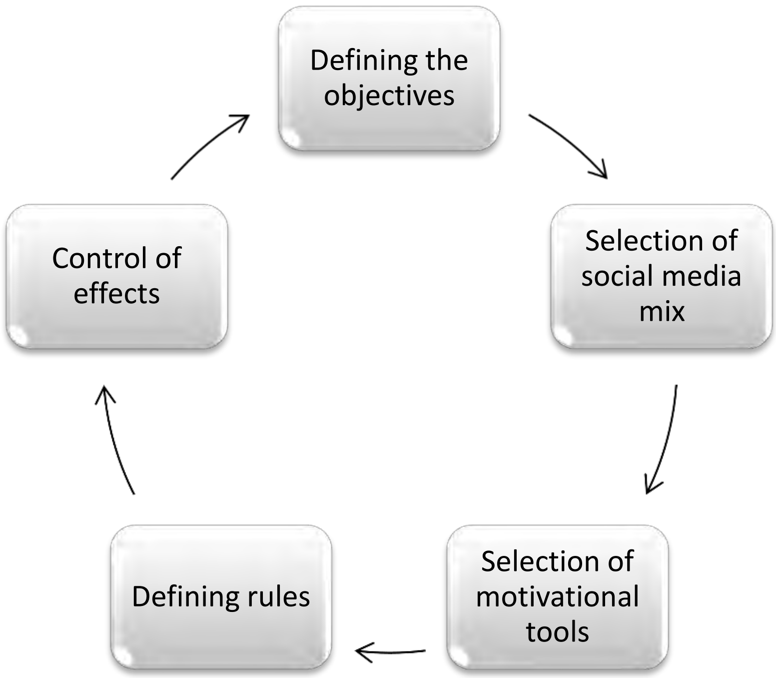

Figure 11: Model of the strategic use of social media in e-learning

Studies have shown that the e-learning courses mainly take advantage of chats and forums. The potential of other social media, which can also support the transfer of knowledge and shape hard and soft skills, have often not been exploited (H1). Social media in e-learning courses are mainly used for communication purposes and less frequently for the exchange of knowledge and cooperation among course participants (H2). They should be used to transfer knowledge and experience to a greater extent (H3). They have been proven to add value to the e-learning course (H4). However it is necessary for the teacher to motivate students to use social media to a greater extent during the e-learning course using positive incentives (e.g. extra points) (H5). Students expect to increase the use of social media in e-learning courses (H6), with the appropriate tools they should be more willing to tap into the potential of social media. Based on the conducted research, the author developed a specific model illustrating various stages of planning, operation and control of the strategic use of social media in e-learning. Owing to this model, social media can expand the knowledge of course participants, shape their skills and social competences, which can contribute to achieving the educational goals of individual e-learning courses.

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The Role of Accessibility and Usability in e-Learning Websites for Students With Disabilities: Can Policies Help?

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Abstract: People with disabilities may still be excluded from some of the learning opportunities at tertiary institutions because of their disabilities. To create a society which respects all people irrespective of their abilities, digital and social divides should be discouraged. This exploratory study investigates the role of usability when people with specific disabilities interact with e-learning environments. The objective is making informed decisions regarding the support presented by this institution's e-learning websites. If disability policies at higher education institutions fully address the needs of students with disabilities and are implemented accordingly, all students will be able to access and utilise all the learning opportunities and graduate competitively. The disability policies for students at tertiary institutions should address all their needs, including accessibility and usability of e-learning websites. The University of South Africa (Unisa) is the largest Open Distance electronic Learning (ODeL) institution in South African. In order to determine how students with disabilities interact with the e-learning website of Unisa, students were observed in the controlled usability laboratory. Students with mobility (limited hand function), visual and auditory disabilities were requested to attempt specific tasks using the Unisa websites. A total of twenty students, fifteen with above mentioned disabilities and five without disabilities, participated in this study to determine the usability of the Unisa's website. The results of this study are reported in this paper.

Keywords: accessibility, usability, design principles, digital divide, disabilities, disability policies, human-computer interaction, usability laboratory

1. Introduction

This exploratory study investigates the role of disability policies and their possible impact on the accessibility and usability of e-learning websites for students with disabilities. Ideally, disability policies should pave the way for students with disabilities to unlock their full potential when using the e-learning websites at the University of South Africa (Unisa), an Open Distance electronic Learning (ODeL) institution.

This study is qualitative with limited quantitative analysis, due to the small number of participants. It fits into the accessibility and usability focus areas of human computer interaction (HCI).

Nowadays, the use of information and communication technologies (ICTs) is shaping nearly every aspect of life by changing the means of teaching and learning, how business is conducted and social interaction. However, many people are still excluded from the possible economic, educational and social benefits offered by ICTs. This occurrence is commonly referred to as the 'digital divide', signifying the difference between those who have access to modern ICTs (particularly broadband access) and those who do not have access (Bertot, 2003).

The success of any interactive system depends on, along with others, its usefulness and the ease of use from the perspective of the users (Nielsen, 2003). If interactive systems are difficult to use, people will stop using them and look for other alternatives, e.g. reverting to old ways of learning and teaching (Florian, 2007; Nielsen, 2003).

Usability of websites is essential in ensuring all people, including those with disabilities, can achieve their objectives when accessing and interacting with websites (Keates, 2006). Specifically, the usability of e-learning websites offers an essential factor to efficiently shrink the digital divide (Nielsen, 2006; Preece, Rogers & Sharp, 2011). It is therefore important that designers use usability design principles, guidelines and standards timely during the development of e-learning websites to narrow this gap. This becomes even more significant when the focus is on a user group that has limited capabilities or are people with disabilities.

This paper is structured as follows: Section 2 gives a brief overview of disability policies followed by a discussion on usability design, principles and standards in Section 3. Section 4 provides background on accessibility testing with the real usability testing of participants in Section 5. The paper concludes in Section 6.

2. The purpose of usability and disability policies

In 1993, the United Nations General Assembly implemented the Standard Rules on the Equalisation of Opportunities for Persons with Disabilities (UN, 1993; UN Educational, Scientific & Cultural Organization, 2009).

For many people with disabilities, accessible and usable websites are essential to perform their work, assist in raising productivity, provides the ability to telecommute, or even give a first chance to be in employment. Consequently, a lack of access to socially important Internet sites for people with disabilities, such as the e-learning websites, can eventually lead to social isolation (Jacko & Hanson, 2002; Just & Carpenter, 1976; Schartz, Schartz & Blanck, 2002).

The purpose of Disability policies is to remove all barriers and should ideally enable people with disabilities equal access and opportunities to, including but not limited to, social media, study and work opportunities. The lack of locally relevant content and usable interfaces form part of the barriers that prevent this underserved user group from taking full advantage of the opportunities offered by new technologies such as e-learning websites (Lazarus & Mora, 2000). Disability policies should significantly influence central aspects of life, such as education, employment and health services (SA, 2015).

Disability policies are usually guided by disability rights organisations (Shakespeare, 2006) to ensure that people with disabilities are not marginalised or socially excluded (Matshedisho, 2007). Disability rights movements of the 1960s triggered the increased focus on disability policies which lead to the adoption of the United Nations Convention on the Rights of Persons with Disabilities (UNCRPD) in 2006 (UN, 2006).

The South African Constitution (No 108 of 1996) states that all South Africans, irrespective of their disabilities, gender and race have the right to basic education, focusing on equity, redress and access in order to restore human rights for all people (SA, 1996). A Bill of Rights also states that all people have the right to education, including adult education as well as technical and vocational education and training (SA, 1996). Once again, the disability rights movement largely motivated the adoption of disability policies. In South Africa, Disabled People South Africa (DPSA), formed in 1984, was instrumental in the identification of the rights of people with disabilities after 1994 (Heap, Lorenzo, & Thomas, 2009). DPSA was also part of the team which defined the South African Disability Rights Charter (Matshedisho, 2007). In 1997 the Integrated National Disability Strategy (INDS) was accepted (SA, 1997). In 2001, an Inclusive Education and Training System White Paper[1] was effected (SA, 2001). The South African disability policy was at a draft stage by the time of writing this paper as there is a White Paper on the Mainstreaming of the Right of Persons with Disabilities to Equality and Dignity 2014 (SA, 2015). A White Paper on the Rights of Persons with Disabilities was approved by the South African Cabinet on 9 December 2015 (SA, 2016).

The guidelines or principles of disability policies include, but are not limited to: accommodation, equity, accessibility, usability, education, health, employment, non-discrimination and inclusion (Slatin & Rush, 2003; SA, 2015).

Disability units at universities, as supported by HEDSA (2019), act as a starting point for coordinated support for students with disabilities. The authors were able to confirm that the tertiary institutions as listed in Table 1 have policies with corresponding implementation dates and specific support units for students with disabilities. However, please note that some universities may have policies, but the authors could not find them. The information regarding the disability units is listed by HEDSA (2019).

Table 1: Disability units and policies of South African tertiary institutions

University/University of Technology	Disability units	Disability policy for students	Year of implementation
Cape Peninsula University of Technology	?	?	2008
Central University of Technology	?	?	n.d.
Durban University of Technology	?		
Mangosuthu University of Technology	?		
Nelson Mandela University	?		

[1] A White Paper follows a green paper and is highly detailed with proposals, and the public can still comment on this paper. A bill is a draft policy which still needs amendments, but the public can no longer comment on it. An act is a passed bill.

University/University of Technology	Disability units	Disability policy for students	Year of implementation
North West University	✓	✓	2012
Rhodes University	✓	✓	2005
Sefako Makgatho Health Sciences University	✓		
Sol Plaatje University	✓		
Tshwane University of Technology	✓	✓	2008
Unisa	✓	✓	2008
University of Cape Town	✓	✓	2011
University of Fort Hare	✓		
University of Johannesburg	✓	✓	2007
University of KwaZulu-Natal	✓	✓	2004
University of Limpopo	✓	✓	n.d.
University of Pretoria	✓	✓	2013
University of Stellenbosch	✓	✓	2018
University of the Free State	✓		
University of the Western Cape	✓	✓	2001
University of the Witwatersrand	✓	✓	2004
University of Venda	✓	✓	2005
University of Zululand	✓	✓	2006
Vaal University of Technology	✓	✓	2013
Walter Sisulu University	✓		

Unisa has a unit called ARCSWiD - Advocacy and Resource Centre for Students with Disabilities; focussing specifically on accommodating the needs of students with disabilities. In 2008 Unisa also implemented a policy for students with disabilities based on the principles of inclusiveness, barrier-free access and acknowledgement of diversity. The policy seeks to ensure that students with disabilities can access all Unisa facilities and study material regardless of their disability.

3. Usability design, principles and standards

Usability is the capability to access and completely utilise a system with minimal errors and within a particular time. People with disabilities should also, at the end of a session with the given system, have achieved the required results (Keates, 2006). Web products such as e-learning websites, should also effectively teach people with disabilities, and a successful e-learning environment must implement learning and teaching strategies that include high usability (Preece *et al.,* 2011).

The conditions that a website should satisfy, specifically for students with disabilities, are adapted from Keates (2006) and shown in Table 2. The conditions in Table 2 are measurable and show how usable the application is (Nielsen, 1993).

Table 2: Nielsen's indicators of good websites

Factor	Explanation
Efficiency	People with disabilities successfully use websites.
Errors	People with disabilities make few mistakes and are able to recover easily if they have made mistakes.
Satisfaction	People with disabilities are satisfied with the functioning of websites.
Memorability	People with disabilities returning to a website are able to remember the system's functionalities.
Learnability	People with disabilities are able to use their previous experiences about the way the e-learning website works.

(Nielsen, 2003)

Note that user perception is central to the value of a website, i.e., the perceived usability and ease of use (Kules & Capra, 2012). Even though numerous assistive technologies exist, it is not a 'one size fits all' solution. People with similar disabilities may use different types of assistive technology (Liffick, 2003). It is a nearly impossible task to make a product usable for all, but one should try to exclude as few people with disabilities as possible in the use of a product. If a website is sufficiently flexible, it should be able to be modified according to individual preferences (Nicolle & Abascal, 2001) which will lead to fewer people with disabilities being excluded.

4. Accessibility evaluation

Websites can be evaluated through automated accessibility testing as well as observing student interactions on websites through eye tracking.

4.1 Automated accessibility testing

A website cannot be usable if it is not accessible. Usability testing is a test taken to ensure that the users are satisfied during their interaction with, for example, websites. This test assesses and guarantees that websites are usable by their expected audience. It does not determine the ability of the users; it tests the usability of websites, not the participants' abilities in using the websites. By the time of the inception of usability testing in the 1980s, users' profiles were expanded to include users with disabilities (Dumas & Fox, 2008; Preece *et al.,* 2011).

Features of usability testing, all of which must be satisfied if it is to be successful, include:

- Concentrating on the usability of websites.
- The real users of the websites, in this case, people with disabilities should evaluate the websites.
- Data is recorded for subsequent analysis.
- The results of the tests are communicated to stakeholders.

The WCAG 2.1 guidelines (Web Content Accessibility Guidelines), as developed by W3C (2016), explains how to make web content more accessible for people with disabilities and provide general guidance on implementing web accessibility, including the *accessibility and usability of e-learning websites*. If the WCAG 2.1 guidelines are stated as a requirement in disability policies, it will result in fully accessible e-learning websites.

Metrics for usability testing are qualitative (Nielsen, 1993), and can be complemented by eye tracking (Barnum, 2010; Dumas & Fox, 2008; Preece *et al.,* 2011).

4.2 Usability testing through eye tracking

This method traces the movement of the participants' eyes rather than concentrating on documented reports and observational results (Kules & Capra, 2012). Eye tracking metrics can provide feedback in various ways. A higher number of fixations e.g. would indicate an inefficient search (Goldberg & Kotval, 1999; Poole & Ball, 2006; Just & Carpenter, 1976):

- Fixations per area of interest: Particular region fixations show a user's interest in that region compared to other regions.
- Duration of fixation: A long period of fixation indicates that a participant finds it difficult to figure out what is going on.
- Gaze: This total of all fixation periods within a recommended region assesses concentration between targets.
- On-target fixation time: A faster time to get to the target within the websites means that participants interact faster with the website.
- All fixations must be on the points they are intended for.

5. Unisa website evaluation

The Unisa website was evaluated through automated accessibility testing and website usability testing with eye-tracking.

5.1 Automated accessibility testing

Overview

Accessibility testing is a subsection of usability testing. This study focus on the accessibility of websites for people with disabilities to establish what effect the accessibility of a website has on their ability to utilise the website (W3C, 2016). The Validator (www.validator.w3.org) was used to determine whether web pages were in agreement with the accessibility design principles (see below). The Functional Accessibility Evaluator was used to determine the number of pages within a website as it is desirable to keep the number of pages with forms and frames to a minimum (www.fae.cita.uiuc.edu). Both the Validator and Functional Accessibility Evaluator were used to evaluate the Unisa website.

Accessibility testing was done as per accessibility design principles as specified in the literature (Jennings, 2010; Sklar, 2015; US Access Board, 2010; W3C, 2016). The WCAG 2.1 Criteria for evaluating the design of accessible websites include the following elements: forms and fields, frames and tables, general design, hyperlinks, metadata, multimedia content, scripts, text and headings (W3C, 2016).

Criteria for success and levels of conformity

The WCAG 2.0 criteria for success are structured into the following three stages of conformity (W3C, 2016):

- Priority 1: This threshold *must* be satisfied otherwise it will be impossible for students with disabilities to get to information from the Web document.
- Priority 2: This threshold *should* be satisfied; else, it will be challenging for students with disabilities to get to the information on the website.
- Priority 3: This threshold may be satisfied, but it will be somewhat challenging for students with disabilities to get to the information in the web document.

From the above WCAG 2.0's success criteria for the three levels of conformity, Jennings's (2010) counting style was chosen

- When a heuristic is applied to various components within a website and more than 75% of the known components meet the standards, the heuristic is successful.
- When a heuristic is applied to various components within a website and less than 75% of the known components meet the standards, the heuristic is unsuccessful.
- When a heuristic is applied to a single component within a website and that component does not meet the standards, the heuristic is not applicable.

5.2 Automated accessibility testing for Unisa and Harvard websites

Both the Unisa and Harvard university websites were measured based on the WCAG 2.0 criteria using the W3C Validator. The heuristics for both universities' websites appear in Table 3. Harvard excelled in the "General Design", "Metadata" and "Text and Headings" categories and obtained a higher score than the Unisa website.

The highest percentage obtained by any Unisa heuristic is "General Design" with 62.5%, still more than 10% below the needed success requirement. The Unisa websites' accessibility evaluation fulfilled only 23 sub-categories of heuristics out of a total of 60 and fail 31 sub-categories. (Detail is available on request).

Table 3: Summary of heuristics passed and failed according to W3C validator

Heuristics	#[1]	No of sub-categories that pass		No of sub-categories that fail		N/A		Heuristics outcome	
		Harvard	Unisa	Harvard	Unisa	Harvard	Unisa	Harvard	Unisa
Forms and fields	12	7	6	3	4	2	2	Fail (58.33%)	Fail (50%)
Frames and tables	6	2	1	4	3		2	Fail (33.33%)	Fail (16.66%)
General design	8	8	5		3		–	Pass (100%)	Fail (62.5%)
Hyperlinks	6	3	1	3	5		–	Fail (50%)	Fail (16.66%)
Metadata	9	7	4	2	4		1	Pass (77.77%)	Fail (44.44%)
Multimedia content	7	2	3	3	3	2	1	Fail (28.57%)	Fail (42.85)
Scripts	4	1	2	3	2		–	Fail (25%)	Fail (50%)
Text and headings	8	7	1	1	7		–	Pass (87.50%)	Fail (12.5%)
Total	**60**	**37**	**23**	**19**	**31**	**4)**	**6**		
Percentage		**61.67%**	**38%**	**31.66%**	**52%**	**6.67%**	**10%**		

[1] # - Number of sub-categories for each heuristic

5.3 UNISA website usability testing using eye tracking

Usability testing with eye tracking was done in a controlled usability laboratory during the second semester in 2013. Figure 1 shows the Unisa website through which the participants had to browse. The myUnisa link is in the centre close to bottom of the page. The face of the student is blanked out for ethical reasons.

Participants

Twenty volunteers, fifteen Unisa students with limited hand functioning, visual (blind and limited eyesight) and auditory disabilities as well as five students without disabilities participated in this study. Each participant's interaction with the website was twenty minutes.

One participant at a time was tested in the usability laboratory. The students were put at ease and the purpose of the test (to test the usability of the website) was explained. The participants were then requested to log onto or just access the Unisa website (www.unisa.ac.za) to find a link to the myUnisa website (www.myUnisa.ac.za) and look for specific information, for example, the date for the release of exam results.

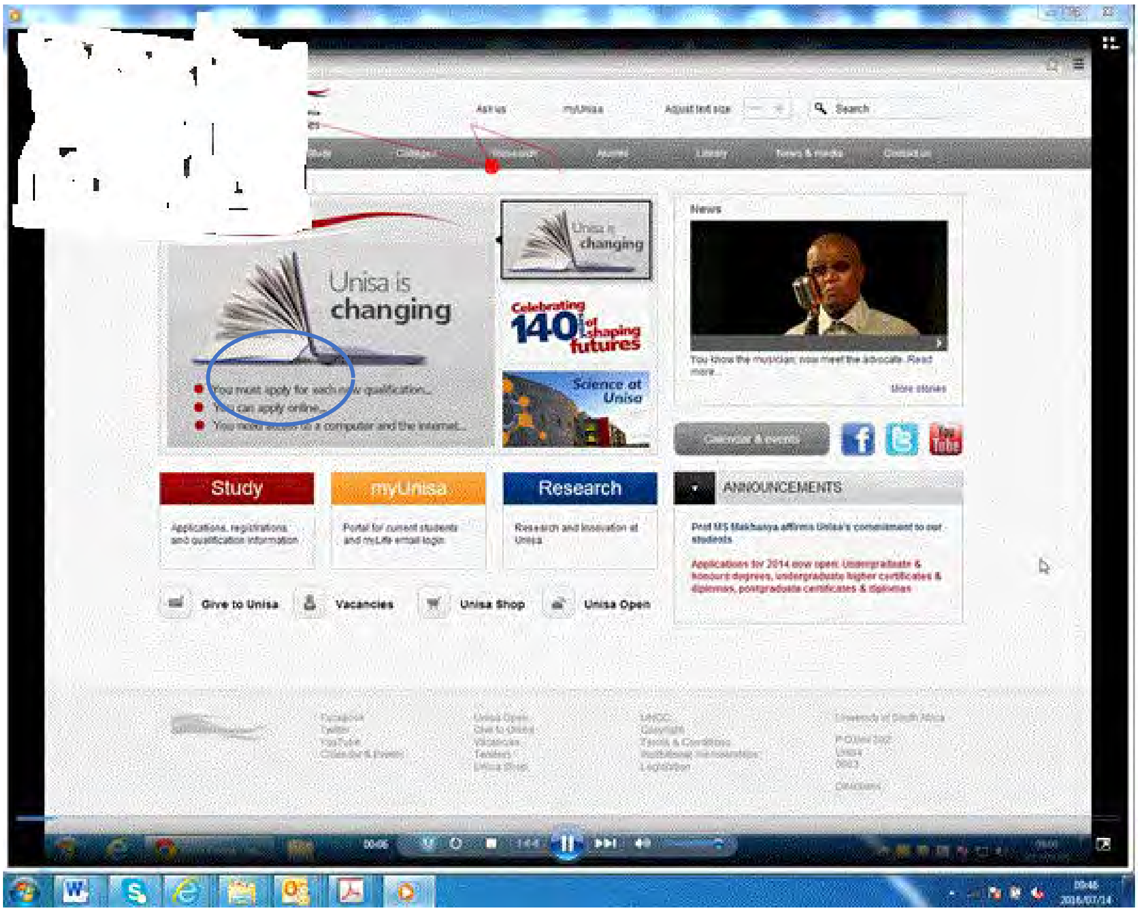

Figure 1: Unisa website

During the usability testing the participants had to perform the following four tasks under controlled circumstances:

Task 1

Use the mouse to find alternative text to the pictures on the Unisa homepage (move over the pictures with the mouse pointer – any picture). Read the text to see whether it interprets the pictures. *Motivation*: User agents (the tools that individuals use to interact with electronic data, e.g., web browsers) (Henry, 2012) are used to help people with disabilities to use alternative text to interpret pictures. Alternative text must be descriptive enough, so that participants can understand the actual meaning of the pictures.

Task 2

Use the main Unisa website www.unisa.ac.za to find a link to the myUnisa website. *Motivation*: This task tests that the language used in a website is natural and explanatory to allow participants to find other links.

Task 3

Participants have to navigate from the homepage to a link to another website page (other than the myUnisa website), for example Facebook, with ease. *Motivation*: This is to determine whether participants will be able to move from one page to another with ease and that such a page is the actual page the participant wants to browse.

Task 4

Participants must log into myUnisa in order get information about, for example, the date of release of exam results. *Motivation*: This is to confirm that participants really obtain the information they want. Values according to the complexity of finishing a task were assigned to the tasks which participants performed. These values are shown in Table 4, while in Table 5 the values assigned to each participant for each task are shown.

Table 4: Keys assigned to the complexity of tasks

Not applicable.	9
No success in completing task.	0
Severe difficulty but succeeded eventually with extra time	1
Severe difficulty eventually succeeded within the time limit: 300 seconds.	2
Little to moderate difficulty: 180 to 240 seconds.	3
Easily, less than 180 seconds	4

The above tasks are tabulated in Table 5 to show how each participant responded to each task. Participants 1 to 5 were participants without disabilities, 6 to 10 had limited hand functioning, 11 to 15 had visual disabilities and 16 to 20 had auditory disabilities. In Table 5, note that to do Task 4 the participants must first do Task 2. If participants could not do Task 2, then Task 4 is not applicable.

Table 5: Values according to complexities of finishing tasks for each individual participant

Task / Participant		Age	Gender	Task 1 (Use the mouse to find alternative text)	Task 2 (Use the main Unisa website to find a link to the myUnisa website)	Task 3 (Navigation from the homepage to web page other than myUnisa)	Task 4 (Participants are able to log into myUnisa and get information)	Total time taken in seconds
Participant 1	Without disabilities	22	Female	4 (53 sec)	4 (40 sec)	4 (30 sec)	4 (49 sec)	172
Participant 2		25	Male	4 (34 sec)	4 (24 sec)	4 (31 sec)	4 (48 sec)	137
Participant 3		19	Male	4 (63 sec)	4 (5 sec)	4 (20 sec)	4 (88 sec)	176
Participant 4		23	Male	4 (58 sec)	4 (22 sec)	4 (25 sec)	4 (60 sec)	165
Participant 5		21	Female	4 (37 sec)	4 (9 sec)	4 (20 sec)	4 (77 sec)	143
Participant 6	Limited hand-functioning	26	Male	2(252 sec)	1(480 sec)	3(240 sec)	*	972
Participant 7		32	Male	2(270 sec)	2(276 sec)	2(300 sec)	2(258 sec)	1104
Participant 8		38	Female	2(276 sec)	1(396 sec)	2(300 sec)	2(288 sec)	1260
Participant 9		37	Female	2(294 sec)	1(420 sec)	2(300 sec)	3(192 sec)	1206
Participant 10		45	Male	2(300 sec)	2(276 sec)	2(300 sec)	2(264 sec)	1140
Participant 11	Visual disabilities	41	Male	2(264 sec)	1(432 sec)	1(360 sec)	*	1056
Participant 12		56	Male	2(252 sec)	1(360 sec)	2(270 sec)	*	882
Participant 13		25	Male	2(246 sec)	1(480 sec)	2(300 sec)	*	1026
Participant 14		52	Female	2(270 sec)	2(258 sec)	2(300 sec)	2(282 sec)	1110
Participant 15		36	Female	2(282 sec)	1(420 sec)	2(300 sec)	*	1002
Participant 16	Auditory disabilities	27	Female	3(228 sec)	3(210 sec)	4(66 sec)	3(216 sec)	720
Participant 17		42	Male	3(210 sec)	1(360 sec)	4(60 sec)	*	630
Participant 18		27	Male	4(120 sec)	3(192 sec)	4(90 sec)	3(186 sec)	588
Participant 19		32	Female	4(156 sec)	3(234 sec)	4 (60 sec)	3(198 sec)	648
Participant 20		33	Male	4(168 sec)	3(180 sec)	4(18 sec)	3(192 sec)	558

(Participants 1 to 5 –Participants without disabilities 6 to 10 - limited hand-functioning, Participants 11 to 15 - visually disabled, Participants 16 to 20 - auditory disabled; * = the participant did not perform the task)

The results in the Table 5 shows that, excluding the participants without disabilities, the students with auditory disabilities were more successful than other participants with disabilities and completed the tasks quicker.

Table 6 indicates the numbers of participants with disabilities who achieved certain scores for each task.

Table 6: The number of participants with disabilities who achieved certain scores for each task

Scores	Task 1		Task 2		Task 3		Task 4	
	Number of participants who completed the task	%	Number of participants who completed the task	%	Number of participants who completed the task	%	Number of participants who completed the task	%
0	0	0	0	0	0	0	6	40
1	0	0	8	53.3	1	6. 7	0	0
2	10	66.7	3	20	8	53.3	4	26.7
3	2	13.3	4	26.7	1	6. 7	5	33.3
4	3	20	0	0	5	33.3	0	0
	15	100	15	100	15	100	15	100

Participants without disabilities were not included in Table 6 since they provided a baseline for the time taken to finish the tasks. These participants' times to finish tasks were much faster than all other participants. A discussion of the observations and results obtained during the usability testing follows. Possible explanations are given for these results. Note that this is an exploratory study and further research is needed.

Task 1 – Use the mouse to find alternative text to the pictures on the Unisa homepage (move over the pictures with the mouse pointer – any picture).

The students with limited hand-functioning had problems with using the mouse to find alternative text because of their limited hand-mobility. Some participants without disabilities were also not able to find alternative text to the pictures and images. Participants with visual disabilities struggled with using the mouse to find alternative text because they could not see properly. In general participants with limited hand-functioning and visual disabilities struggled the most to finish this task. The participants with auditory disabilities were able to easily finish this task.

Task 2 - Use the main Unisa website www.unisa.ac.za to find a link to the myUnisa website.

The participants with visual disabilities struggled the most to finish this task while the participants with auditory disabilities found it easier to finish this task.

Task 3 - Participants have to navigate from the homepage to a link to another website page (other than the myUnisa website), for example Facebook, with ease.

The participants with visual disabilities struggled most to finish this task. Most participants with limited hand-functioning disabilities experienced severe difficulty in completing this task. Only participants with auditory disabilities could easily navigate to other webpages.

Task 4 – Participants must log into myUnisa in order get information about, for example, the date of release of exam results.

Only 60% of the participants were able to finish task 4. To do Task 4, participants had to be able to do Task 2. If participants could not do Task 2 then Task 4 was not applicable. Participants with auditory disabilities were able to finish this task easily. Most of the participants with visual disabilities were not able to finish this task as it was difficult for them to do Task 2.

6. Discussion and conclusion

Both the Unisa and myUnisa websites did not pass the accessibility evaluation. Alternate text is an essential principle of the accessibility design principles checklists, yet website images did not have alternate text or the text was not appropriately used in the websites. People with disabilities, for example blind people, mainly use a keyboard with screen readers and, for example, screen magnifiers or braille displays to navigate the websites, so they have to use input devices with scripts that are neutral. This requires a keyboard-event handler for every element after the mouse-event handler to allow a blind user to navigate a website using the tab key.

Possible explanations for why participants struggled or were not successful may be the following: Task 2 shows that students found it difficult to navigate between the Unisa website and other websites as they could not find or do not know where the myUnisa website page icon is located on the Unisa main web page. Task 4 shows that most visually impaired students are not able to access myUnisa. Only one participant with visual disabilities could complete Task 4 having been able to use the Unisa main website to get to myUnisa. Students with limited hand-mobility also struggled to complete Task 4 as they were not able to use their assistive devices and took long to finish tasks. As a result, it was difficult for them to access information on this e-learning website.

Possible reasons why students with *visual disabilities* could not do the tasks include the unreliable screen layout on the monitor and navigation through the Web; web content that does not allow students with visual disabilities to access the necessary information; irrelevant descriptions for some pictures in the websites; no assistive technologies were used; participants' sight was negatively affected when images, photographs, diagrams and charts are enlarged; no corresponding substitute text for animation, video and audio; participants did not know where the sound is managed or how to switch it on; and participants are not attentive enough in their interaction with the websites.

Possible reasons why students with *limited hand-functioning disabilities* could not do the tasks include no support for navigation with other assistive technologies (e.g. voice recognition software); and participants having difficulty to control the mouse to locate the exact position for a specific task.

Compared to students with limited hand-functioning and visual disabilities most of the students with auditory disabilities were able to complete all the tasks fairly well. Students with visual disabilities could not log into myUnisa and get information since they were not able to locate the myUnisa hyperlink on the Unisa main website.

Specific problems on the Unisa and myUnisa websites identified during the controlled usability evaluation were as follows:

- The participants were unable to use the websites without their respective assistive technologies, for example, students were not aware of an option to enlarge text on the Unisa website.
- Participants found it difficult to get to the myUnisa link from the Unisa website.
- The participants struggled to get to the right web pages.
- Some participants did not remember their myUnisa passwords and could not determine how to retrieve or reset it on/from the website, because the link to do so was not easy to locate.
- The participants took a long time to locate certain links within the websites.

Some of the participants were not able to use the keyboard properly and said they were never trained to use computers. It is clear that, without proper training, these students will not be able to use Unisa's e-learning website, and that they still need to use their respective assistive technologies. The fact that the students forgot their passwords indicates that access to and therefore usability of myUnisa is still challenging. This indicates that it is important for the university to improve on failed heuristics.

The results of the controlled usability evaluation indicate that most participants have problems with the usability of this university's websites. Students needed their assistive devices to fully access the website. Students with limited hand-functioning and with visual disabilities struggle to access myUnisa. As a result, it is difficult for them to use the information available in this e-learning tool. Some students were not aware that myUnisa training is provided at Unisa or still need to attend training intervention on myUnisa as well as end-user computing. Whether the participants will benefit or not from the training will depend on the level of their disability. However, it should enable more students with disabilities to use the websites with more success.

The Unisa and myUnisa automated website evaluation has indicated that accessibility design principles need to be adhered to for these websites to cater for students with disabilities. The fact that national disability guidelines are at a draft stage and not yet enforceable means that higher learning institutions are not obliged to adhere to them. As a result, these institutions developed their own disability policies based on their environment. Therefore, people with disabilities may have problems with the usability of websites. This evaluation was limited and need further research, perhaps allowing participants to use their own assistive devices.

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Adding Narrative to Gamification and Educational Games With Generic Templates

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Abstract: Adding narrative, that is, a story, to gamification and educational games can boost students' motivation and engagement. This requires a narrative fitting the course in which it will be deployed to and a gameplay to which the narrative fits without seeming to be tacked on. In this article, a gamification template called Reification and an education game template called Synapses are introduced both aiming at relieving educators from having to find an appropriate game or gamification leaving them only the task of finding a fitting narrative. Reification is making something abstract concrete with the intention of making the represented concept more tangible. In case of the gamification mechanism Reification, a learner's progress in a course is made concrete through visualization: A student's progress is visualized as a landscape in which each object, such as a tree, makes concrete one of the student's accomplishments, such as a solved exercise. Reification aims to provide students with a tangible overview of their learning progress and allows them to compare their landscape to their peers'. Reification is illustrated in the article with a course on Egyptology. Synapses is a game which supports students in overcoming and preventing the development of misconceptions, which are commonly held incorrect beliefs by students about courses' contents. After each lecture, students are tasked to organize parts of the lecture's content in a concept map, or to revise their concept maps in reaction to mistakes made in exercises. The game's narrative takes different turns depending on the percentage of students having a correct concept map. Synapses is illustrated in the article with a course on Logic. This article represents a work-in-progress: The concepts are grounded in theory with evaluations of the introduced implementations planned for future work.

Keywords: gamification, game-based learning, gameful design, motivation, learner's misconceptions, concept maps

1. Introduction

Insufficient motivation by learners to engage with learning content or partake in learning is nowadays often addressed by adding gamification, in most cases in form of points, badges, and leaderboards (Nicholson, 2015) which have been shown to have a positive effect on students' motivation and learning (Hamari et al., 2014; Seaborn and Fels, 2015). Points, badges, and leaderboards reduce *games* to their most basic components and ignore other aspects of games, such as narrative and gameplay. Adding narrative to gamification and educational games has been shown to have positive effects on students' motivation and engagement (Wood and Reiners, 2015; Kapp, Blair and Mesch, 2013), but adding narrative to points, badges, and leaderboards is not an easy task, as those elements – even if found in real games – are not conceived to have an associated narrative. It is similar with educational games: Often a very generic narrative (e.g., a space race) is used with only the domain of the learning activities being changed. Nonetheless, there are educational games and gamification with a more sophisticated narrative dimension (O'Donovan et al., 2013; Villagrasa et al., 2014), but those are most often custom built which is time and cost intensive.

With the aim of freeing educators from having to have an idea for a game or gamification, this article introduces two templates: a gamification template called *Reification* and an educational game template called *Synapses* which are nearly as generic as points, badges, and leaderboards, but can easily be enriched with a narrative.

Reification makes students' learning progress tangible through visualization: A student's progress is visualized as a landscape in which each object, such as a tree, represents one of the student's learning achievements, such as a solved exercise. Depending on the student's progress in solving the exercise, the object can be shown in different states, such as a small tree for an unfinished submission to a big tree for a complete submission. Optionally, objects in the landscape can decay when students show insufficient activity in the course. Therefore, active students are presented with a lush landscape, while the landscape of passive students looks withered. *Reification* aims to provide students with an accessible overview of their learning progress and allows them to assess their learning progress by comparing their landscape to their peers'. Building their personal landscape and having to fear to lose their progress by inactivity uses similar mechanisms as social games, which have been suggested to be the reason why players keep on playing those games (Newheiser, 2009).

Synapses is a game which supports students in overcoming and preventing the development of misconceptions. After each lecture, each student is tasked to organize the lecture's contents in a concept map to be built with concepts and associations provided by lecturers. Correctly constructed concept maps contribute to a student's score. Concept maps are visualized in form of a network of synapses and are connected to exercises: A mistake in an exercise is seen as an error in the corresponding region of the concept map resulting in the student being tasked to rebuild that region of their concept map. The game's narrative takes different turns depending on students' performances; the best outcome only being achieved when the majority of students has a correct concept map.

The contributions of this article are twofold: First, the introduction of two novel generic templates for game-based learning which can easily be enriched with a narrative that fits the context they are deployed in and second, two planned exemplary implementations of the templates in course on Egyptology and Logic, respectively, to be evaluated in the future.

This article is structured as follows: Section 1 is this introduction. Section 2 introduces related work. In Section 3 both templates and their exemplary implementations are described. Section 4 concludes the article and gives perspectives for further research.

2. Related work

The approach discussed in this article is a contribution to gamification and educational games and is related to misconceptions and behavioural change.

2.1 Gamification

Deterding et al. (2011) define gamification as "the use of video game elements in non-gaming systems" (Deterding et al., 2011, p. 1) and cite Reeves and Read (2009) for examples of game elements who list among their ten ingredients of games "narrative context", "feedback", and "reputation, ranks and levels" (Reeves and Read, 2009, p. 80) as game elements. Even though there are more game elements besides "reputation, ranks and levels", most often gamification focusses on that element in form of points, badges, and leaderboards which nonetheless have shown to produce positive results in the majority of studies (Hamari, Koivisto and Sarsa, 2014; Seaborn and Fels, 2015; Nah et al., 2014).

Zichermann and Cunningham (2011) exclude narrative explicitly from their list of gamification elements, as gamification (according to them) is used to build "non-fiction experiences" (Zichermann and Cunningham, 2011, p. 35). While the majority of studies examined in a survey on gamification in education by Nah et al. (2014) only used points, badges, and leaderboards, three of them included some kind of narrative: O'Donovan, Gain and Marais (2013) gamified a course on computer games development with a storyline set in a steampunk world where students took on roles as members of a secret order who are tasked to retrieve a certain item which is achieved by solving learning tasks. Students reacted positively to the gamification and the course had higher attendance compared to other non-gamified courses, but students criticized that the storyline was not integrated throughout all the tasks of the course. Villagrasa, Fonseca and Durán (2014) gamified a course on 3D modelling where students took on the role of creating a pavilion for a fictional world expo on a parcel of a virtual island, which then could be visited by other students using a virtual reality headset. Students showed a positive attitude towards the gamification, but a negative attitude towards points and badges. In their book on implementing gamification in learning and instruction, Kapp, Blair and Mesch (2013) state that "storytelling is one of the most effective yet underused methods for enhancing adult learning" (Kapp, Blair and Mesch, 2013, p. 118). Nicholson (2015) coined the term "meaningful gamification" as a form of gamification that goes beyond reward-based gamification and introduces six areas in which the aforementioned "meaningful gamification" can take place, "exposition" being one of them. Exposition refers to the "process of presenting a narrative layer through game design elements" (Nicholson, 2015, p. 7). While McGonigal (2011) only sees "goals", "rules", "feedback system", and "voluntary participation" (McGonigal, 2011, p. 21) as the four defining traits of games, according to her "a compelling story can make a goal more enticing" (McGonigal, 2011, p. 21).

2.2 Educational games

Backlund and Hendrix (2013) define educational games as "serious games specifically used for education" (Backlund und Hendrix, 2013, p. 1). In turn, they define serious games as "games (…) for purposes beyond pure entertainment" (Backlund und Hendrix, 2013, p. 1). Qin, Chui and Pang (2010) consider computer games as a spectrum which can be seen in Figure 1. The more left, the more learning and training takes the main focus; the more right, the more fun takes the main focus. Qin, Chui and Pang (2010) consider serious games and simulation games as a mixture of both; as games that make learning and training fun.

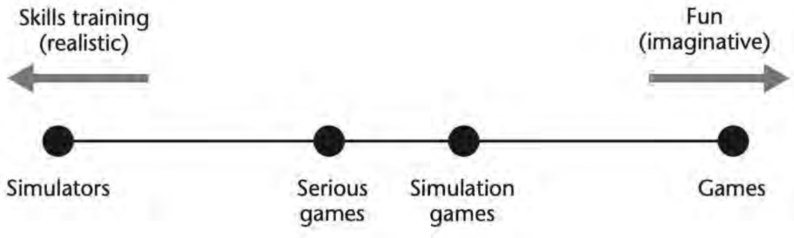

Figure 1: Computer game spectrum (taken from Qin, Chui and Pang (2010, p. 46))

Backlund and Hendrix (2013) examined in their study both games specifically built for learning as well as *real games* used in educational scenarios. In the majority of examined studies a positive effect of games on learning was shown, with the authors concluding that games can be "effective learning materials" (Backlund and Hendrix, 2013, p. 6). Vogel et al. (2006) conducted a meta-analysis which reports "higher cognitive gains and better attitude toward learning" (Vogel et al., 2006, p. 237) when comparing interactive simulations and games to traditional teaching methods.

When looking at a few of the examined studies from Backlund and Hendrix (2013) for higher education that used games specifically built for education, results are mixed: Ebner and Holzinger (2007) developed a game that supports students in learning internal forces in Mechanics. The game consists of multiple choice questions with time limit and a leaderboard. Their evaluation showed that students learn a similar amount from the game when compared to traditional methods and had fun while playing the game. Wangenheim, Thiry and Kochanski (2009) developed a game for learning software measuring which puts students in the role of a measurement analyst tasked to do software measurement in a realistic scenario. The authors could not find evidence of a learning effect in the group playing the game compared to a group not playing the game. Qin, Chui and Pang (2010) developed a game teaching medical students how to stop a patient's bleeding during an operation. They developed two games unrelated to medicine but schooled the psychomotor skills required to stop bleeding and found that students who played those games beforehand consistently performed better than a group that was not schooled using said games, even after that group had repeatedly performed the same task.

2.3 Misconceptions and conceptual change

Student misconceptions (also referred to, among others, as preconcepts and naive concepts (Leonard, Kalinowski and Andrews, 2014)) have been subject of numerous scientific studies (Confrey, 1990). While the research on student misconceptions arose in the field of science education, where misconceptions are often rooted in concrete phenomena (such as photosynthesis (Fisher and Moody, 2002)) authors recently use the notion of *misconceptions* in computer science education (Qian and Lehman, 2017), where the term *systematic errors* was previously more commonly used (Confrey, 1990). Gurel, Eryılmaz and McDermott (2015) found that misconceptions are most commonly identified using open-ended questionnaires and interviews, which have to be evaluated by hand. An approach similar to identifying misconceptions by analysing concept maps was performed by Köse (2008), who analysed conceptual drawings of students (Köse, 2008).

The conceptual change model, first defined by Posner, Strike and Hewson (1982), describes the process of overcoming misconceptions: The model states that misconceptions are abandoned for better concepts if the previous concept is perceived as inadequate, while the new concept is perceived as intelligible, plausible, and fruitful. This model has found applications in face-to-face teaching strategies, which would typically consist of invoking a conflict between the misconceptions held within learners and concepts to be learned (e.g, by showing a concrete experiment contradicting a common misconception) (Scott, Asoko and Driver, 1992). Another, more scalable approach to invoking conceptual change is the use of *refutation texts* (Tippett, 2010), which provide an argumentation against common misconceptions.

Misconceptions are often developed while acquiring the knowledge (Confrey, 1990). To prevent their development while knowledge is acquired, concept maps can be beneficial. Reategui et al. (2018) propose to use concept maps for acquiring knowledge. Their results show that students organizing their knowledge using concept maps had higher learning gains compared to students using traditional teaching methods.

3. Generic gGames

This section introduces the gamification template *Reification* as well as the education game template *Synapses* and illustrates them by means of two exemplary implementations.

3.1 Reification

Reify, the process of reification, is defined as "to consider or represent (something abstract) as a material or concrete thing" (Merriam-Webster, 2019). An example for reification can be found in cars where growing plants on the dashboard reify eco-friendly driving style as in Ford's EcoGuide (see Inbar et al. (2011)).

The gamification mechanism *Reification* introduced in this section aims at making learners' progress tangible through visualization and at the same time motivating learners to maintain their activity. A similar approach is proposed in Raymer (2006) who envisioned a system in which learners are rewarded with items to show on a virtual character for completing learning tasks. Concepts discussed in this chapter were initially introduced in Hartmann (2018) as part of a master thesis supervised by the authors.

3.1.1 Concept

Reification visualizes each learner's progress in form of a landscape on which the student can freely place objects which are associated with learning tasks, e.g., doing an assigned reading, attending the lecture, or doing homework. There are two different types of tasks:

- An atomic task rewards a learner with an object as soon as the task's goal, e.g., visiting the weekly lecture, is accomplished.
- A progress tasks rewards the student with an object before any goal is reached whose state (and with it the visualization) changes when the learner reaches certain goals, e.g., for every submitted exercises on a homework consisting of multiple exercises.

Figure 2 illustrates *Reification*: The left side shows part of a learner's landscape with two objects, the right side shows three associated tasks. The first task is a progress task, where the tree is growing for each part of the homework the learner submits resulting in a tree carrying apples after all parts have been submitted. The second task is an atomic task which rewarded the learner with a flower to place in the landscape after they attended the lecture.

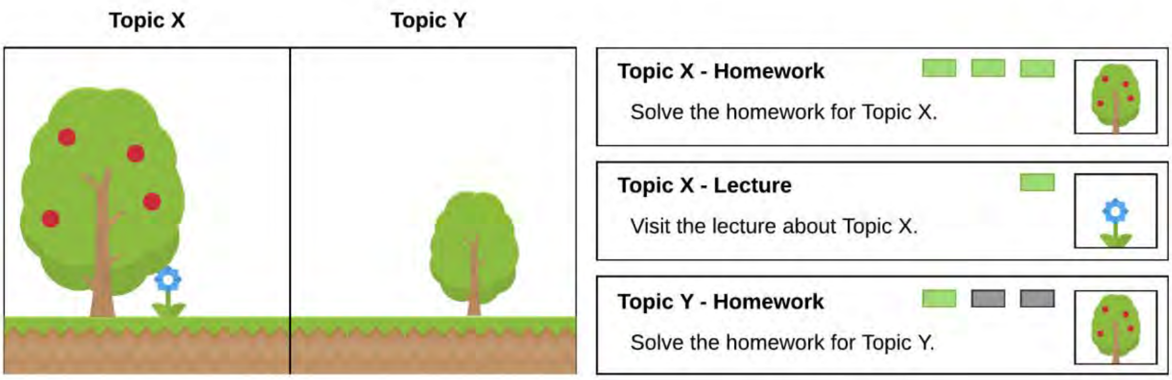

Figure 2: Reification with two segments and one progress and one simple task referring to Topic A (adapted from Hartmann (2018); images taken from Kenney (https://www.kenney.nl))

Another key part of *Reification* can be seen in Figure 2 as well: The landscape can be divided into different segments, e.g., by topic or by week. A segmented landscape allows learners to easily identify areas they have taken sufficiently care of, and areas where more work is needed as well as assess their learning progress by comparing their landscape to their peer's landscapes. For example, the third task in Figure 2 refers to the homework about Topic Y and the associated tree signals – through its size – to the learner that there is work to do in regard to Topic Y. To motivate learners to work throughout a course's duration and not only shortly before the examination, *decay* can be used: If a student's activity is not above some threshold, their landscape begins to decay, e.g., by changing from a lush jungle to a dry desert, which should motivate students because of loss aversion (see Tversky and Kahneman, 1991).

Reification is grounded in social games, such as FarmVille, which motivate their players to keep on playing with similar mechanisms: Crops are given at the beginning (progress tasks), have to be tended to (doing the homework) in order for the player to be finally able to harvest them. If the player does not regularly tend to their crops, they wither (decay) and have to be disposed of. While FarmVille is criticized for its addictive nature in combination with the ability to spend real money in the game (Newheiser, 2009; Griffiths, 2010), it has been suggested that exactly that core gameplay loop is what keeps players playing the game (Newheiser, 2009). Even ten years later, FarmVille is still successful (with around $11 million being spent by players in the first quarter of 2019 (Wilson, 2019)) which points at the core gameplay loop of planting, tending to, and harvesting crops is still able to motivate players in 2019**.** Utilizing similar mechanisms for *Reification* can be seen as less critical, as the number of exercises is limited and doing more than the assigned exercises has no positive effects on a student's landscape.

Reification can be applied in most contexts where points, badges, and leaderboards can be applied as well and should turn out to be more motivating for students because of its narrative. When teaching Art History, students could be given an art gallery instead of a landscape with tasks rewarding them artworks. A course on Geography could reward students with a landmark of a country after learning about the country to be placed on a world map. The next section illustrates *Reification* by the means of a course on Egyptology where students incrementally build historical structures of Ancient Egypt by solving quizzes.

3.1.2 Application

At the authors' university, Egyptology major students are taught in the same courses as Egyptology minor students due to a low number of students which leads to an audience with heterogenous knowledge. Aiming at supporting students in catching up to their peers, an online course consisting of a large number of quizzes was created. *Reification* will be applied to motivate students to keep on working on their knowledge.

Ancient Egypt spans 5000 years during which structures in different building styles were built. Therefore, the different structures are suitable as rewards, as they allow an overview of which periods have been covered and which still have to be covered.

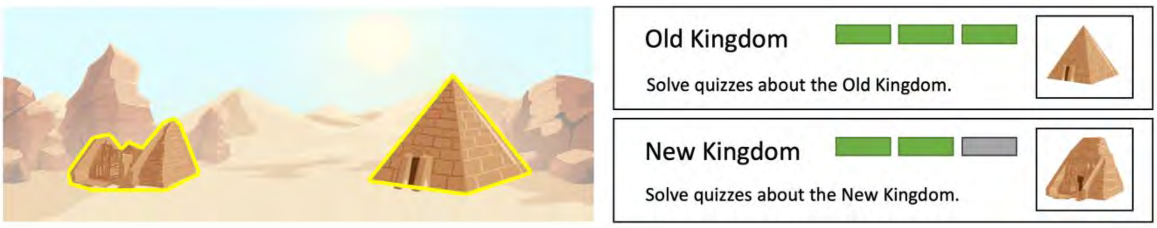

Figure 3: *Reification* for course on Egyptology showing one finished progress task and one progress task two-thirds finished

Figure 3 shows how *Reification* applied to that course will look like: For each period, a number of structures were drawn in three different stages of completion, from foundation only to half-done to finished. Each student can choose a period, place the foundation of one of the period's structures, and begin to complete the structure by correctly answering quizzes referring to that period. An example for the three states a structure runs through can be seen in Figure 4.

Figure 4: Example for the different states a temple goes through while a student is answering quizzes

Decay is not intended to be used in this implementation, as the goal is not getting students to do the quizzes regularly rather than motivating them to do them at all: The course allows students to catch up and motivates them throughout the process. After they acquired the knowledge required to follow the lecture, working on the quizzes is no longer important, as further learning is done through other learning activities.

3.2 Synapses

Synapses is a template for an educational game that aims to engage students with lecture's contents after a lecture by letting students elaborate on them in a playful way aiming to overcome and prevent the development of misconceptions.

3.2.1 Concept

Synapses represents the content of a course as a concept map with each lecture adding new concepts and associations available for use on the concept map. After each lecture, students are tasked to work newly acquired concepts using the new (and existing) associations into the concept map. By doing so, students are reflecting and elaborating on the lecture's contents, which, as shown in Section 2, can help overcome and prevent the development of misconceptions. Correctly constructed concept maps contribute to a student's score. The general narrative of the game is the organisation of the newly acquired knowledge in the student's brain. Therefore, the concepts and associations are visualized in form of (simplified) synapses, an example of which can be seen in Figure 5.

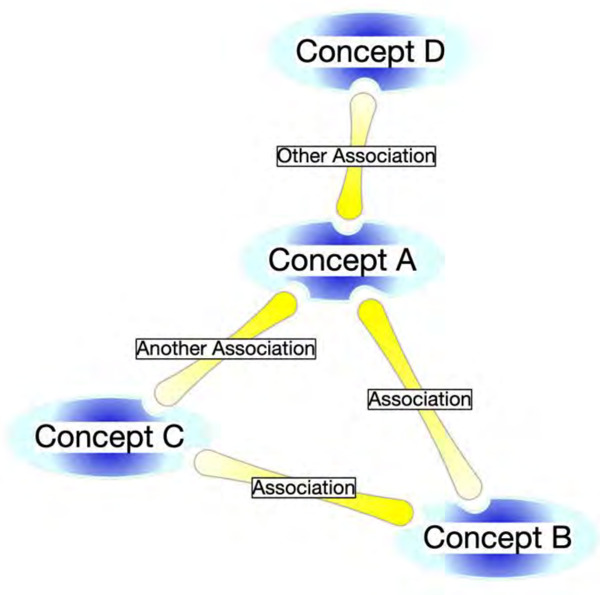

Figure 5: Visualization of a learner's concept map in form of (simplified) human brain

Students' misconceptions most often become apparent as mistakes done in exercises. The authors' found that the frequency of misconceptions follows a power law: Few misconceptions constitute the majority of all mistake occurrences (see Appendix). When misconceptions for a topic are known (e.g., by collecting them from a previous term's exercises), most of them can be mapped to regions of the concept map. If a student makes a mistake which teachers identify as a mistake stemming from a misconception, the system tasks the student to rearrange the associated region of the concept map.

An example for the mapping of a mistake resulting from a misconception to a region of the concept map can be seen in Figure 6. In the submission on the left side of Figure 6**,** the order of operations of multiplication and addition was violated leading to a wrong result. The right side of Figure 6 shows a part of the concept map where the region from which the misconception most likely stems from is highlighted, namely the binding power of operators. Letting the student who made that mistake elaborate on operators and their binding power should help them understand why their result is wrong and what is the correct result.

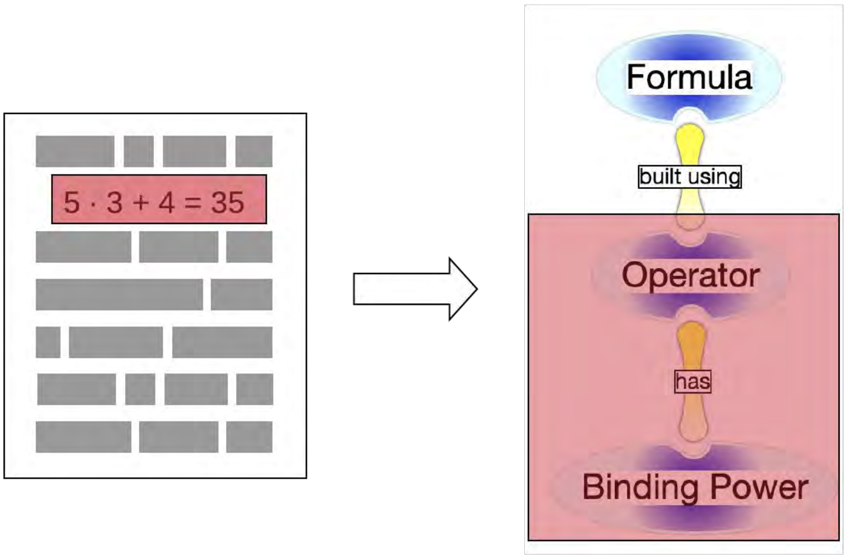

Figure 6: Exemplary mapping of a common misconception in arithmetic to a region in the concept map

The intention of this intervention is to prompt the student to reflect and elaborate on the concepts and associations and their connection to the mistake made. Therefore, the intervention moves away from feedback given as a monologue towards a dialogue with the system. As mentioned above, the majority of mistakes stem from a limited number of misconceptions, therefore preparing such interventions (i.e. associating misconceptions to regions of the concept map) should be feasible without too much extra work.

The game follows a social narrative with a story taking different turns depending on the percentage of students having a correct concept map, e.g., something positive happens if the majority is correct, nothing or something negative happens if the majority is incorrect; the best outcome only being achieved when the majority of students has a correct concept map.

Synapses has limitations in its genericity: Not every subject is suited to be represented in form of a concept map, not all misconceptions may follow the power law, and misconceptions may not always be able to be mapped onto regions of the concept map. Besides, the process of building the initial (correct) concept map used for scoring and the mapping of misconceptions to regions might be time-consuming, but can be reused each term a course is taught.

3.2.2 Application

An exemplary application of *Synapses* was conceived for a course on Logic where students are confronted with a large number of new concepts to be immediately applied in weekly homework exercises. As narrative, Paris and its Métro were set in a fictional world where the laws of nature are determined by the opinion of the majority of its inhabitants. For example, if the majority thinks that elephants can fly, elephants would fly in that world. The Paris Métro was chosen because it is an example for a system parts of which were validated for correctness using propositional logics. For the game, the audience is thought of as the entire population of the fictional world: If the majority of students have an incorrect concept map, that world's formal logic is broken and therefore the Paris Métro no longer works leading to delays. Throughout the term, the audience's accumulated delays lead to changes in the virtual world's Paris and different outcomes each week.

4. Conclusion and perspectives

This article introduced a template for a gamification mechanism and a template for an educational game with the aim of providing educators with templates which can be filled with a narrative that engages students more than gamification without narrative. *Reification* takes learning progress and makes it visible in form of a landscape in which each element can be placed by the learner and represents a learning task. *Synapses* aims at overcoming and preventing the development of misconceptions by tasking students to organize the concepts learnt in a lecture in a concept map. Both templates are generic which relieves educators of the task of developing a gamification or educational game and only leaves them the task of finding a fitting narrative and can be provided to educators that are unable to implement those by themselves to allow them to motivate their students with engaging storylines. For both templates, exemplary implementations were introduced, but no evaluations were done. While the concepts are grounded in theory and there is evidence that adding narrative can make gamification and game-based learning more engaging, empirical evaluations are required: Can *Reification* motivate learners to do the desired learning activities and can *Synapses* help overcome and prevent the development of misconceptions? Furthermore, narrative as engagement mechanism in educational games and gamification is underrepresented in research and should be examined in other contexts and for other concepts in the future as well.

Appendix 1

In a course on theoretical computer science the mistakes stemming most likely from misconceptions were compiled using 2 judges ($\kappa = 0.7$). Figure 7 shows the misconceptions and their occurrences exhibiting a power law. A more detailed look on the data can be found in Heller and Bry (2018).

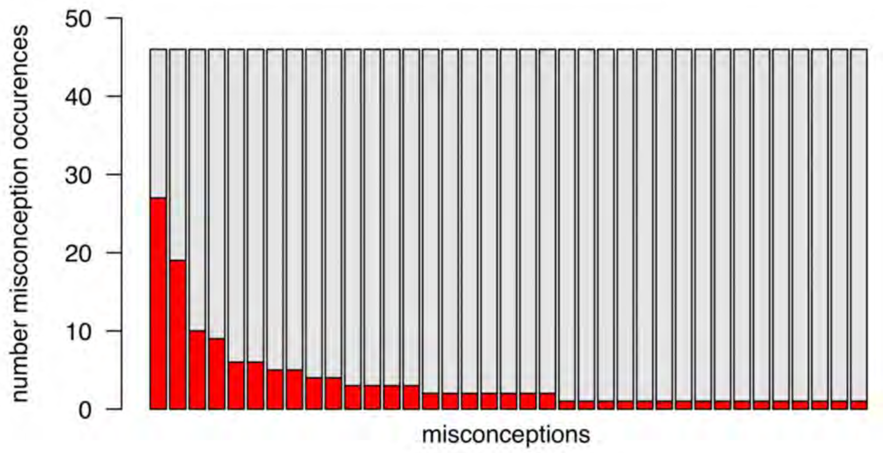

Figure 7: The number of students doing exhibiting a certain misconceptions

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Digital Literacy and Course Design

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Abstract: This paper presents a course planning model for lower and upper secondary schools in the fields of digital literacy and computational thinking. The examples in the paper are based on a Danish regional project entitled "crossingIT," in which about 35 unique courses were developed and conducted by local educators. Duration of the courses ranged from approximately two hours to four a week for fifteen weeks. The model highlights four perspectives in course planning: (1) a traditional planning perspective, with a focus on learning objectives, learning activities, practical organisation, evaluations, etc; (2) methods for teaching digital production such as iterative design cycles, pair programming pedagogy and video tutorials as well as textbooks; (3) the field of digital literacy including, for example, computational thinking skills, ethics, critical thinking and societal perspectives; and (4) Environment, including local company participation, career learning and cross-school teaching. The model can be used for both planning and analysing courses in the fields of digital literacy and computational thinking. The article offers specific examples of teaching methods and specific cases from practice. Teaching in this field does not have a long tradition in Denmark. The model provides specific advice for well-rounded didactic planning in the fields of computational thinking and digital literacy.

Keywords: digital literacy, computational thinking, teaching, learning, course design and didactics, coding and programming

1. Introduction

What is important for educators and managers to consider when teaching programming, digital design and digital literacy in secondary education? Are there didactic methods specifically related to digital design and digital production? This article presents a model for planning and evaluating teaching in programming, digital design and digital literacy.

The model was developed for secondary education in Denmark in collaboration with teachers. The teachers were part of the ROBOlearning project (2018-2020)[1] which included four upper secondary schools, with most students ranging from 16 – 19 years of age, and five primary and lower secondary schools, focusing on students ranging from 13 – 15 years of age. The upper secondary schools encompassed general Upper Secondary School, Technical and Commercial Upper Secondary School and Vocational Education and Training[2]. In addition, the model was used to evaluate 18 of 35 courses in digital production and digital literacy in the "crossingIT" project (2017-2019).[3]

The learning perspective in this article is based on experiential, collaborative and participatory learning processes as described by Kolb (1984), Wenger (1998), Papert (1993), Schön (2001), Rusk et al (2008), Resnick et al (2009) and Majgaard (2015), among others. Learning often takes place when the students actively participate and experience new subject matter. These experiences need to be explicitly reflected upon in the community of practice in the classroom.

The new didactic model "ROBOdidaktik" (March 2019) was inspired by Hiim and Hippe (2007) and more recently by Gynther (2010) and Hachmann et al (2014), who both integrate digital production and innovation into didactic considerations. "ROBOdidaktik" adds a concrete focus on digital production and methods in the classroom, as well as an orientation towards various aspects in the environment of the educational settings.
Organisation of the paper: first the didactic model is introduced, and then its four dimensions (teaching design, digital production methods, digital literacy and environment) are described in detail, supplemented with illustrative examples from the project crossingIT (2017-2019). The paper ends with a summary and conclusion.

[1]https://www.robo-sydfyn.dk/
[2]https://international.kk.dk/artikel/how-danish-school-system-structured
[3]https://www.crossingit.dk/

2. Didactic model for the development and evaluation of courses

This section presents a model for evaluation of teaching and lesson planning in programming, digital design and digital literacy. The model can be used for exploring all the relevant aspects in the design phases of a course and its further development. Furthermore, the model can assist in systematically evaluating existing courses.

The model was developed in collaboration with a selected group of teachers in the ROBOlearning project. In three workshops and several project seminars, the teachers explained their approach to planning and conducting teaching in digital literacy and production. They explained their ideas in keywords and provided elaborate examples of planned and conducted teaching in the field. In the ROBOlearning project, the teachers are now documenting their teaching using the four elements in the model. As a supplement, we developed questions to support and operationalise the model. Supportive questions as well as courses can be found on the project's website.

In the development phase, a round as well as a linear phase model illustrating the four elements was presented to the teachers. They preferred the round model. Learning and teaching is often circular, iterative and complex. The round model underlines that the starting point could be anywhere. Additionally, the model balances a technology and learning goal-driven approach by presenting complementary approaches to didactic planning.

Teaching computational and digital literacy is often driven by new exciting technology; this is referred to as "technology-driven teaching" (Majgaard, 2010). Teachers and researchers often mention that there should more to this type of teaching than exploring a new digital gadget. The teachers find it hard to achieve specific educational objectives by simply exploring a new gadget. As a contrast to the technology-driven approach, there is teaching driven by educational goals and learning objectives. The strength of the goal-driven approach is that the teachers know exactly what they are aiming for and when to stop, and they continue until the goals are reached. The disadvantage of this approach is that the teachers focus too much on the learning objectives and may become unable to adjust the goal(s) according to student progress and the potential discovered in the technology. The advantage of the technology-driven approach is the opportunity to explore new and untested technological breakthroughs. The disadvantage, on the other hand, is that the product may be useless.

Developing a new way of teaching requires that teachers balance conflicting priorities. When applying teaching technologies, the learning goals obviously have high priority, but learning only occurs if the students interact correctly with the technology and the technology is appropriate (and cheap enough for schools to afford) (Majgaard, 2010).

This new didactic model proposes acknowledging and balancing the technology-driven approach with the learning goals- driven approach.

The model introduces four dimensions: (1) teaching design: the traditional didactic dimension, covering aspects such as the identification of learning objectives, learning activities, practical organisation and evaluations; (2) digital production: this covers development methods such as iterative design cycles, pair programming pedagogy and the production of video tutorials as well as textbooks; (3) digital literacy: this dimension includes computational thinking skills, ethical approaches, critical thinking and societal perspectives; and (4) the environment, which encompasses co-creation with local companies or other educational institutions, and promotes career learning by gradually involving a wide range of environments into educational processes (Law, 2010). See figure 1 below:

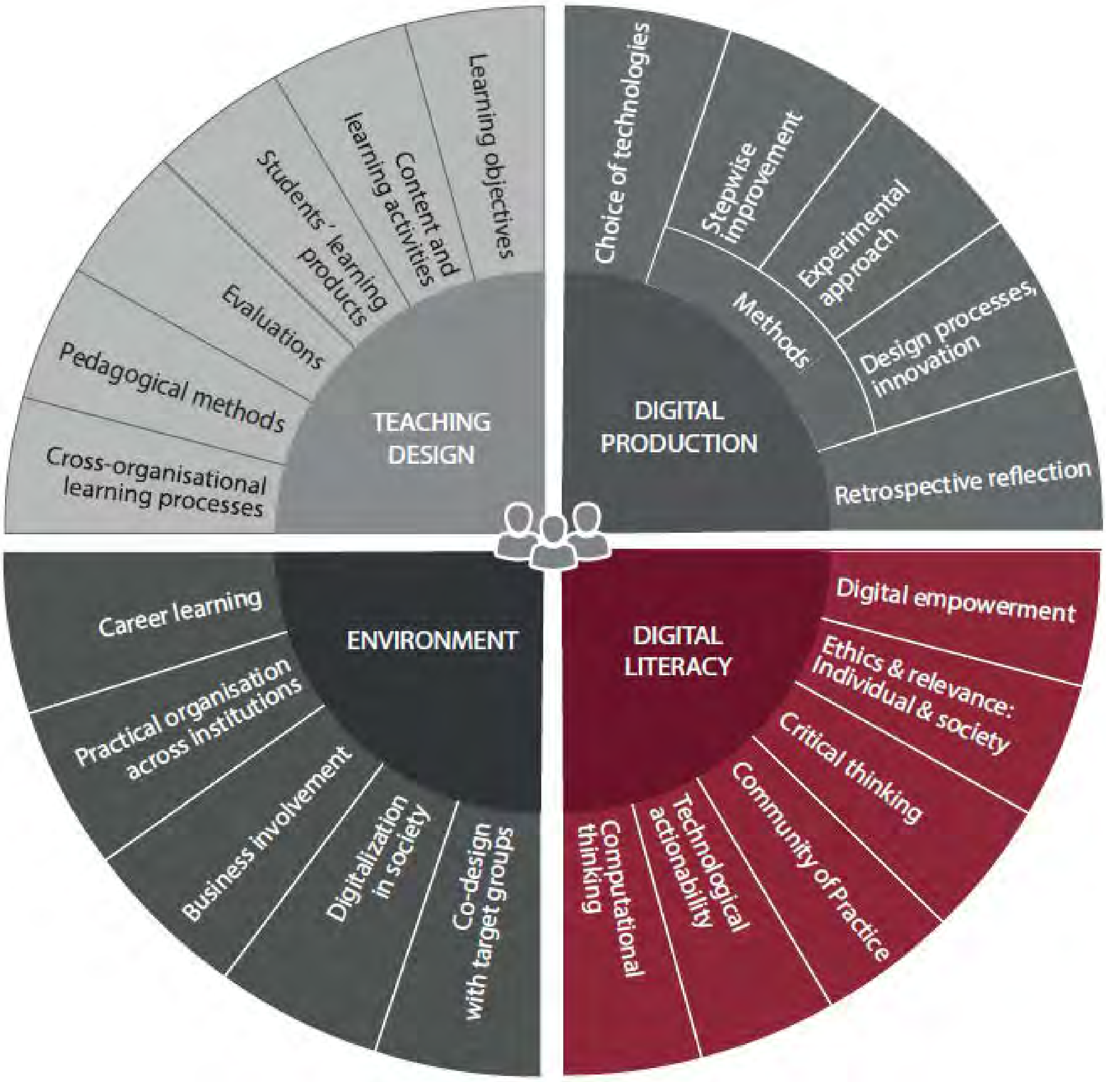


Figure 1: Didactic model for teaching in the field of digital production and literacy, for Danish original, see robo-sydfyn.dk (2019)

3. Teaching design (1)

Teaching design includes common elements of lesson planning such as learning objectives, activities, scaffolding and practical organisation: see figure 1. In addition, the teacher must decide on the learning output the students must produce and how it should be evaluated (Gynther, 2010; Hiim and Hippe 2007). Traditionally, learning output includes written texts (such as reports) and oral presentations. When the subject area extends to IT and technology, the products become more multi-faceted and often digitally interactive. They may include homemade computer games, digital simulations, apps, programs, code examples, student-produced video tutorials, robotic artefacts, video material explaining the students' digital products, etc. The teacher should formulate specific requirements for these digital products (for example in games: the number of levels, start and end scenes). In addition, the requirements can relate to a thematic framework such as, for example, climate or future scenarios.

Example: the local "World Championship in game design" in Svendborg, Denmark, took place over four days as the second iteration of an elective course for 150 7th-graders (13-14 years of age – lower secondary school) and 75 first-year HHX students (17-18 years of age – upper secondary business school).[4] The goal was to develop computer games in groups of four lower secondary school students, each group supported and supervised by two HHX students. A small group of HHX students also assisted as event coordinators. The learning objectives

[4]https://www.crossingit.dk/erhvervsgymnasier/uvforloeb-gym/

for the lower secondary school students were competencies in block programming, coupled with learning objectives in Danish and marketing. The learning objectives for HHX students included dissemination of academic material, mentoring of younger students, event coordination and organisation, as well as the production of teaching materials, in the form of 15 video tutorials. The course ended with a competition of student presentations in an auditorium, assessed and awarded by a panel of judges.

All course materials were added to a Padlet[5]: the time schedule, video tutorials, the students' games, documentation, etc: see figure below.

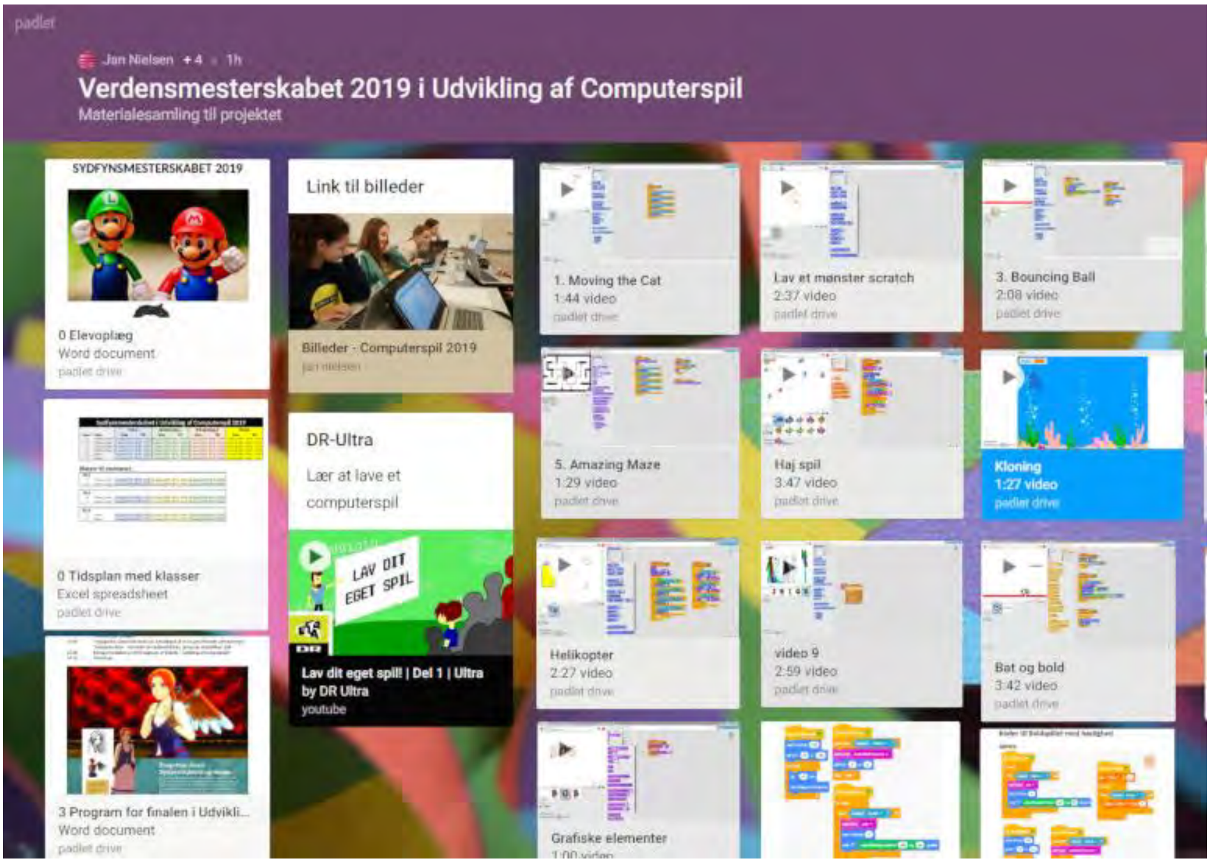


Figure 2: Open platform for teaching material

Optimally, the requirements for the games could have been worked out more precisely, for example with a start scene, three levels, end scene and score. The large-scale case can easily be downsized to a single class. The teaching design involved an impressive logistic organisation. The local schools are now planning a third iteration of the championship in game design.

4. Digital production (2)

The dimension of digital production consists of methods for digital production, e.g. well-ordered problems, well-prepared running codes constructed by the teacher ("worked example" Caspersen et al), video teasers, all of which form the basis for the students' products. It is important that the students not only copy the "worked examples", but that the running examples should kick-start their own further digital production. The examples ensure that all students get a head start, avoiding some of the frustrations and avoiding "getting stuck" from the start. There is, however, also a risk that over-developed examples block creativity (Majgaard, 2017). In other words, the worked examples should create a low floor and a high ceiling (Brennan and Resnick, 2012).

Example: Worked example. The teacher developed a simple running game on the platform code.org, which was shared via the intranet with the students: see figure 3 (a). The students developed in groups their own versions of Christmas games. In some of the students' games, presents and coal fell from the sky and Santa Claus had to collect the presents: see figure 3 (b).

[5]https://padlet.com/jni5/Computerspil

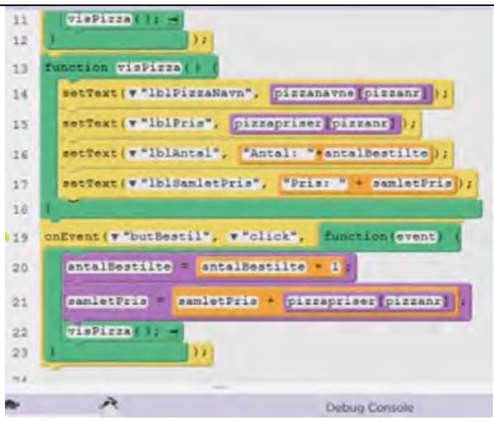
3 (a) Worked example developed by the teacher

3 (b) Student game based on teacher´s example

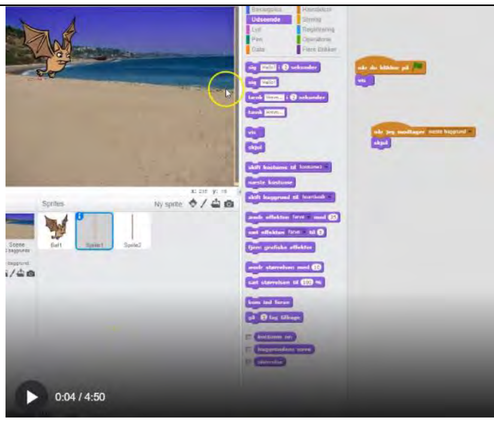
Figure 3: Screen shots of running versions of the worked example and student game (Business College Syd, Sønderborg 2018)

The running version of the game inspired and benefitted many of the students, although in different ways. But some of the technically advanced students preferred to work in a more experimenting way, without templates and using their own more professional software. It was easier for the teacher to supervise more uniform projects. On the other hand, this could have led to less creative solutions.

Example: Video tutorials. Video tutorials can be found online, and they sometimes match the learning objectives. Often teachers create their own tutorials that fit their specific curriculum and where the teacher acts as the expert: see figure 4 (a). Video tutorials can also be student products: see figure 4 (b). The students train the presentation of academic concepts about programming, producing a new running program at the same time.



4 (a) Video tutorial on pizza ordering system developed by the teacher[6]



4 (b) Video tutorial developed by a student[7]

Figure 4: Screen shots from video tutorials created by teacher and students

Video tutorials have proven to have great advantages: In video tutorials, the learner observes the functionality of the programming environment, which often is not explicitly articulated by the voice in the video. This show-and-tell approach is related to the concept of tacit knowledge (Majgaard and Lykke, 2018; Nonaka 1995). Tacit knowledge is rooted in actions, procedures and routines. Tacit knowledge consists partly of embodied informal knowledge that is hard to explain explicitly in words (Nonaka, 1995). Tacit knowledge is displayed visually in the interactions and system behaviour recorded in the video. Tacit knowledge on display is one of the greatest potentials of video tutorials (Majgaard and Lykke, 2018). On the other hand, there are also challenges associated with video tutorials; they may not match specific learning goals, programming environment versions can be obsolete, it can be time consuming to revisit specific parts of the video, the pace may be too fast, important

[6]https://www.youtube.com/watch?v=wIf8kbZ3T6c
[7]https://padlet-uploads.storage.googleapis.com/344941766/2f897a566fdd2812a8571236c35fef77/video_7.mp4

steps can be skipped, and they can be time consuming for students to produce and for teachers to review (Majgaard & Lykke, 2018).

Pair programming is also an effective method. Students sit in twos, programming and problem solving. At fixed intervals (for example 15 minutes), students change seats, so that it is not always the same students who sit in front of the computer and lead the way (Lui, 2006). This promotes a professional dialogue about digital production between the students, and more students participate actively.

Methods for iterative project development where groups of students experiment in freer settings are widely used (Fullerton, 2018). This requires a defined framework including pre-defined milestones, interim products, design phases and sometimes even team roles. A well-defined framework secures less chaotic design processes and classrooms. In addition, it provides the students with a framework in which they can move towards becoming creative designers.

5. Digital literacy (3)

The concept of digital literacy embraces the critical and reflected use of technology and digital sources, innovative thinking, and personal and societal positioning in relation to the role of technology. The concept includes critical use of social media, assessment of digital sources and application of IT-based tools. In addition, digital literacy includes practice-based methods for digital production and technological knowledge students gain by coding simple simulations themselves (Brennan and Resnick, 2012; Majgaard, 2018).

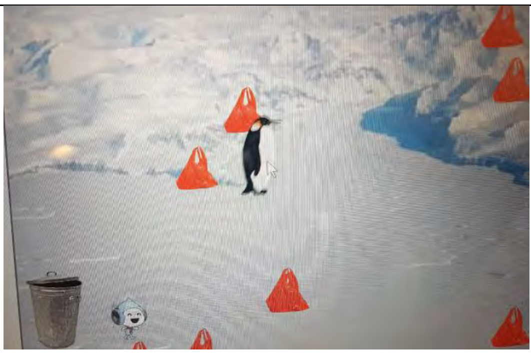
Digital literacy is, however, a broad and slightly imprecise concept. Sometimes it can be merely defined as possessing predominantly technical competencies (Brennan and Resnick, 2012; Gee, 2013). At other times, its definition extends to professional socialisation and innovative design competencies (Martin, 2008). Technical competence increases with the ability to engage in critical analysis of digital data (Buckingham, 2008). Martin (2008) has attempted to relate these elements to each other. His model focuses primarily on the use of technology and less on the design and coding of new digital applications. Table 1 below is inspired by Martin (2008) and has a focus on design and coding. The three perspectives described are the personal perspective, the perspective of community of practice and the digital production perspective.

Table 1: Digital literacy from three perspectives (Majgaard 2018; Martin, 2008)

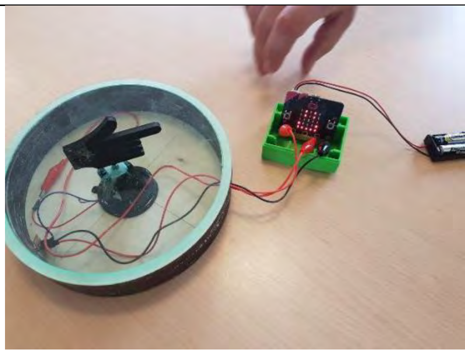
Digital literacy from the student's personal point of view: The critical and reflected user: *Understands the importance of IT security, e.g. encryption, privacy, authentication, identity theft, etc.* *Understands the unwritten rules of social media, for example when acting as Influencers* *Understands how to identify and select credible digital sources* *Develops meaningful content using the rich resources of the Internet.* The creative and innovative designer: *Dares to undertake technical experiments* *Develops new ideas, concepts and prototypes* *Combines techniques and skills in new ways based on personal preferences.* The critical and reflected citizen: *Is aware of technology in society and its social effects* *Is open to the development of technology to support society* *Sees the uses of technology in coping with global challenges such as pollution, climate change, security and crime* *Is mindful of ethical issues.*
Digital literacy in the community of practice perspective: *Digital technology used in professional practice at work or in the classroom.* *Roles* *Tacit knowledge: digital practices are sometimes transmitted in actions that are not expressed in words, for example: handling of a programming interface or a word processing application.*
Digital literacy from a digital production perspective: *Understanding and mastering programming and technologies* *Knowledge of algorithms including loops, variables, methods etc.* *Knowledge of the order in which the code and algorithms are executed* *Design of code structure* *Testing and troubleshooting*.

The personal perspective is the most complicated aspect, as it requires critical and reflected thinking on rather complex and complicated subject matter such as IT security and how information is spread on social media. At the same time, the students are expected to choose credible sources of information in order to acquire new knowledge: see table 1. Creativity and innovative skills are often expressed in ways that reflect the individual. New ideas emerge from personal interests, beliefs and skills. For example, some university students chose to develop an intelligent shoe for elderly people with dementia, while other students chose to develop digital props for role-playing games. Both groups used the same sensor technology, and their projects became equally technically complicated. The group developing the intelligent shoe added a societal component to their idea – this illustrates the reflected citizen perspective of the model.

Example a: Creativity and personal viewpoints. In the game competition, the 7th-grade students won with a game about collecting plastic in a polluted world visualised in various levels: see figure 5 (a). The game idea reflects the students' viewpoints and their need to create meaning in their student products. Another group of upper secondary students developed more open projects and one of these was a turn-taking robot game involving a finger was randomly pointing in different directions: see figure 5 (b). Often students chose to make digital versions of analogue games.



5 (a) Student game about collecting plastic in a polluted world



5 (b) Robot student game involving a finger pointing randomly in any direction.

Figure 5: Student products reflecting students' personal viewpoints

Example b: Social media. In another example, students analysed product placement in influencer videos and developed their own simple commercial model.

Example c: Ethics. Students were introduced to the "trolley dilemma" and were asked to address the subject of driverless cars. The students had to decide which pedestrians to save in a complex traffic situation[8].

Digital literacy in the perspective of community of practice refers to the role of technology in, for example, the classroom, where teachers use video tutorials to supplement teaching materials: see table 1. The students find video tutorials on their own to supplement the official textbooks. In addition, groups of students often develop new digital prototypes in the community of the classroom (Lave and Wenger, 1991).

Finally, digital literacy from a digital production perspective: the students are taught to code, see table 1. Often digital production skills are described as computational thinking skills (Brennan and Resnick, 2012). Digital literacy includes iterative development of knowledge and practical skills on algorithms formed by lines of code including loops, statements, variables, communication with keyboard input and output screen etc. Gradually, the students learn to correct their code by trial and error (Bateson, 2000). The programming environment acts as an object to think with, since it immediately responds to the programmer's new quirks (Papert, 1994).

6. Environment (4)

The fourth dimension, the environment or outside world, involves, among other things, career learning (Law, 2010), business collaboration and cooperation between different educational settings.

Educational choices and career planning are often undertaken far too randomly, dependent on social expectations or conditions and (a lack of) role models. This is indicated by the fact that too many young people drop out of their educational programmes or make choices based on tradition, such as gender-biased choices.

[8]https://arkiv.emu.dk/modul/trolley-problem-%e2%80%93-en-etisk-dilemmaleg

At the same time, there is a need for rethinking careers to meet the future challenges of a globalised and strongly technology-influenced labour market.

In this unpredictable and fragmented world, educational institutions can create more connectivity and more transparency by strengthening the “educational chain” from primary school via secondary school to higher or further education (Danish Government, 2017). Learning objectives and academic fields can be coordinated across the educational levels to a far higher degree. Didactic approaches to ease transitions can be shared. Learning activities such as “bridging courses” from lower secondary schools for grade 8 students (Denmark) do not only prepare young students for the learning conditions and content in secondary schools, but they also illustrate various career paths.

Coding and programming offer great possibilities for being practised with a wide range of technologies and for advancing from grade zero to PhD-level. But the young people involved must experience a sense of cohesion and logical progression in the learning process.

Career learning is a newly emerged concept that includes the development of stage-by-stage self-propelled control of the learning process (Law, 2010). Career learning methods promote learning processes towards making sustainable choices for personal pathways in education and work life.

Ideally, input to student projects comes from real-life and practice-based problems supplied by companies or the trades in general. From time to time, companies are invited to present concepts or evaluate projects in secondary education. The idea is that collaboration with companies and universities inspires and widens the students’ personal perspectives and helps them to make more informed decisions on their career choices. The cross-organisational collaboration and work-based learning clearly motivates the students.

Example: In the World Championship example, the students from upper secondary school met and supervised students from lower secondary school on the upper secondary school premises. In Denmark, secondary schools are physically separate from each other and the students have to choose which upper secondary school to apply to, dependent on competencies and interests. The championship event broadened the lower secondary students’ knowledge of local upper secondary education.

7. Summary and conclusion

This article has introduced a model that highlights some of the typical issues involved when introducing coding, digital design and digital literacy into lower and upper secondary schools. All examples are taken from the crossingIT project. More information can be found in Danish at www.crossingit.dk.

In the planning phase 1, the teaching design requirements for the digital product must be specified. Phase 2 (digital production) encompasses the production method and how the production method will be conducted.

The digital literacy table (see table 1) for phase 3 is not complete, but it provides examples of the three aspects: the students’ personal point of view, the community of practice, and the technical level including computational thinking. A single course can typically not cover all these aspects, but, over time, the teacher can tick off more and more aspects and perhaps even add new ones.

The fourth dimension - environment - is crucial in secondary education, because the students must make decisions about their final education and profession beyond secondary education. They have to acquire knowledge of the world outside of school and family. Involving companies and other educational institutions promotes the students’ career learning. This is also a part of didactic course planning.

Development and application of the didactic model will continue in the coming years in the ROBOlearning project. See more at https://robo-sydfyn.dk.

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Application of Digital Tools for the Development of Entrepreneurship Competencies

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Abstract: The article presents existing digital tools usable for forming entrepreneurship competencies. Entrepreneurship competencies combine creativity, a sense of initiative, problem-solving, an ability to marshal resources, and financial and technological knowledge. These competencies enable entrepreneurs and entrepreneurial employees to provoke and adapt to change. They can be developed through entrepreneurship education and training which focus on promoting an entrepreneurial mindset and behaviour. A perceived lack of capabilities remains one of the most frequently cited barriers for people to start a business. Formal education can play an important role in developing entrepreneurship competencies. Schools, vocational education and training institutions and higher education institutions are enriching their study programmes with dedicated courses on how to start a business, either as self-standing modules or embedded into curricula. Teachers need to be supported in their new roles of promoting entrepreneurship competencies. A common approach in entrepreneurship education is problem-based learning and learning by doing and the success of which depends on the overall teaching and learning environment. The current educational environment needs to be equipped with digital tools that are developing relatively quickly and form the Digital Learning Environment (DLE). If DLE is intended to be used for entrepreneurship education, we can call them Entrepreneurial Digital Learning Environment (EDLE). The set EDLE elements can be used individually or in groups as e-learning tools and as a part of non-formal and formal learning by students and adult participants. In formal education these elements, when integrated with face-to-face learning, will form a modern blended learning strategy. The article gives an overview of the basic EDLE components, which are primarily: web platforms, BIZMOOCs, e-Testing, webinars, e-books, video sequences, podcasts and social networks. Readers will gain a comprehensive overview of the potential of these tools for a specific educational area - entrepreneurship education - and may become their active users, both as teachers and as pupils. Enterprise and entrepreneurship spirit in everyday life has a universal character in the global world; therefore, concrete examples from individual EDLE components are selected from a larger number of countries and can be also useful in most countries.

Keywords: entrepreneurship competecies, entrepreneurial digital learning environment (EDLE), digital tools, BizMOOC, testing of entrepreneurship competencies, digital entrepreneurial platform

1. Introduction

The sense of initiative and entrepreneurship refers to an individual‘s ability to turn ideas into action. It includes creativity, innovation and risk-taking, as well as the ability to plan and manage projects in order to achieve objectives. It supports individuals, not only in their everyday lives at home and in society but also in the workplace, in being aware of the context of their work and being able to seize opportunities. It is also a foundation for more specific skills and knowledge needed by those establishing or contributing to social or commercial activity. This should include awareness of ethical values and promote good governance. (Recommendation, 2006). The newest European Entrepreneurship Competence Framework (EntreComp) (2016) is a broad-based tool with 3 competence areas (Ideas and opportunities, Resources and Into action) 15 competences, 15 descriptors, 8 proficiency levels and 442 learning outcomes. EntreComp Framework (i) reflects the complexity of the entrepreneurship competence domain, which touches upon several aspects of our everyday lives, and (ii) can be used as a multi-purpose reference guide. EntreComp can be used as a reference for the design of curricula in formal education and the training sector. It can also be used for activities and programmes in non-formal learning contexts (for instance, to foster intrapreneurship with existing organizations). It aims to establish a bridge between the worlds of education and work as regards entrepreneurship as a competence. Entrepreneurship as competence is developed through action by individuals or collective entities to create value for others. The progression in entrepreneurial learning is made up of two aspects: 1. Developing increasing autonomy and responsibility in acting upon ideas and opportunities to create value; 2. Developing the capacity to generate value from simple and predictable contexts up to complex, constantly changing environments.

In education for entrepreneurship, a key role is played by teachers from all stages of education (Entrepreneurship education: Enabling teachers, 2011). The report states that education for entrepreneurship as a new educational challenge has to be approached by teacher training and education. In this regard, requirements to define teachers' roles in a new way emerge; they should fundamentally increase their responsibility not only regarding pupils' knowledge but mainly regarding the development of their skills and formation of their attitudes and assumptions and also their behaviour. It is often pointed out that teachers who encourage entrepreneurial spirit in their pupils and develop their aptitudes to entrepreneurship have to also possess entrepreneurial, personal and didactic competences so that they could serve as an example for their pupils and teach entrepreneurship as facilitators of education and coaches in a school entrepreneurial environment (YEDAC Teachers guideline). The teacher's role changes from an educator standing in front of the class to a person who leads the students as one of them. The teacher should focus on organising and facilitating educational activities, motivating students to actively participate in education and then taking the role of an advisor guiding students in various activities. In this way, students' activity and behavioural skills will be developed. One of the thirteen recommendations for the "maximisation" of the effects of education for entrepreneurship states that "teachers are key factors and can inspire students as behaviour models and mentors" (Entrepreneurship Education. A road to success, 2015). (Malach, Kristová, 2017).

2. Trends in the development of digital technology in education

According to Kaushik (2016), the trends in Innovating Pedagogy for the Digital Age are following: blended learning, MOOCs and badges to accredit learning, flipped classrooms, flexible and personalised pedagogies through Bring Your Own Devices (BYOD), learning through storytelling or narrative-based pedagogies.

Prognoses in the development of educational technology are discussed in New Media Horizon Reports published every year and recently also in EDUCAUSE Horizon Reports (Alexander et al. 2018). The long-term trends repeatedly include progressing of higher education instructions towards innovative cultures, as for the medium-term trends they involve the growing focus on measuring learning and redesigning learning spaces. Adaptive learning technologies, mobile learning, Internet of Things and the new generation of LMS have been already applied. In two to five years, important developments in educational technology for higher education will aim to spread mobile learning and analytics technologies, mixed reality and artificial intelligence and later a blockchain and virtual assistant. According to New Media Consortium experts, the established ones could include, for instance, Bring Your Own Device (BYOD), flipped classroom, gamification a 3D printing.

Isaias (2017) specifies the development of digital tools in higher education instruction. He states that higher education is progressively being displaced from the traditional classroom and, as it progresses towards online settings, it requires the support of technology to facilitate that transference. Within the context of higher education, there are numerous technologies that will have a revolutionary impact on teaching and learning: learning management systems, adaptive learning technologies, massive open online courses, mobile learning, artificial intelligence, activity-based technology, Internet of Things and social technology. These technologies are expected to have profound implications in traditional learning environments and require thorough preparation. Predictions as they may be, the exercise of forecasting provides the present with the opportunity to prepare for the future.

Navitas Ventures (2017) carried out an expert survey among 168 university leaders, students and recent graduates and founders and leaders of education start-ups in all continents focusing on the digital transformation in higher education. The question "What key outcomes is your digital transformation focused on delivering?" brought these answers: improving attractiveness of the university (50% respondents), remaining relevant (56%), growth and sustainability (61%), meeting needs of the future workforce (67%), efficiency (78%), meeting changing student needs (83%) and improving student experience (94%). The survey also found that many new educational technologies, which should be used by universities, have been driven by technology (such as smart devices, cloud computing, broadband internet, and the increasing ease of creating websites and software). Survey respondents regarded artificial intelligence and machine learning as the most significant from the range of emerging technologies. This was followed by the Internet of Things and virtual/augmented reality. Respondents considered chatbots, robotics, and blockchain as being relatively less important, which also reflects the novelty of these technologies.

The OECD report (2016) dealing with innovating education points out that although they cannot transform education by themselves, digital technologies do have huge potential to transform teaching and learning practices in schools and open up new horizons. The challenge of achieving this transformation is more about integrating new types of instruction than overcoming technological barriers. Digital technology can facilitate:

- Innovative pedagogic models, for example, based on gaming, online laboratories and real-time assessment, which have been shown to improve higher-order thinking skills and conceptual understanding and in many cases have enhanced students' creativity, imagination and problem-solving skills.
- Simulations such as remote or virtual online laboratories, providing relatively low-cost flexible access to experiential learning.
- International collaborations, overcoming barriers of geography and formal classroom hours. These give students insight into other cultures and experience multicultural communication.
- Real-time formative assessment and skills-based assessments, allowing teachers to monitor student learning as it happens and adjust their teaching accordingly. Technology supported assessment enables skill development to be monitored in a more comprehensive way than is possible without technology.
- E-learning, open educational resources and massive open online courses, mainly aimed at autonomous learners.

3. Entrepreneurial teachers

Teachers are a critical factor for the achievement of the entrepreneurship and enterprise education aims. Currently, not many countries prepare such teachers in pre-graduate studies and they obtain the competences to teach entrepreneurship as a part of further education courses. A number of international projects have been implemented (e.g. SEECEl, YEDAC, ENTREVA, NETT, PLAYER, etc.) and they have enriched the theory of entrepreneurial education to include new knowledge and practice with methodological tools, pupil aids and diagnostic tools.

As a part of SEECEL projects, competence components were also defined to teach entrepreneurship in the domain of knowledge, skills and attitudes and specific learning outcomes were set in individual components.

In YEDAC projects teachers' competences for teaching enterprise form a triad: entrepreneurial competences, personal competences and teaching competences. Both approaches to defining competences do not currently have an explicitly expressed request for teachers to be prepared to make effective use of all the options of digital technologies for teaching, as described in this article. This finding leads us to the conclusion that entrepreneurship teachers should expand their competences with the help of specialist courses directly in the area of application of all EDLE tools.

The designer of these courses could be inspired during the formulation of the aims and the determination of the content of the preparations.

4. Entrepreneurial digital learning environment (EDLE)

The use of digital tools for the development of an entrepreneurial spirit is a natural path towards a) effective achieving of intended objectives of entrepreneurial education, b) directing motivation for setting up a business in the future. There are still not many studies which would deal with the use of information and communication or digital technologies in entrepreneurial education (this term is recommended by The Quality Assurance Agency for Higher Education (QAA), 2018, meaning both enterprise as well as entrepreneurship education).

The use of multimedia tools for the development of an entrepreneurial spirit was discussed by Lodyga (2013). Information is transmitted in the language of activities through functional means (natural objects and models), in the language of images (visual and audio-visual materials) and in the symbolic language (verbal and graphic material). This variety of stimuli activates different types of pupils' activities such as perceiving and a manual, intellectual and emotional activity.

Posiadala (2018) writes about the meaning and role of the project method using information and communication technologies in the development of entrepreneurial competence. She points out that the project method creates the conditions under which students develop an entrepreneurial attitude, learn group interaction and acquire communication skills, which are important for the socialization of students: multimedia and interactive poster, creating a website, blog, multimedia presentations, podcast or videophone, multimedia and interactive timeline, communication and collaboration software, enabling sharing of information and graphics (Google, Facebook, Twitter, Snapchat, LinkedIn), videoconferences (e.g. Skype, iChat).

The use of innovative technology (Internet access, computer classroom, electronic library systems) in entrepreneurship education at universities has been examined by Akhmetsin et al. (2019). 82 % respondents from three Russian universities think that innovative technologies and methods as well as the teacher's ability to implement them greatly influence the students' academic progress. Nonetheless, the research done by Duruamaku-Dim, J & Duruamaku-Dim,G. (2014) showed that the ICT potentiality is not used sufficiently in entrepreneurship education and it is caused by the low level of ICT competence of university teachers.

The use of PowToon (a web based ICT tool for animated video) in entrepreneurship education has been researched by Wu, Yan and Pan (2018). The study found that the animated presentations attracted more investment than the groups that did not prepare animated videos. It shows that developed videos help entrepreneurial teams better deliver their business ideas to investors in a well-thought out way.

Jagodič and Dermol (2014) analysed the situation in seven EU countries and observed that the use of specific ICT tools might be encouraged by (i) the development of career counsellors' and teachers' competencies for using the ICT tools, (ii) easiness of ICT tools use, and (iii) their availability and spread in a specific geographic area. Besides, the study found out that (iv) ICT tools should upgrade previously used non-ICT tools focused on the entrepreneurial competencies development. Soegoto (2018) confirmed that IT based entrepreneurship education is effective to be applied and increases the entrepreneurial intentions of students.

Based on the analysis of trends in the development of digital technologies in education created by the Digital Learning Environment (DLE) and attempts to apply them in entrepreneurship education, the authors of the study endeavour to create and describe a specific environment for entrepreneurship education which can be called the Entrepreneurial Digital Learning Environment (EDLE). The EDLE tools used (identified) thus far or potential EDLE tools were integrated into eight groups which include: web platforms, BIZMOOCs, e-testing, webinars, e-books, video sequence, podcasts and social media (see Figure 1).

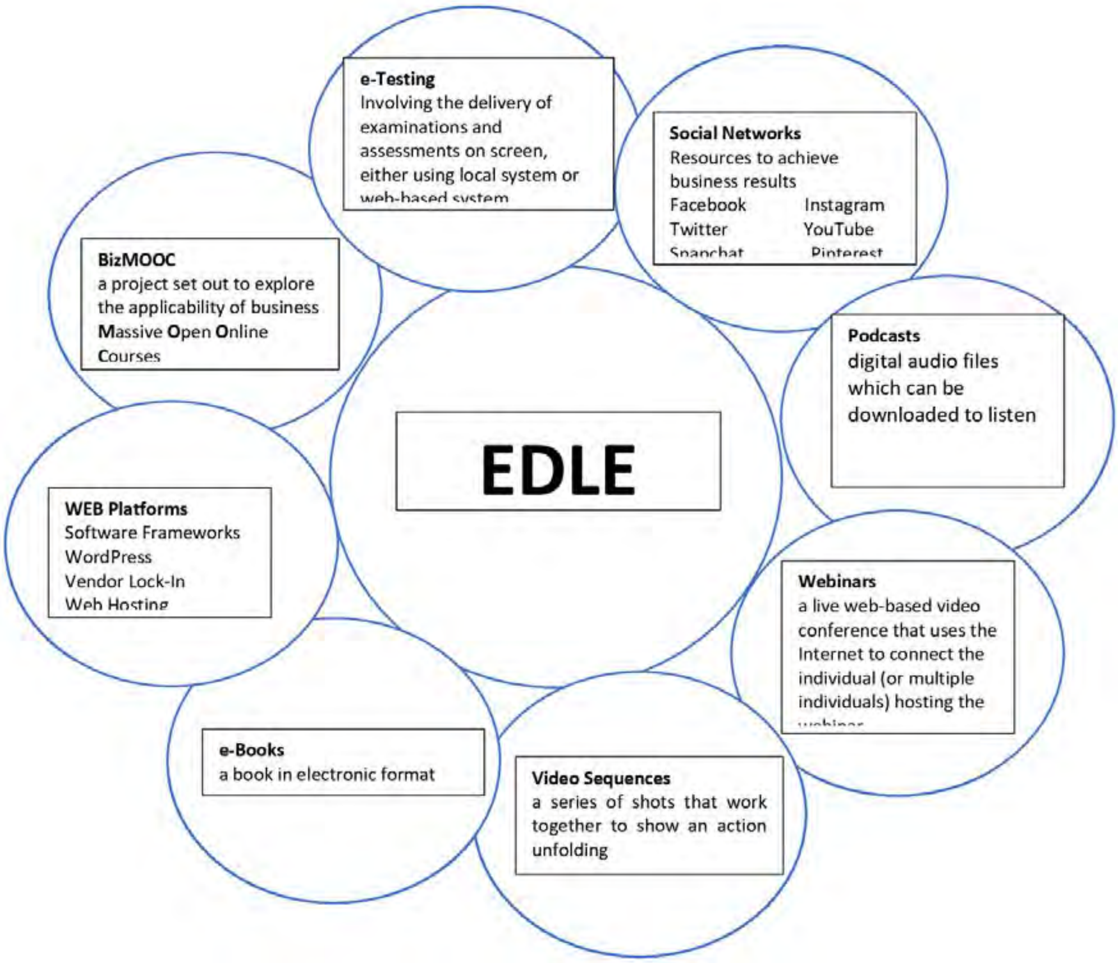

Figure 1: Entrepreneurial digital learning environment (EDLE). Source: Own

5. Elements of EDLE

The characteristics of individual elements of EDLE and examples of real application are presented below. The number of particular applications within each element will develop and expand. In addition, new elements will appear in EDLE in accordance with the above-mentioned trends in the development of digital technologies in education.

5.1 e-Books

An e-book is a book in electronic format. It is downloaded to a computer, PC, Mac, laptop, tablet, smartphone or any other kind of a reading device, and is read on the screen. It can have numbered pages, table of contents, pictures and graphics, exactly like a printed book.

The Embedding Entrepreneurship Education (EEE) Teaching Toolkit modules focus on entrepreneurship education and introduce different aspects of both theoretical and practical entrepreneurial knowledge to support innovative thinking and start-ups. The EEE Teaching Toolkit consists of 23 modules and has been selected as a good practice example of "EntreComp" in action. The modules can be combined in different ways to create new and extend existing academic courses. The modules focus on entrepreneurship education and introduce different aspects of both theoretical and practical entrepreneurial knowledge to support innovative thinking and start-ups. The book contains 206 pages. (Available at: https://www.eee-platform.eu/entrepreneurship-teaching-toolkit/)

There is a countless number of ways how to use e-books to support entrepreneurship. Together with an e-book, there are courses offered which use this e-book. (Available at: http://www.freebookcentre.net/Business/Entrepreneurship-Books.html). Within the COMPETENDO initiative, handbooks were created for facilitators, trainers, animators or other educators. They are published as PDF files and e-books on the website and are available in hard copy format. (Available at: https://competendo.net/en/Main_Page).

5.2 BizMOOCs

MOOC stands for massive open online courses. There is not an unambiguous, straightforward and broadly accepted definition of a MOOC. Investigators of the EU project called "E-learning, Communication and Open-data: Massive Mobile, Ubiquitous and Open Learning (ECO)" adopted the following clear operational definition: MOOC is an online course designed for a large number of participants that can be accessed by anyone anywhere, as long as they have an internet connection, is open to everyone without entry qualifications and offers a full/complete course experience online for free (Brouns et al., 2014).

Dado at al. (2013) see the main reasons for the use of MOOCs in higher education in the fact that they improve the competitiveness of acquired education, flexibility and frequency of the education process.

The BizMOOC project represents one of the largest attempts to research and understand the phenomena of MOOC across the European area. In 2016, the BizMOOC project set out to explore the applicability of MOOCs for the world of business. Based on these findings, BizMOOC focusing on lifelong learning and business key competences "Learning to learn (through MOOCs)", "Entrepreneurship and intrapreneurship" and "Innovation, creativity and problem-solving" were developed to test different approaches to career-orientated learning.

Authors of this article decided to also take the BizMOOC course and are very pleased. BizMOOC allows a private enterprise or a public or educational institution to teach their employees, students or other stakeholders in an innovative, easy to manage and scalable and flexible way and to acquire knowledge and develop skill set.

Since online meetings have already passed, students can take this course at any time and look at the participants' answers. All available information is provided in the form of statistics and video files. At the end, students can pass the test by answering the questions and the answers will be shown to the learner immediately. (Available at: https://mooc.house/courses/bizmooc2018/overview)

The ECO-SystemApp is an online training course for entrepreneurship educators. It consists of seven modules. The general objective of the ECO-SystemApp is fostering an entrepreneurial environment that will boost the ecosystems knowledge based on entrepreneurial learning and experience (Available at: http://ecosystemapp.net/e-learning/course/index.php?categoryid=3).

5.3 Social networks

Generally speaking, social media contains at least some of the following characteristics:

- Social media challenges traditional models.
- Social media allows people to communicate.
- Social media allows people to collaborate.
- Social media gives people an audience.
- Social media services often remove hierarchy and are built from the bottom up.
- Social media is open and transparent (European Schoolnet, 2013).

There are literally hundreds of social media services out there on the internet. Some of the most popular are Facebook, Instagram, YouTube, Snapchat, LinkedIn, Twitter and others).

Social networks are also used more and more often by teachers of entrepreneurship education in schools and various courses. Initiated by Junior Achievement Europe, the EE-HUB is a specialised international network bringing together European and national governments, businesses, NGOs, researchers and educators to collaborate and share knowledge. It is a unique source of expertise, experience and research, with the mission to increase the quantity, quality and impact of entrepreneurship education in Europe. Together with JA Europe, the EE-HUB advocates that every young person should have at least one practical entrepreneurial experience before they leave school. (Available at: http://www.ee-hub.eu).

6. Podcasts

A podcast, or generically a netcast, is an episodic series of digital audio files which a user can download in order to listen. Alternatively, the word “podcast” may refer to the individual component of such a series or to an individual media file.

The author of podcasts posts audio or video recordings usually in the MP3 format on the Internet.

The following website is focused on the development of an entrepreneurial spirit and entrepreneurship. (Available at: https://www.bluleadz.com/blog/18-of-the-best-business-podcasts-you-should-listen-to-in-2018). The Babson College (a private business school in Wellesley, Massachusetts, established in 1919), focuses primarily on entrepreneurship education. (Available at: https://libguides.babson.edu/c.php?g=891641&p=6445521). Another website providing business education podcasts based in London. (Available at: https://player.fm/featured/business-education).

6.1 Web platforms

The Lifelong Learning Platform is an umbrella that gathers 42 European organisations active in the field of education, training and youth, coming from all over Europe and beyond. Currently, these networks represent more than 50 000 educational institutions and associations covering all sectors of formal, non-formal and informal learning. Their members reach out to several millions of beneficiaries. By bringing together actors from all sectors of education and training, the Lifelong Learning Platform creates a space to exchange innovative practices, Europe-wide. By doing so, it contributes to increased flexibility between systems and proposes concrete solutions to make lifelong learning a reality for all. (Available at: http://lllplatform.eu/policy-areas/xxi-century-skills/entrepreneurship/12160/).

The School Education Gateway website helps teachers and other education stakeholders stay informed about European actions for schools. Presented in 23 European languages, the School Education Gateway is a single point of entry for teachers, school leaders, policy makers, experts and other professionals in the field of school education.

The main services of the platform include articles and viewpoints, resources, publications to stay informed, ready-to-use tutorials and teaching materials, European Toolkit for Schools, Erasmus+ opportunities and Teacher Academy, that allows teachers to discover a wide range of training opportunities and resources for their classroom. (Available at: https://www.schooleducationgateway.eu/en/pub/teacher_academy/catalogue/detail.cfm?cbmid=5569220).

EntreEd platform champions entrepreneurship education and provides advocacy, leadership, networking, technical assistance, and resources nationally across all levels and disciplines of education, promoting quality practices and programmes. It promotes the incorporation of entrepreneurship education across all levels of education and community-based programs, through infusion within existing courses and by the support of separate courses and programs developed in entrepreneurship. It encourages the participation of partnerships with business, industry, agency and trade associations, and brings together diverse groups within the consortium whose interests foster economic development through entrepreneurship education. It also encourages teacher education institutions and accrediting groups to incorporate competencies of entrepreneurship into teacher training curricula. (Available at: http://www.entre-ed.org/resources/forteachers/).

In order to stimulate the development of entrepreneurship, the Regional Government of Extremadura runs the COMEET+ Community Entrepreneurship Education platform which aims to support communities as incubators of tomorrow's entrepreneurs. The project promotes a holistic approach to entrepreneurship education engaging and enabling parents, teachers, youth educators, and people working in community associations. The project partners aimed to create a useful social learning platform for different community actors who work with entrepreneurial education. This learning platform is adapted to the training needs of different actors such as teachers, families, youth workers and entrepreneurship facilitators' needs (McCallum et al, 2018. p. 120).

6.2 e-Testing

E-testing is a rapidly growing area of e-assessment involving the delivery of examinations and assessments on screen, either using local systems or web-based systems.

An e-test is any test that replicates or replaces paper-based tests with a computer screen, also referred to as on-screen tests. This involves the transfer of paper tests to a computer with little or no change to their appearance on paper.

E-testing offers greater flexibility allowing learners to take their assessments at any time when they are ready to be assessed and not just at a point in time dictated by examinations and awarding bodies. The flexibility of location and test times leads to greater learner engagement. Reduced paper usage and less administration time add to the cost-saving benefits of e-testing. (e-Assessment Guide to Effective Practice, 2007).

Some e-tests available for self-assessment of entrepreneurship are the following:

BalinkBayan, a Philippine web portal, offers a questionnaire, which includes 50 statements, and will take about 10 minutes to complete. There are no right or wrong answers.

For each statement, respondents have to choose the number that best describes their opinion. Using this tool, people can evaluate their entrepreneurial traits such as motivations, aptitudes and attitudes. (Available at: https://balinkbayan.ph/EntrepAssessment)/. The Psychometric tests website is a collaborative project created by psychology postgraduates from universities across the UK. The personality questionnaires on this website are typically the result of research projects or on-going course material. The Entrepreneur Test have 50 questions and measures five key personality traits which have been found to correlate with those of successful entrepreneurs. This questionnaire will not be used for selection decisions; it is solely for personal use. (Available at: https://www.psychometrictest.org.uk/entrepreneur-test/). E-Scan is by far the most complete and reliable entrepreneur test that exists. (Available at: https://entrepreneurscan.com). HumanMetrics is an online tests provider focused on personality, relationships, and entrepreneurship testing and includes 28 questions. (Available at: http://www.humanmetrics.com/entrepreneur/quiz).

6.3 Webinar

A webinar is a live, web-based video conference that uses the Internet to connect the individual (or multiple individuals) hosting the webinar to an audience of viewers and listeners from all over the world. Hosts can show themselves speaking, switch to their computer screens for slideshows or demonstrations, and even invite guests from other locations to co-host the webinar with them.

The Entrepreneurial Learning Initiative (ELI) is a global thought leader dedicated to expanding human potential through entrepreneurial mindset education. ELI serves academic institutions, government agencies, profit, and non-profit organizations around the world to empower their constituents with an entrepreneurial mindset through professional development, certification training, curriculum content, and consulting. (Available at: https://elimindset.com). The webinar addressed question of how teachers can teach entrepreneurial skills to students through any subject. (Available at: http://keyconet.eun.org/webinars).

6.4 Video sequences

Shooting and editing effective sequences are essential video storytelling skills. Shot sequences can enhance cohesion, help communicate more information in less time and create an overall sense of purpose.

In video storytelling, a sequence is simply a series of shots that work together to show an action unfolding. Shot sequences are ubiquitous - most shots in most stories are part of a larger sequence. That is because they're a foundational storytelling tool in a medium that is not only visual but also depicts the passage of time. TEDx opens peoples' minds and connects the worlds. It is a non-profit organization centred around the main theme: "Ideas worth spreading" - sharing inspiring business ideas and stories. TEDxPrague was established in 2009, inspired by TED and under its license. Thanks to this fact, we have become a part of the worldwide TEDx community. Available at: https://www.ted.com/talks/linda_zhang_why_schools_should_teach_entrepreneurship). Massachusetts Institute of Technology courses embody the inventiveness, openness, rigour and quality that are hallmarks of MIT, and many use materials developed for MIT residential courses in the Institute's five schools and 33 academic disciplines. (Available at: https://www.edx.org/school/mitx). MIT courses can be audited free or students can choose to receive a verified certificate for a small fee. (Available at: https://ocw.mit.edu/courses/sloan-school-of-management/15-390-new-enterprises-spring-2013/video-tutorials/lecture-1/).

Entrepreneur & Innovation Exchange (EIX) is a social media learning platform and its goal is to dramatically improve the success rate of new business ventures. Dedicated to entrepreneurship students, professors and entrepreneurs, EIX is philanthropically funded by the Schulze Family Foundation. It is a free resource designed to advance and share the best research and practice of entrepreneurship, and make it relevant and accessible to both aspiring and practising entrepreneurs. (Available at: https://eiexchange.com).

To activate the entrepreneurial mindset in young people, US Network for Teaching Entrepreneurship (NFTE) begins by igniting the imagination and then takes students through the journey of creating and refining an original business concept. Students are guided by NFTE's expert Entrepreneurial Teacher Corps and supported by the entrepreneurs and business leaders who volunteer as classroom speakers, field trip hosts, business plan coaches, and competition judges. (Available at: https://www.nfte.com).

7. Conclusion

The providers of entrepreneurship education, it means schools, educational institutions, foundations or communities or consortia try to increase its attractiveness, effectiveness and efficacy. More and more often, they use the potential of tools creating the Digital Learning Environment. At present, it is possible to aggregate these applications to support the development of entrepreneurship into the EDLE system, which includes eight elements at the moment (Diagram 1). Their brief description can be useful not only for instructors of entrepreneurship education but also for the creators of software products (or hardware equipment) for education in the field of the development of entrepreneurship. An assessment of the didactic effects of each educational device (teaching and learning methods, teaching resources or organisationally as a part of teaching) is a demanding and long-term activity. In terms of research, it is very hard to assess what changes in interactions among teachers and pupils and resources are caused and whether these changes are positive. Entrepreneurship education in school is a relatively new part of the development of an individual that has not yet been the subject of across-the-board research (such as PISA, TIMSS, ICILS), so research data is not available about its effects and the methods of realisation. The authors assume that in the near future such research will be realised and will focus also on the potential benefits of individual elements or EDLE units. Previous research by the authors (Malach, 2015, Malach and Kristova, 2017) shows that it is possible to create tools that measure parts of a comprehensively determined sense of initiative and entrepreneurship and entrepreneurial intention. This study was performed as a part of a solution for the SGS grant competition at Ostrava University called “Developing the Creativity and Entrepreneurship of a Teacher of Music Education” in 2019–2020.

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Gamification for Promoting Acceptance of an Online Learning Environment Among Teachers

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Abstract: This study examines the impact of a gamified approach on acceptance of an online learning environment among teachers. It uses two predictors of TAM3's Behavioural Intention, namely Perceived Usefulness and Perceived Ease of Use, in combination with a construct specifically related to gamification, i.e., Teacher's Gamification Competence. Thirty teachers attending an online teacher training path expressed their reaction to the course by completing surveys. The results of group comparison (players vs non-players) showed that teachers who completed the gamified activity had a higher level of Perceived Ease of Use and Perceived Usefulness than those who completed the control activity. From that analysis, however, insufficient evidence emerged to maintain that the gamified activity contributed in promoting greater acceptance of the Open Online Tool (OOT) in question than the non-gamified control activity did. The results of correlation analysis showed that Perceived Ease of Use was positively correlated to Perceived Usefulness; in addition, Teacher's Gamification Competence was positively correlated to Perceived Ease of Use.

Keywords: gamification, online technologies, technology acceptance model, perceived ease of use, perceived usefulness, teachers' professional development

1. Introduction

Over the last two decades, online learning technologies have become widely used for training in both academic and professional settings, and teachers are required to use these tools for their teaching practices. However, to accept and use online learning technologies is not always easy for teachers. Moreover, becoming a *digitally competent* teacher means more than being acquainted with and able to use digital tools (technology). This involves constructing theoretical-practical knowledge that is closely interconnected with both the disciplinary (content) and methodological (pedagogy) teaching areas. The most widely accepted model for this is *Technological Pedagogical Content Knowledge* (TPAK) (Mishra and Koehler, 2006).

From the technological point of view, teachers are not always equipped with the competencies they need to use online learning technologies effectively for designing and implementing learning activities. Of even greater concern is that some teachers are reticent to adopt online learning technologies, whether for intrinsic or extrinsic reasons. In this scenario, professional development interventions become crucial to accompany teachers in the process of acquiring technological competencies. However, as suggested by Brinkerhoff (2006), "[a] variety of barriers relating to resources, institutional and administrative policies, skills development and attitudes can hinder the effectiveness of technology professional development, resulting in underutilized technology resources and lack of integration of those resources within instruction" (p. 22). It therefore seems appropriate to critically reflect on the design of teacher training paths focused on technological skills in the attempt to raise intervention effectiveness and foster familiarization in a more motivating, engaging and challenging way.

It is with this in mind that we developed a gamified approach designed to promote acceptance of an online learning environment (i.e., the Open Online Tool, OOT) among Higher Education (HE) nurse teachers participating in an online training path. One of the objectives of the training path is to familiarize the HE teachers with the OOT, which currently hosts their training course and which they themselves will later use with their undergraduate nursing students.

The training path includes specific tasks intended to familiarize the teachers with the OOT's main features. Among these was a gamified activity designed to generate more effective and engaging familiarization with the platform. We then set out to evaluate the impact of this gamified approach on general acceptance of the OOT. This was done by building on the Technology Acceptance Model 3 (TAM3) (Venkatesh and Bala, 2008), a widely used model for quantifying technology acceptance. So the ultimate purpose of this paper is to present this study into the implementation and effectiveness of the gamified approach, together with the results that were obtained.

2. Literature review

2.1 Gamification and technology acceptance

Gamification is generally defined as the use of game design elements in non-game context(s) in order to influence user behaviour. While this definition of gamification is perhaps one of the most generally agreed upon in the landscape of the literature relevant to the present study (Landers, 2014), the definition itself contains a contentious term. The meaning of the expression "game element" is far from being well established. In the context of this study, we refer to Hunicke, LeBlanc and Zubek's (2004) definition of game elements as game mechanics, game dynamics and game aesthetics. Elsewhere, gamification is reported to be effective for supporting teachers' professional development, particularly for motivation/engagement and bringing added value to the learning experience (Dagnino, Pozzi, Ceregini, Manganello, and Persico, 2017; Pozzi, Persico, Collazos, Dagnino and Munoz, 2016). However, the impact of gamification on the acceptance of e-learning technologies in teachers' professional development has received little attention so far. Research efforts seem to focus more on trainees' attitudes and perceptions in adopting gamification *itself as a teaching strategy* (An, 2018) and on exploring the effects of teachers' professional development on acceptance of digital game-based learning (Hsu, Su and Liang, 2013)). Nevertheless, outside the context of teachers' professional development and online learning technologies, Baptista and Oliveira (2017) reported some encouraging research findings on gamification's impact in the acceptance of mobile banking services. The study showed a direct and strong relationship between gamification and intention to use mobile banking services.

2.2 Evolution of technology acceptance

To perform this study, the authors developed and adopted a theoretical extension of the unified theory of acceptance and use of technology (UTAUT), as defined by Venkatesh, Morris, Davis, and Davis (2003). UTAUT is one of the several technology acceptance models cited and discussed in the literature, which largely sprang from the seminal Technology Acceptance Model (TAM) originally proposed by Davis et al. (1989). The TAM describes acceptance of technology by focusing on two personal beliefs, *Perceived Usefulness* and *Perceived Ease of Use*, as major determinants of the attitudes and intentions related to *Attitude toward Using* a technology. Subsequently, the model has been substantially extended and modified, particularly with the TAM2 (Venkatesh and Davis, 2000) and TAM3 (Venkatesh and Bala, 2008) models. TAM2 extends the original TAM by including additional key determinants spanning social influence processes and cognitive instrumental processes. TAM3 combines TAM2 and the model of the determinants of Perceived Ease of Use (Venkatesh, 2000) to develop an integrated model of the determinants of individual level adoption and use. The TAM model is widely adopted in the literature, as well as its various integrations. Although teachers' professional development *per se* is rarely examined as a context of investigation in this regard, a number of studies have explored teachers' specific acceptance of e-learning technologies, confirming TAM's postulated relationships (Yuen and Ma, 2008). However, those studies do not comprehensively explain what makes teachers perceive these technologies as useful and easy to use. Therefore, this aspect requires further investigation, in combination with a model able to provide specific insights on how to positively influence *Attitude toward Using* a technology.

With these premises in mind, we developed a gamified approach for promoting acceptance of an online learning environment among HE teachers and then evaluated their technology acceptance with TAM3. This model is specifically designed for computer innovations and has been tested many times in professional contexts. More specifically, we tried to understand two antecedents of TAM3's central construct *Behavioural Intention* (to use), namely *Perceived Usefulness* and *Perceived Ease of Use*. *Perceived Usefulness* is "the degree to which a person believes that using a particular system would enhance his or her job performance" (Davis, 1989, p.320). *Perceived Ease of Use* refers to "the degree to which a person believes that using a particular system would be free of effort" (Davis, 1989, p.320). Finally, we supplemented TAM3 with one construct related to gamification (*Teacher's Gamification Competence*) specifically defined for the purposes of the present study to gather insights on how to positively impact on the acceptance and use of the proposed technology.

Thus, the research questions and research hypotheses in this study were defined as follows:

RQ1. What is the impact of the proposed gamified approach on teachers' acceptance of the Open Online Tool (OOT)'?

H1. Teachers who completed the gamified activity will report higher Perceived Ease of Use and Perceived Usefulness than those who completed the control activity.

H2. The gamified activity will promote greater acceptance of the OOT than the control activity will.

RQ2. Is there a relation between teachers' Perceived Ease of Use and Perceived Usefulness of the OOT?

H3. There will be a positive relation between Perceived Ease of Use and Perceived Usefulness.

RQ3. Is there a relation between Teachers' Gamification Competence and the two core TAM constructs considered for this study (Perceived Usefulness and Perceived Ease of Use)?

H4. There will be a positive relation between Teachers' Gamification Competence and Perceived Ease of Use.

H5. There will be a positive relation between Teachers' Gamification Competence and Perceived Usefulness.

3. Method

This study is based on quantitative assessment methods. It was performed using *The OOT Evaluation Survey for Teachers*, a survey featuring a five-point Likert-type scale which was designed by the authors for measuring OOT acceptance at the end of the training path. At the beginning of the study, this instrument was tested in a preliminary pilot phase involving a small sample of users for preliminary formative evaluation purposes. Given the data collected in this preliminary phase was analysed and acted upon for optimisation of the final evaluation, they are not presented in this paper. Also, we wish to emphasize that this study deliberately precludes measurement of *Behavioural Intention*, since the training path is still underway at the time of the writing and the familiarization process is not yet completed. *Behavioural Intention* is due to be measured as part of the final OOT evaluation. Measurement of participant outcomes carried out at this initial stage of the course has proved both useful and necessary for defining the measurement tools that will be applied.

3.1 Study setting

The study was conducted during an online teacher training path offered to HE nurse educators. The course started in May 2019 and will end in June 2019.

The gamified approach was proposed within the training path as follows. In May 2019, the teachers who had enrolled in the online course participated in an online webinar on the OOT and its features (; for more details, see Manganello, Vassilakis, Papadakis and Pozzi (2019). Subsequently, the teachers were invited either to play the *OOT Challenge Game* or, alternatively, to browse the OOT User Manual.

The game was based on a narrative telling the story of a nurse. The player was asked to help the nurse by performing seven tasks on the platform, each one representing one level of the challenge. Each task envisaged the use of one specific functionality of the OOT, as presented earlier in the webinar. For each task completed, the player earned points, collected a level badge, and unlocked the next level. To win the game, the player had to complete all the levels.

Both the *OOT Challenge Game* and the OOT user manual were made available to trainees immediately after the online webinar and remained active for just under two weeks.

3.2 Instruments

For the purposes of this study, we adopted two specific instruments:

- the *Pre-Course Profile Survey*, which we designed for collecting information about teachers' background and current practice before the beginning of the training path, and
- the *M2 Survey*, which we designed for collecting teachers' initial impressions about the OOT and their feedback on the familiarization activities.

Specifically, three gamification related items were drawn from the *Pre-course profile survey*, while seventeen derived from the *M2 Survey*. Of the latter, five relate to acceptance of the OOT - Perceived Usefulness, eight to acceptance of the OOT - Perceived Ease of Use, two to the gamified activity chosen for OOT familiarization, and two to the non-gamified activity chosen for OOT familiarization. The items utilized a five-point Likert-type scale ranging from “strongly disagree” to “strongly agree”. Table 1 lists the items used for this study. All those from PU 01 to PU 05 and from PEU 01 to PEU 08 are based on the authors’ adoption of TAM3 and were modified to fit with OOT evaluation needs.

Table 1: List of items used for this study

TGC 01	I am familiar with the ideas and concepts related to gamification.
TGC 02	As a student, I find it engaging to participate in courses that apply gamification techniques.
TGC 03	As a teacher, I know how to design activities employing gamification techniques.
PU 01	The OOT functionalities supporting community engagement are useful.
PU 02	The OOT functionalities allowing interaction and collaboration will help me encourage students to engage in sharing-based learning activities.
PU 03	The OOT functionalities delivering multi-modal learning contents to meet different learning styles are useful.
PU 04	The OOT functionalities supporting the recognition of students’ prior learning are useful.
PU 05	The OOT functionalities supporting assessment and tracking of learning activities will help me provide students with effective feedback.
PEU 01	I find the main OOT functionalities easy to use.
PEU 02	The OOT Database functionality for building, displaying and searching a set of data records is easy to use.
PEU 03	Choosing alternative materials /activity with the OOT Group Choice functionality is easy.
PEU 04	Submitting evidence through the OOT “Learning Plan” function so as to get recognition of prior non-formal/informal learning is easy.
PEU 05	Exploring the OOT Community space is easy.
PEU 06	Creating a new thread or answering an existing post in the OOT Forum is easy.
PEU 07	Attending an OOT webinar is easy.
PEU 08	Answering an OOT quiz is easy.
CAG 01	Playing the OOT Challenge Game helped me appreciate the usefulness of the main OOT functionalities.
CAG 02	Playing the “OOT Challenge Game” helped me appreciate the ease of use of the main OOT functionalities.
CAM 01	Browsing the “OOT User manual” helped me appreciate the usefulness of the main OOT functionalities
CAM 02	Browsing the “OOT User manual” helped me appreciate the ease of use of the main OOT functionalities

3.3 Participants

A total of 70 teachers out of the 73 who enrolled in the online course completed the online webinar activity, either by joining the live session or watching the recording. Of those 70, 52 teachers took part in the subsequent choice activity (Play the OOT Challenge Game or Browse the OOT User Manual). Of those, 38 teachers decided to play the OOT Challenge Game, while 14 decided to carry out the control activity (that is, browsing the OOT User Manual). Thirty out of those 52 teachers completed both the *Pre-course profile survey* and the *Survey M2*. Their ages ranged from 31 to 60 years of age: 5 teachers were 31-40 (16.7%); 13 were 41-50 (43.3%); and 12 were 51-60 (40%). In terms of gender, 21 teachers were female (70%) and nine were male (30%).

3.4 Data analysis

The datasets were analysed using SPSS statistical software. In order to test Hypotheses 1 and 2, we performed a group comparison between players (teachers who had chosen to play the OOT Challenge Game; N=16) and non-players (teachers who chosen to browse the OOT User Manual; N=14). Non-parametric correlation analysis was conducted to test Hypotheses 3, 4, and 5.

4. Results

4.1 The results of group comparison (players vs. non-players)

Table 2 shows descriptive statistics of the two groups with respect to the scores obtained on the items from Survey M2 which are considered in this study.

Table 2: Medians, means and standard deviations for players and non-players on the items from survey M2

	Players (N=16)*			Non-Players (N=14)**		
	Median	**Mean**	**SD**	**Median**	**Mean**	**SD**
PU 01	4.00	3.69	0.479	3.00	2.86	0.363
PU 02	4.00	3.56	0.512	3.00	2.71	0.726
PU 03	4.00	3.56	0.512	3.00	2.93	0.267
PU 04	3.00	3.25	0.683	3.00	2.79	0.426
PU 05	3.00	3.19	0.544	3.00	2.79	0.426
PEU 01	3.00	3.19	0.750	2.00	2.07	0.829
PEU 02	3.00	2.88	0.806	2.50	2.43	0.938
PEU 03	3.00	2.88	0.719	2.00	2.36	0.842
PEU 04	3.00	3.00	0.730	2.00	2.29	0.914
PEU 05	3.00	3.13	0.619	3.00	2.64	0.633
PEU 06	3.50	3.44	0.629	3.00	2.57	0.646
PEU 07	4.00	3.56	0.629	3.00	2.79	0.699
PEU 08	3.00	3.13	0.619	3.00	2.43	0.852
CAG 01* / CAM 01**	3.00	3.13	0.806	3.00	2.64	0.633
CAG 02* / CAM 02**	3.00	3.13	0.719	3.00	2.64	0.633

The results of the Mann–Whitney test are presented in Table 3 (Perceived Usefulness) and in Table 4 (Perceived Ease of Use).

Table 3: Comparison between players and non-players on the five items of Perceived Usefulness

	PU 01	**PU 02**	**PU 03**	**PU 04**	**PU 05**
Mann-Whitney U	30	43	45,5	69	73
p	000	0.003	0.004	0.077	0.110

Table 4: Comparison between players and non-players on the eight items of Perceived Ease of Use

	PEU 01	**PEU 02**	**PEU 03**	**PEU 04**	**PEU 05**	**PEU 06**	**PEU 07**	**PEU 08**
Mann-Whitney U	38	86	74,5	64	73	42,5	47	5
p	0.001	0.294	0.120	0.047	0.110	0.003	0.006	0.052

The mean scores reported by players are significantly higher than those reported by non-players for the following items: PU 01, PU02, and PU 03 (Perceived Usefulness); PEU 01, PEU 04, PEU 06, and PEU 07 (Perceived Ease of Use).

4.2 Results of correlation analysis

Table 5 provides descriptive statistics for the items related to Perceived Ease of Use (PEU) and Perceived Usefulness (PU).

Table **6** shows the result of the Spearman correlation analysis for the same items.

Table 5: Means and standard deviations for the thirteen items related to the OOT acceptance (Survey M2)

	M	**SD**	**N**		**M**	**SD**	**N**
PU 01	3.30	0.596	30	**PEU 01**	2.67	0.959	30
PU 02	3.17	0.747	30	**PEU 02**	2.67	0.884	30
PU 03	3.27	0.521	30	**PEU 03**	2.63	0.809	30
PU 04	3.03	0.615	30	**PEU 04**	2.67	0.884	30
PU 05	3.00	0.525	30	**PEU 05**	2.90	0.662	30
				PEU 06	3.03	0.765	30
				PEU 07	3.20	0.761	30
				PEU 08	2.80	0.805	30

Table 6: Spearman correlations for the thirteen items related to the OOT acceptance (Survey M2)

	PU 01	PU 02	PU 03	PU 04	PU 05
PEU 01	0.638**	0.728**	0.497**	0.542**	0.576**
PEU 02	0.372*	0.350	0.436*	0.635**	0.492**
PEU 03	0.344	0.376*	0.399*	0.580**	0.572**
PEU 04	0.435*	0.466**	0.441*	0.619**	0.538**
PEU 05	0.354	0.471**	0.496**	0.569**	0.572**
PEU 06	0.517**	0.719**	0.628**	0.482**	0.579**
PEU 07	0.607**	0.713**	0.604**	0.482**	0.665**
PEU 08	0.477**	0.321	0.631**	0.744**	0.559**

** p < 0.01 (2-code)

* p < 0.05 (2-code)

The results of Spearman's correlation analysis showed a positive correlation between Perceived Ease of Use (PEU) and Perceived Usefulness (PU).

Table 7 provides descriptive statistics for the three items related to gamification (Pre-course profile survey).

Table 7: Means and standard deviations for the three items related to gamification (Pre-course profile survey)

	M	SD	N
TGC 01	1.43	1.135	30
TGC 02	0.80	0.997	30
TGC 03	0.70	1.055	30

The results of Spearman's correlation analysis showed a positive correlation between Teachers\ Gamification Competence (TGC) and Perceived Ease of Use (PEU). More specifically, TGC 01 and PEU 02 (r =0.382; $p < 0.05$), TGC 01 and PEU 04 ($r = 0.363$; $p < 0.05$), TGC 01 and PEU 06 ($r = 0.438$; $p < 0.05$), and TGC 03 and PEU 07 ($r = 0.395$; $p < 0.05$).

The results of Spearman's correlation analysis did not show correlation between Teacher's Gamification Competence (TGC) and Perceived Usefulness (PU).

5. Discussion

This study examined the impact of a gamified approach on the acceptance of an online learning environment (i.e., the OOT) among HE teachers, using two predictors of TAM3's Behavioural Intention (i.e., Perceived Usefulness and Perceived Ease of Use), as well as one construct related to gamification (i.e., Teachers' Gamification Competence). More specifically, by combining these, the study sought to provide additional insights into what makes teachers perceive a specific technology as useful and easy to use.

5.1 RQ1. What is the impact of the gamified approach on teachers' acceptance of the OOT?

The findings demonstrated that teachers who completed the gamified activity reported a higher level of Perceived Ease of Use and Perceived Usefulness than those who completed the control activity (H1).

Compared to teachers who didn't play the OOT Challenge Game, those who did reported a higher level of Perceived Usefulness regarding the following OOT functionalities:

- support for community engagement (PU 01),
- scaffolding of interactions and collaboration that promote student engagement in sharing-based learning activities (PU 02),
- delivering multi-modal learning contents to meet different learning styles (PU 03).

Compared to teachers who didn't play the OOT Challenge Game, those who did reported a higher level of Perceived Ease of Use regarding the main OOT functionalities (PEU 01). Moreover, they reported a higher level

of Perceived Ease of Use regarding the OOT Learning Plan functionality (PEU 04), the Forum functionality (PEU 06), and the Webinar functionality (PEU 07).
The study findings did not show sufficient evidence to claim that the gamified activity promoted greater acceptance of the OOT than the non-gamified control activity did (H2). Indeed, no significant difference emerged between the average values of the two groups. Hence, the results of group comparison did not support H2.

5.2 RQ2. Is there a relation between teachers' perceived ease of use and teachers' perceived usefulness of the OOT?

Perceived Ease of Use was positively related to Perceived Usefulness (H3). The study findings demonstrated that there were positive correlations between the perceived ease of use of the OOT's main functionalities (PEU 01) and the perceived usefulness of all the functionalities considered, that is: support for community engagement (PU 01); interaction and collaboration for student engagement in sharing-based learning activities (PU 02); delivery of multi-modal learning contents to meet different learning styles (PU 03); support for recognition of students' prior (formal, non-formal and informal) learning (PU 04); and assessment and tracking of learning activities for providing students with effective feedback (PU 05).

As to the specific functionalities of the OOT, positive correlations were found between:

- Perceived Ease of Use of the Database functionality (PEU 02) and those supporting recognition of students' prior learning (PU 04), as well as those supporting assessment and tracking of learning activities (PU 05);
- Perceived Ease of Use of the Group Choice functionality (PEU 03) and those supporting recognition of students' prior learning (PU 04), as well as those supporting assessment and tracking of learning activities (PU 05).
- Perceived Ease of Use of the Learning Plan functionality (PEU 04) and those allowing interaction and collaboration (PU 02), as well as those supporting recognition of students' prior learning (PU 04) and those supporting assessment and tracking of learning activities (PU 05);
- Perceived Ease of Use of the Community Space (PEU 05) and those allowing interaction and collaboration (PU 02), as well as those delivering multi-modal learning contents (PU 03), those supporting the recognition of students' prior learning (PU 04), and those supporting assessment and tracking of learning activities (PU 05);
- Perceived Ease of Use of the Forum functionality (PEU 06) and those supporting community engagement (PU 01), as well as those supporting interaction and collaboration for student engagement in sharing-based learning activities (PU 02), those delivering multi-modal learning contents (PU 03), those supporting the recognition of students' prior learning (PU 04), and those supporting assessment and tracking of learning activities (PU 05);
- Perceived Ease of Use of the Webinar functionality (PEU 07) and those supporting community engagement (PU 01), as well as those allowing interaction and collaboration (PU 02), those for delivering multi-modal learning contents (PU 03), those supporting the recognition of students' prior learning (PU 04), and those supporting assessment and tracking of learning activities (PU 05);
- Perceived Ease of Use of the Quiz functionality (PEU 08) and those supporting community engagement (PU 01), as well as those for delivering multi-modal learning contents (PU 03), those supporting the recognition of students' prior learning (PU 04), and those supporting assessment and tracking of learning activities (PU 05).

5.3 RQ3. Is there relation between teachers' gamification competence and TAM's two central constructs considered in this study (perceived usefulness and perceived ease of use)?

Teachers' Gamification Competence was positively correlated to Perceived Ease of Use (H4). The study findings showed that there were positive correlations between:

- The teachers' self-reported familiarity with the ideas and concepts related to gamification (TGC 01) and perceived Ease of Use of the following functionalities: Database (PEU 02), Learning Plan (PEU 04), and Forum. Within the gamified activity, the players explored all three functionalities. This is an interesting result bearing in mind that the Database and Learning Plan functionalities can be considered among the most complex of the functionalities that the OOT offers.

- The teachers' self-reported ability to design learning activities employing gamification techniques (TGC 03) and the Perceived Ease of Use of the Webinar functionality (PEU 07). The latter was used in the context of the proposed activity to provide the teachers with a demonstrative presentation of the OOT's main features, prior to their choosing whether to play the OOT Challenge Game or to browse the OOT User Manual.

With reference to Teachers' Gamification Competence and Perceived Usefulness, the study findings did not support H5.

5.4 Limitations and future research

The authors acknowledge that this study has a number of limitations. Firstly, since the number of users in the pilot was limited, the analysis cannot be considered statistically representative. Secondly, in order to adopt TAM3 for the OOT evaluation, we were forced to make some changes and additions to the list of indicators. Future research in this area will need to adopt standardized questionnaires in order to ensure consistency of model analysis and reliability of the data collection tool, where applied in a different study setting. Thirdly, the gamification model supplementing TAM3 in this study was a rather simply one. Future research will need to adopt more solidly defined gamification construct(s). Finally, this study relied exclusively on self-reported data, while future research will need to use such data in conjunction with objective data derived from the tracking of activities performed by OOT users.

6. Conclusions

This study investigated the impact of a gamified approach on the acceptance of an online learning environment among teachers, using two predictors of TAM3's Behavioural Intention, together with one construct related to gamification. The result of this study showed that teachers who completed the gamified activity had a higher level of Perceived Ease of Use and Perceived Usefulness than those who completed the control activity. However, insufficient evidence emerged to claim that the gamified activity contributed in promoting greater acceptance of the OOT more than the non-gamified control activity did. On the other hand, teachers' Perceived Ease of Use of the OOT was positively correlated to their Perceived Usefulness of the OOT. More specifically, the findings of the present study showed that Teachers' Gamification Competence was positively correlated to Perceived Ease of Use of the OOT.

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Towards an ICT Enabler for Enhancing Non-Cognitive Skills in a Lifelong Learning Setting

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Abstract: Non-cognitive skills (NCS) such as critical thinking, creativity, reliability, problem-solving, self-management, decision-making, and communication are the keys to a successful life and career development in a knowledge society. In contrast to hard skills or cognitive ability, which are the mainstream of formal and informal education, NCS is yet to be recognised and measured in academic curriculums, despite that many studies have shown the importance of NCS in building the character of a person. The system requirements and design architecture for an ICT solution are sought in this study that can quantify and assess NCS. A Design Science Approach (DSA) is followed in systematically eliciting the requirements and hence the functionalities and main modules of the ICT enabler. The resulting artefact includes the functionalities for a dashboard that the personal profile and skills of users can be visualised, and a matching system of NCS required for prospective occupations, together with a recommender system that can recommend courses to acquire NCS. The requirements were elicited and refined, starting in a co-creation session with project stakeholders from six European countries. The elicited requirements from the co-creation session were validated by pilots consisting of 190 participants from three European countries. Finally, the results were transformed into wireframes, and, ranked based on the perceptions of the end-user focus group participants, refined by the experts in the field. The discovered system features include visualisation of skills profiles of individual users, with an ability to upgrade the profile autonomously as they complete courses or assessment tests in the platform. The ICT enabler is designed under a project of European Commission Directorate General for Communications Networks, Content & Technology (DG CONNECT), named SkillsMatch.

Keywords: ICT enabler, soft skills, assessment, lifelong learning, non-cognitive skills

1. Introduction

On June 2016, the European Commission launched the New Skills Agenda for Europe aiming for ensuring that the right training, the right skills, and the right supports are available to people in the European Union (Kraatz, 2017). Introduced actions are designed to enhance the quality and relevance of supply and demand (EU, 2017), where the supply is about the available skills and developing them by creating relevant education programs for citizens in EU member states. The demand is the need of certain skills in the job market. It is necessary to raise the awareness of skills and discover possible methods to compare them if the supply to be adequate to cater to the demand in the labour market.

In this study, the UNESCO definition of NCS is followed, that is "patterns of thought, feelings and behaviours" (Borghans et al., 2008) that are socially determined and can be developed and changed throughout the lifetime. NCS can include personality traits, attitudes, and motivations. The focus of this study is to assess and gather the need for an ICT enabler with the purpose of development and evaluation of NCS of individuals.

2. Background

In a knowledge-based economy, the workforce requires skills that allow analysing and solving complex problems through digitised communication structures (EU, 2017; Kraatz, 2017). Skills such as critical thinking, problem-solving, interpersonal skills, adaptability, persistence, creativity, initiative and leadership, which are referred to as transversal, soft or non-cognitive skills, are shown to be in increasingly higher demand by future employers (EU, 2012; Cinque, 2016; EU, 2011). Such skills reshape individuals character and provide flexibility to adapt to challenges in the rapidly changing and highly interconnected world (EU, 2011). Until recent past, cognitive skills, which are typically acquired by formal and informal as well as non-formal education, were considered as the priority in qualifying for being employed in related occupations (Kautz et al., 2014). However, the recent calls from the European Union such as (EU, 2017), as well as other related studies including Cinque (2016) have shown that the non-cognitive skills play a vital role in the emerging labour markets. (Kautz, Heckman, Diris, Ter Weel, & Borghans, 2014; EU, 2011).

Furthermore, compared to cognitive skills, which can be measured by standards examinations, tests, and other evaluation and assessment methods, standardised methods for measuring the NCS are yet to be established (Cinque, 2016; EUR-Lex, 2012; EQAVET, 2015). Heckman & Rubinstein (2001) emphasise that negligence of NCS when analysing earnings, schooling, and other life outcomes residues by a lack of reliable measures for quantifying them (Heckman & Rubinstein, 2001). Related literature provides approaches that incorporate assessment of different non-cognitive skills in school curriculums at different educational levels (Kautz et al., 2014; EU, 2011). Many of the methods used for measuring the NCS are context and civic conditions dependent and highly intertwined with cognitive ability (Heckman & Rubinstein, 2001; EU, 2012). The European framework for Skills, Competencies, Qualifications and Occupations(ESCO), which classify skills, competencies, qualifications and occupations and harmonising the terminologies across Europe, have included all the NCS in the set of skills to be mapped with the occupations and qualifications (ESCO, 2016). Therefore, the ESCO framework allows to describe, identify and classify the NCS concerning professional occupations and qualifications relevant for the EU labour market and education and training. This helps the NCS to be integrated effectively in the contexts of jobs and education, and enable the worlds of labour market and education/training to communicate more effectively with each other in creating support for assessing, validating and training on NCS across Europe.

According to EU (2017), "Open knowledge technologies have the potential to effectively support innovative learning and training strategies for non-cognitive skills" (EU, 2017), and stresses the need for more accurate methods for measuring, assessing and validating the acquisition of NCS. Among the state-of-the-art practices of NCS assessments, EU member states specific solutions; "summary statements of student achievements and capabilities", are practised (Cedefop, 2019). Commonly found NCS assessment methods are formative and conducted in parallel with the assessment of cognitive skills (Kautz et al., 2014).

It was shown that NCS could be taught or improved by suitable training programs (Kraatz, 2017; EQAVET, 2015). Proper and systematic approaches to improving the NCS are emphasised under "Rethinking Education" strategy, focusing on the development of knowledge, skills and attitudes appropriate to a specific context, highlighting the role of NCS (EQAVET, 2015). Thus, vocational education and training programs, informal education settings, or lifelong learning opportunities for improving NCS has been promoted (Cinque, 2016; EUR-Lex, 2012). Moreover, digital learning technologies and solutions have the potential to equip European citizens with fulfilling the gaps in the level of skills and thereby enhancing their employability, while contributing towards better employment opportunities and growth. Massive Open Online Courses (MOOCs) allow students, practitioners and educational institutions to share free-to-use course material and the EU-funded Open Education Europa portal provides access to the many resources available (EUNET, 2017). With the abovementioned potentials and the examples of good practices in the vicinity, a comprehensive and inclusive solution is sought by the recommendations from the EU (EU, 2017; SkillsMatch, 2018) and other related contexts (EUR-Lex, 2012), for improving, measuring, assessing, validating and presenting NCS. The project SkillsMatch: Mapping and validating knowledge develop and demonstrate a European-wide assessment and learning, guiding technology (SkillsMatch, 2018), is a tailored solution, which will help users to adapt their skill assets to the demands of the labour market focusing on the support of Non-Cognitive Skills (NCS). This project is funded by the European Union and focuses on the assessment of Non-Cognitive Skills and their importance and influence on employment and lifelong learning. Thereby the project aims at identifying non-cognitive skills and developing a framework for training and prototyping tailored learning roadmaps for non-cognitive skills for different occupations. It also aims at testing and validating the prototype at the EU level, taking the cultural indicators also into account.

As a part of the project SkillsMatch, which aims at contributing to the strategic objectives of the ET2020 strategic framework (EUR-Lex, 2012) as described above, this study reports the outcome of a systematic approach to eliciting requirements and designing the architecture for a digital solution that can be applicable across the borders of the EU. The designed solution is tailored for supporting the citizens in the EU member states to measure and improve their NCS and thereby enhance their employability.

3. Methodology

The strategy for this research is governed by the concepts of the Design Science Approach (DSR) (Hevner et al., 2004), and its six phases to the development of artefacts. In serving each phase of the DSR, specific methods of co-creation (Ramaswamy & Guillart, 2010), focus group sessions and survey methods are used as described in the subsequent sections.

3.1 Design Science Approach (DSR)

Since this research aims to understand the need to create a purposeful IT artefact to address an important societal problem (Hevner et al., 2004), DSR is selected as the strategy. The requirements are gathered and refined in several iterations as a part of the DSR, and the final developed artefact would be the set of the requirements and the system architecture as illustrated in Figure 1.

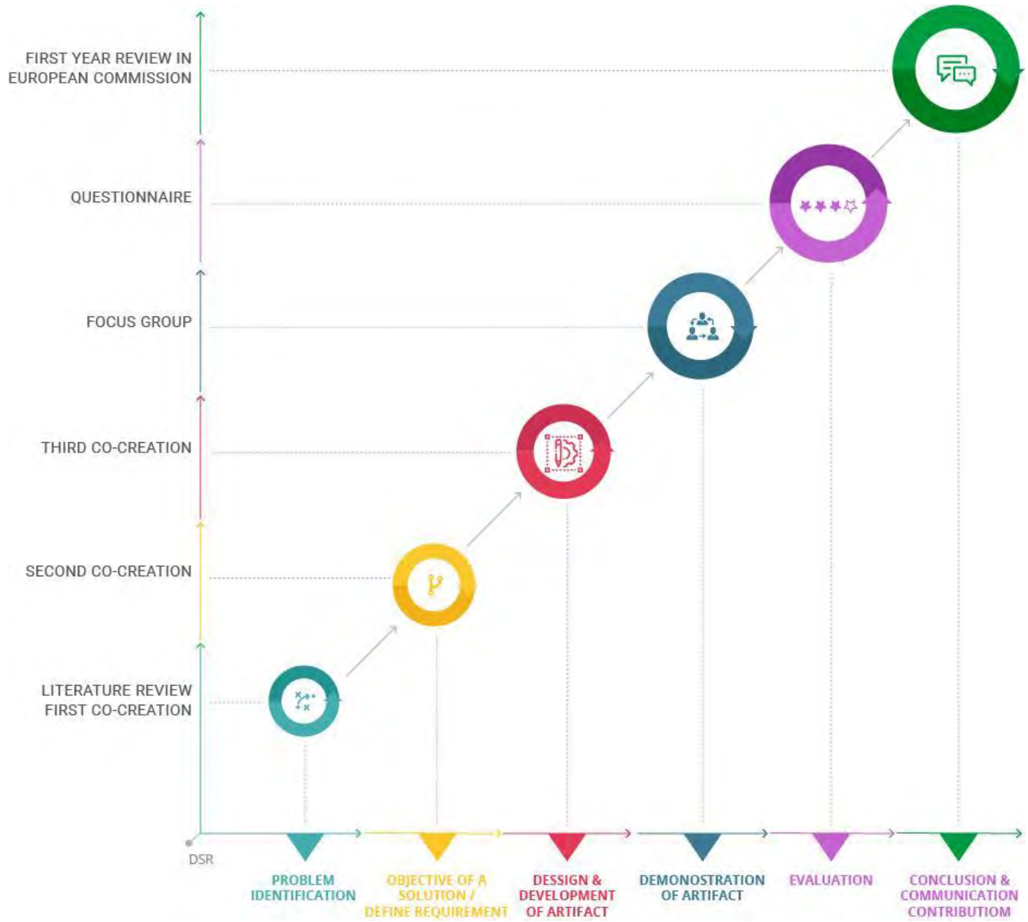

Figure 1: The DSR steps of development of the requirements for an ICT enabler

Figure 1 shows the progress of the development of the artefact, starting from brainstorming and literature review towards progressing on to the evaluation of the artefact. As Figure 1 illustrates, the maturity of the artefact is increasing with the number of refinements of the requirement set.

3.1.1 Phase 1: Problem identification

The problem identification was carried out as a part of the preparation phase (cf. Figure 1), and experts conducted a cross-field collaboration literature review to have a better understanding about state of the art, which was presented and discussed during the preparation phase. The literature review and identifying existing technologies created a solid ground for understanding the gap between the supply and demand of NCS, and the extent of the problem to be addressed.

Given that all partners and experts attending the workshops were familiar with the problem and state of the art, the main focus was directed towards the need assessment activities. The preparation phase concluded by identifying the project stakeholders and their motivation and expectations from the NCS support system.

3.1.2 Phase 2: Objectives of a solution

During the second co-creation session, all participants designed a mock-up solution for the problem identified in the preceding phase and illustrated their expectations from the ideal system, based on the identified and agreed problem to be solved. Experts participated in the session, following creativity techniques like Osborn's checklist (Mycoted, 2019) and also SCAMPER (SCAMPER, 2019), refined and built on the brainstormed novel ideas and expectations flexibly and iteratively. During these sessions, five system views have been emerged and elaborated, as stated in the results section.

3.1.3 Phase 3: Design and development of artefacts

Designing the artefact was undertaken during the third co-creation workshop, where the system stakeholders, who are being identified in the first phase of the DSR process, participated in contributing to tailoring the design that could extend facilitating their own user journeys and also their desired interaction with the system. Based on the outcome of this session, the researchers elicited high-level functional requirements.

3.1.4 Phase 4: Demonstration of artefact

The designed artefact was demonstrated for a focus group of purposely selected 190 individuals from Spain, Ireland and Sweden. This focus group played the role of the end users of the prospective system of measuring and enhancing NCS. A series of action plans including creating awareness about NCS and state of the art and existing technologies for enhancing and measuring the NCS were executed to prepare end users of the system and other stakeholders for artefact demonstration. During the demonstration session, wireframes and mock-ups are used for the end users to understand the concept of NCS and its importance in employment, and, how the proposed system can support and facilitate the process. Based on the session outcome, observations and discussions, new requirements and ideas have been gathered, and already existing requirements are refined.

3.1.5 Phase 5: Evaluation

A plan has been created for validating and eliciting requirements from the project focus group by using a survey questionnaire. A semi-structured questionnaire consisting of closed questions about already identified requirements and open-ended questions to capture new requirements, if any, was distributed among the 190 participants of the focus group. All data collections took place during two weeks in March in three countries, Spain, Sweden and Ireland.

3.1.6 Phase 6: Conclusion and communication

Based on the data gathered from each country, and the lessons learned in the focus group sessions in each of the three countries, requirements are further refined, and new requirements are added, if any. Through a co-design workshop with the members of the experts' group, these requirements were further refined to summarise the requirements to corresponding functionalities and the systems architecture, that are to be used in future for developing the ICT enabler for enhancing NCS. This final artefact is presented in a SkillsMatch project deliverable and also in the European Commission review on 4th July 2019.

3.2 Specific methods used in the DSR

3.2.1 Co-creation

Co-creation (Ramaswamy & Guillart, 2010) is a methodology that allows a strong “out-of-the-box” collaboration between researchers, governmental agencies, business developers, technical experts, and citizens, help them with speaking the same language, to meet and address the issues from a common perspective with comparable tools and resources. When parties are expected to create together, they must be equal partners with similar levels of resources and speak a common language. The collaborators in the co-creation sessions were the consortium of the SkillsMatch project (SkillsMatch, 2018) from seven different organisations in four countries in the EU, that is, Spain, Ireland, Italy and Sweden. Furthermore, two experts who served as the responsible entity for the focus-groups – pilot leaders – as described subsequently, were also participating in these sessions. Different toolkits were used to understand the expectations of experts and end users of the system interactively and collaboratively; e.g., wooden figures to represent the experts and stakeholders, user case cards, templates (paper) to record the module requirements, colour codes, post-ics, group setting, and facilitation to illustrate the reality. This resulted in a better visual support for critically analysing different situations and scenarios related to the problem.

Based on the co-creation methodology, the requirement elicitation process was designed to answer the questions; What is the current state of the art? Who are the stakeholders? What are their requirements and incentives? What is the end result we envision? And, how can this be accomplished in a measurable way?

The main activities focused on during the first co-creation session was to seek the answers for the questions one and two above, i.e., the literature review and consortium brainstorming on defining the problem with a clear scope. Identification of the stakeholders and their motivation and realisation also carried out in the same session. Many experts were invited to this session during the first co-creation to capture a complete list of system users and stakeholders.

During the second Co-Creation meeting, diverse stakeholders visualised respective user journeys within the system. Then each group created use case cards with their desired interaction with the system. Each user card consisted of three sections that should be filled in in the following format: 1. When … (Situation) 2. I want to... (Motivation) 3. So I can ... (Expected outcome). Each of the session participants could fill as many use cards as they desire.

Figure 2: User journey co-creation exercise

In order to collaboratively and collectively reach and agree on stakeholder system envisions, researchers gathered and analysed the outcome of the second Co-Creation meeting and built a mock-up of SkillsMatch system modules. The result (artefact) was brought forward to the third co-creation session, where the focus groups validated the requirements. Each country presented its lesson learned from the activities. Based on the results that have been gathered from 1) Validated requirements 2) lessons learned from focus groups, and, 3) extracted knowledge from both of the previous co-creation sessions, the artefact is refined further agreeing with all experts on the final set of functionalities and requirements.

3.2.2 Focus groups

The SkillsMatch focus group sample consists of 190 individuals and experts from diverse backgrounds and balanced in gender. The individuals are selected based on the relevance of them to be a potential end-user of the prospective system. In Sweden, the focus group was selected from unemployed migrants with higher education qualifications; in Spain, the participants were members of a trade union with short term and casual employment and, finally, in Ireland, they were selected from unemployed youth. Two experts from each of the organisations in the three countries were managing the focus group activities in these counties. Example of a focus group session is shown in Figure 3.

3.2.3 Survey as a method for validating the artefact

Survey is selected to evaluate and validate the artefact (requirement set). Also, it was seen as another iteration to make sure that researchers fully understood the end-users needs and their prioritizations for each system module. Based on the outcomes of the co-creation meetings and the requirements identified by the diverse end-users, the requirements were validated by the focus group. This validation was conducted through a questionnaire. The questionnaire included questions about system processes, modules, and methods such as a range of assessment methodologies, training approaches, and accreditation options. Focus groups were also asked to assess and prioritise the requirements leading to system modules and functionalities using a five-point

Likert scale. Whenever necessary, the questions followed by the open-ended comment section to capture additional thoughts the users might have in relation to those questions in the Likert scale.

Figure 3: A Focus group session in Ireland

4. Results and analysis

In the six steps of the DSR approach, the following outcomes were obtained. Accordingly, the stakeholders are identified, user stories are documented, and functionality of the prospective system, i.e., the ICT enabler for supporting the improvement of NCS, is derived based on what has been gathered and refined from different research methods are presented.

4.1 Identified stakeholders

The following entities are identified as the principal stakeholders of the system:

- **End-Users:** Individuals who are seeking to improve their NCS and looking for enhancing their employability.
- **Training Providers:** The educators or administrators in educational institutes, who would like to add their available courses and/or create new courses based on the knowledge provided in the platform.
- **Employers and Recruiters:** Company representatives and employers, who are willing to advertise and add their job opportunities in the platform, and benefit from customised search to find relevant candidates.

Also, there are the following stakeholders identified, who might not directly interact with the system.

- **Policy Makers:** Policymakers who are willing to learn about the trends and statistics from NCS demand and supply from a citizen perspective, education or employment.
- **General public:** is any entity that has the general interest of knowing supply and demand trends of NCS. The officials from government organisations, public and private institutions, researchers, and other members of non-governmental organisations who are interested in knowing labour market dynamics are also treated as stakeholders in this category.

The first three types of stakeholders will be system end-users that should be able to register in the system and receive the services offered by the system.

4.2 Experts views

In the first co-creation session, the participants in a group setting brainstormed about the features that could be needed by the stakeholders of the system and presented them as user stories, as illustrated in Figure 4. These user stories served as a basis for the systems thinking behind the design of the artefact.

View 1:
A person does the self-assessment, which gets mapped according to a list of skills (from 24 to 2000-eportfolio). There will also be an evaluation of skills, which will be done through 6 questionnaires, and might end in a certification. The self-assessment will be matched to occupations and/or training to improve skills.

View 2:
Users assess their full set of skills (non-cognitive) in a self-assessment tool. Then we have a list of 20 or 2000 skills; when a person enters a tool, the person can select the 50 that represent them best; they can decide on their own, on which level of skills they have. Then, whenever they take courses, and acquire more skills, they can easily change it in the platform. From there, they can see the NC skills profile, and check if they missed something. Then they can add some context (what the person has studied, interests, aspirations, preferences, etc). When we take it further, the person can choose an occupation (dream job) and from there, they go to training. Another way of doing this, is going directly to training.

View 3:
User makes a self-assessment and get a profile. Then there is a suggestion of training, to allow the person to improve their profile. If the person wants a particular occupation, then the recommender will recommend accordingly.

View 4:
Imagine that the self-evaluation has 20-25 skills (non-cognitive skills). The person might be interested in one of them, and enter at that point (clicks in a bubble); he/she gets a set of questions. But all skills are interconnected, and the systems becomes like an interconnected network. Then the system will give recommendations. (see graph in the bottom). This describes a more sophisticated tool, with more nodes focused on specific skills (ex. Leadership) as in a beehive model. Partners were worried about creating the relation between the nodes (since this had not been created yet). Comments were made like: 'how to break one NC skills in sublevels?'. 'It is too early to discuss this as we have not started the analysis.' 'it should have a validation layer.'

View 5:
The user wants to make her/himself employable and attractive to the market. It might be interesting to add personality tests which could be integrated in our system (plugin) and eventually appear in the ePortfolio (ex. 16 personalities test and DISC). Standalone puzzle piece for NCS. User might want to enhance one or few NCS not based on occupation (ex. "fix" my conflict resolution skills). Also interesting: 1) to add interest and background in combination with self-assessment results and 2) then system proposes an occupation. The system needs to be flexible to some degree.

Figure 4: Summarised expert views at the brainstorming session for systems requirements

4.3 User stories

During the second co-creation meeting, eleven user stories of individuals and job seekers, ten stories from training providers and nine stories for employers were gathered. Figure 5 shows selected examples from the different stakeholder groups.

Job seekers:
- When I've made a decision on my career. I want to assure that I'm qualified. So I can get the job.
- When I'm not yet qualified for the job I want. I want to get qualified. So I can get the job
- When I'm ready to work. I want to find job advertisements. So I can apply for jobs.
- When I have completed my assessments. I want to find matching jobs. So I can apply for relevant jobs.
- When I have done my assessments. I want to find the right course. So I can improve my skills.
- When I'm applying for jobs. I want to have a good cv. So I can submit to employers.

Employers:
- When I want to use a competency model. I want to get help in understanding and using it. So my job requirements will be aligned.
- When formulate job description. I want to get help in creating job description. So I can use skills match for job description
- When I need a resource. I want to publish an ad. So I can get applications.
- When I need to find a short list of candidates for interviews. I want to match skills/levels of competences. So I can select the best candidate.
- When I need to give training to new employees. I want to have access to relevant courses. So I can use these courses (internally/externally) for professional development of employees.

Training providers:
- When I need information. I want to get access to updated info. So I can download statistics.
- When I want to find more info or/start. I want to learn NCS, framework, data model etc. So I can design a more effective courses - competitive advantage.
- When I'm designing a course. I want to be able to have options on delivery methods, workshops/video/online/f2f. So I can effectively deliver different NCS with relevant pedagogy.
- When I want to have more students. I want to be listed as a training provider. So I can appear in the platform listings.
- When course has been running for some time. I want to stay competitive. So I can continue to deliver relevant course.
- When I want to promote a course. I want to give certificates. So I can partner with a certificate provider.

Figure 5: Selected examples of user stories from the three different stakeholder groups

4.4 Focus groups

Three focus groups from 3 countries were used in demonstrating and validating the artefact, developed in the phases 1-3 of the DSR process. Table 1 shows the descriptive statistics of the focus groups.

Table 1: Descriptive statistics of the focus groups

Country	Focus	Number of participants	Additional Remarks
Sweden	young migrants Mother tongue of participants: English, Russian, Persian, Arabic, Ukrainian, Spanish, Hindi	82 (22 male, 60 female)	Participants have been holding at least a bachelor's degree in the following fields: Engineering, Natural science, Law, Economy, Accounting, Marketing, Medicine and Psychology

Country	Focus	Number of participants	Additional Remarks
Spain	50% employed people and 50% of unemployed people.	46 people unemployed and 12 employed. (38% male and 62% female)	90% above 36 years old and born or raised in Spain. Profiles: 75% have a higher education degree.
Ireland	unemployed migrants	50 people (25 male and 25 female)	Between the age of 18 and 61

5. Reflections and discussion

"Participants consider NC skills to be important for their career development and believe that this platform can help them to identify how they are in NC skills and how they can improve them. Some of the participants do not know how to define and identify the NC skills well"(a respondent from focus group)

This study sought for a set of requirements for developing an ICT enabler that could support measuring and enhancing NCS and thereby enhancing the employability of individuals. The outcome of the study is summarised in Figure 6.

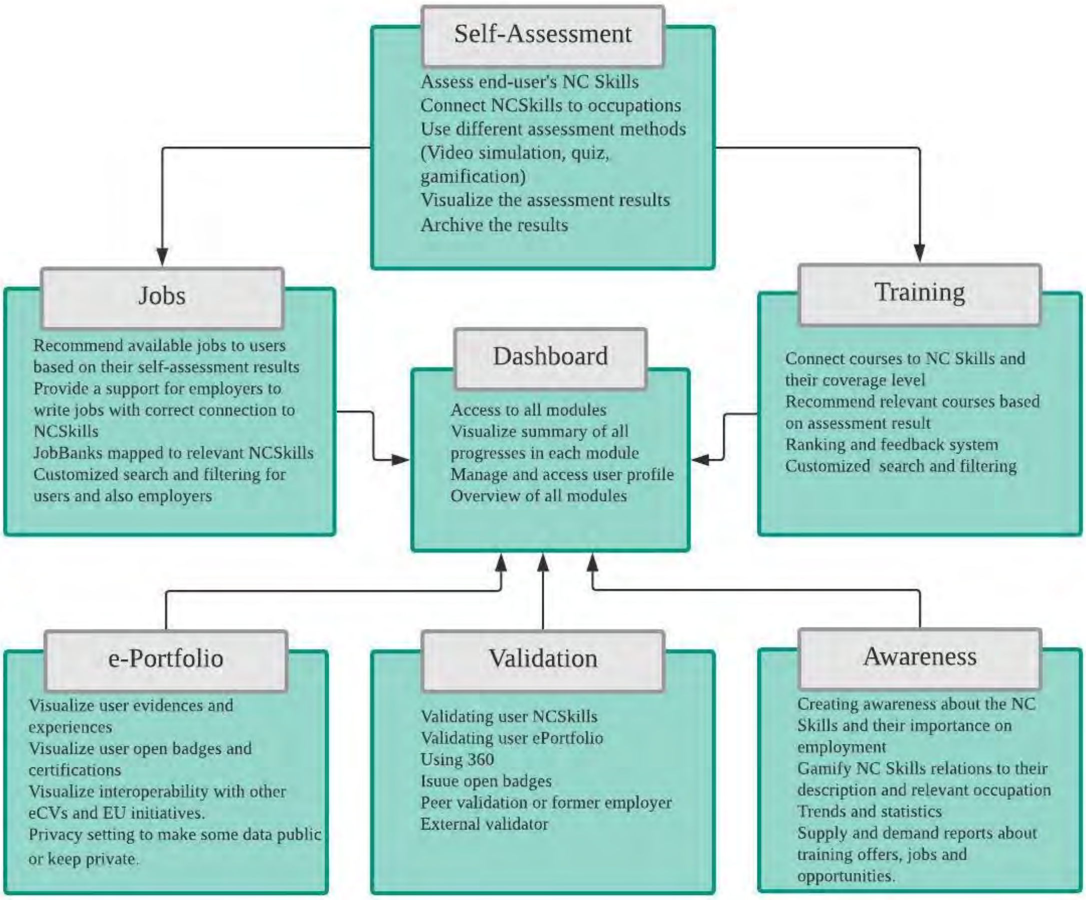

Figure 6: The artefact; the final requirement set for an ICT enabler for measuring and enhancing the NCS of individuals

During the exercise of the process, several observations, critical points and recommendations that could be worthwhile to consider during the implementation of the ICT enabler emerged. Those remarks are stated below under the respective system modules:

Awareness module: The lack of knowledge about NCS and their influences on employability among participants was evident in the focus group meeting. Attention was drawn towards this fact when the researchers noticed that even experts attending the co-creation meetings have limited knowledge and vague understanding of NCS. This observation emphasises the need for creating awareness of NCS among the users of the system. The module should focus on NCS descriptions and their levels. Variety of methods has been exploited, and the experts and focus groups favoured a gamification methodology, such as simple flipping cards or memory games. Possible connections of this with the trends and statistics about the need for NCS in different regions or certain occupations were also identified.

Self-assessment module: The main components that all experts agreed on and have been ranked very high with a focus group are to have the possibility of Self-assessment. To be able to enhance and improve users NCS, it is vital to help them to understand the gaps between their skills and the skills needed for their occupation. In order to do that the NCS should be assessed. Due to the ethical considerations and difficulties to have a formal assessment on NCS, experts agreed that self-assessment feature is a possible solution to mitigate the risks. Measuring NCS is another challenge for researchers and experts. What should each level of NCS contain? How refined should the levels be? How can the user-progress be measured and recognised? And so forth. Some NCS such as tenacity, e.g., is complex to assess compared to leadership skills. The experts suggested multi-methods for delivering the assessment for each NCS, e.g., video simulation, quizzes, interviews and situational tests. The experts also agreed to use positive and encouraging language in formulating the results. Risks associated with assessing NCS, e.g., the validity of the methods for assessing the users and the risks for assigning measurable value to questions and quizzes, scores and the effect that these methods could have on the individuals have been identified.

Training module: Many focus group participants claimed that they value the learning about what are the NCSs and also the provisions to improve them within the context of their occupation. Interestingly the employed participants emphasised that they can relate the need for these skills in their working place, and they are keen to enhance and bridging their knowledge gap. The learning road map could be a useful and demanding feature to achieve the required skills for a particular occupation, according to the participants.

Two methods will be used to gather courses. 1. Web scraping of available courses and using text mining and machine learning algorithms to map the courses to NCS. 2. Courses will be added by training providers manually to increase accuracy on mapping and coverage of levels. The Recommender system, using these two methods, will suggest a course relevant to the user skills gap. The user and training provider should also benefit from ranking and collecting feedback features. Interactive learning opportunities such as face to face sessions, workshops and online or distance education possibilities are encouraged. Certified courses from verified providers and ensuring the users about the quality of the courses could nevertheless be challenging.

Jobs module: Two methods gather job postings. 1. Web scraping of job banks from national and international third parties with the use of text mining and machine learning methods. 2. Manually add available job vacancies to the system, accurately mapped to the NCS and level coverage they desire, by engaging employers. The Recommender system would support matching NCS assessment results of the users to job vacancies. The system also provides support for employers to learn and use relevant NCS needed by the job vacancies they post. Clarity and the measurability of NCS in current job ads anyway, might affect the credibility of the method. However, stronger incentives are deserved by the employers to join the project as just assessed and validated NCS might not be enough.

Validation modules: Validation is the most critical and challenging aspect of the prospective system with many limitations from a technology perspective to ethical considerations. Experts and researchers agreed upon using diverse methods to validate user NCSs. The project will focus on techniques such as 360 degrees, peer ranking and current/former employer feedback. Certifications, open badges and engaging third-party evaluators for validation are also considered. Many participants raised their concerns about validation methods; “the feedback of someone who knows us” has not been viewed as a credible method to identify and assess skills, since it is not objective and subjected to be biased in their perception. Possibility of validation by experts in face to face settings also was acknowledged irrespective of the cost involved in it. It's equally important to pay attention to the context and environment that NCS is going to be validated, according to the perception of the respondents.

6. Concluding remarks

This study focussed on a technological solution; an ICT enabler to facilitate measuring and improving non-cognitive skills for enhancing the employability of individuals, and hence aimed at developing an artefact; a set of requirements, thereby a system architecture that could support user needs in such a context. Following the concepts of co-creation methodology to collectively create the solution with all the stakeholders of the system, the final artefact resulted in seven modules that serve for different purposes of the prospective ICT enabler. The artefact is validated using three focus groups. The end users ranked the functionalities of the system with high values on average, and according to a participant, "*The project is great, and we can find out who we are and what skills we need to improve"*.

The promising further extension of this study is to implement the functionalities discovered and evaluate the complete system for usability and impact, which is already planned under the EU project SkillsMatch (SkillsMatch, 2018).

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Technology-Based Education and Students' Performance: Literature Review

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Abstract: The present paper is dedicated for the process of reviewing the available literature about technology-based education and students' performance. Thus, this paper casts light on technology-based education; students' performance; the relationship between technology-based education; and education technology in Bahrain as it was presented from the point of view of other researchers. This paper contributes to establishing an adequate background about the topic for the readers. It also guides the researcher to pinpoint what exactly prior researchers came across from their studies. The theoretical framework and conceptual model for the research are designed in light of what the research concludes from her literature review process. Further to that, this paper aims to exhibit a clear understanding of the subject while comparing and contrasting various literatures from a number of previously published articles.

Keywords: technology-based education, e-learning, students' performance

1. Introduction

It is important to understand whether or not recent technologies can enhance education. The current impact of tech has rather produced unconvincing results when it comes to developing for the sake of education. Also, it seems difficult to assess how effective the impact of technology has been in the field of education. However, there have been a few studies that did eventually provide conclusive results in the following different levels (Tour, 2015). Participation: Encourages students to participate in the class more effectively. Motivation: Technology motivates students to learn more, and have better knowledge. Autonomous learning: Enables students to be independent and be able to develop themselves accordingly. Parent involvement: Technology encourages Parents involvement in educating their children. Extension of student learning time: Technology would encourage students to devote more time to learn. Teachers are always expected to adapt to new teaching techniques in addition to gaining the ability to combine teaching content and resources. They are recommended to create this collaborative environment where students and teachers interact together seamlessly (Higgins & Xiao, 2013). The aforementioned teaching styles, presentation and collaboration, may be deemed impossible or simply tough and inefficient if it were not because of the recent technology available in classrooms today. An example of this includes the interactive whiteboards. These have been the principle tools of learning through presentation. The board itself facilitates that very intuitive and interactive environment that teaching should strive for (Jones & Hafner, 2012). Laptops and tablets can be used in classroom as supporting equipment for more personalized sessions. It is found that 2% of students worldwide use a handled computing device provided by the school. This in turn was expected to rise to 7% by 2016 (Graham, 2012). Every teacher may use such devices to a certain point. For example, an instructor may use the whiteboard throughout the whole course in a continuing basis, while others may use it to simply make a point or reinforce a certain point of a lesson. Currently, 13% of the 34 million classrooms around the world have an interactive display. This means that the majority of classrooms are unequipped (87%). For a long time, students have been using equipment that encourages individual learning. For example, simple white slates allow students to write or draw their answers and show the result to the teacher or class (Alroaini, 2012).

2. The major impact of ICT

The major impact of ICT in today's society and specifically in education is what can be called the globalization of information. The creation of the internet has made it possible for a user, sitting comfortably in his home, office or library, to contact a person or institution located anywhere all over the world with the aim of exchanging information of any kind: political, economic, cultural, scientific-technical, etc.

This is a challenge facing the educational process in many countries that not only provides people with knowledge and develops habits and skills, but also forms values that allow assimilating and resolving these negative incidents favourably (Merchant, 2009). Furthermore, applying new technologies in a university centre requires more than buying new computers and creating a website. The success of the use of technology in teaching and learning also depends on the capacity to introduce important changes in the educational and organizational culture. The difficulty is in using technology to create an environment that conducts the developing nature of individuals to make the best use of the huge amount of available information for their own continuous development of intellect and ability (Wajszczyk, 2014). In recent years, a number of definitions have emerged within the field of educational technology. Media (e.g. video, overhead projector, computer, etc.) are the products used within a learning system to achieve specific objectives and Educational Technology is a complex organization of many elements that are designed to help cause changes in student behaviour. At present, with the rapid advance of technology, the media occupies an increasingly important place in the teaching-learning process, as a promoter or agent of educational change, as well as being varied, alternative, and suitable to the objective and the content, among other significant aspects (Robinson, 2013). In this sense, any resources that can be used in a given circumstance to facilitate teaching and learning methods, that is, with a didactic intentionality can be distinguished as a didactic means. Didactic refers to"any material made with the intention to facilitate the teaching and learning processes" (Seoane & Rodríguez, 2014). If the possibility of connecting a certain material with other texts or documents located on different computers through a network is added, then the educational potential of the material increases in a noticeable way. The modulating potentialities of the media are not given by the type of technology they support, but by their effects conditioned by the interaction between the symbolic structures of the messages they carry, the cognitive characteristics of the interacting subjects and the context in which the media is used. One of the teaching methods worth mentioning is the "upside down classroom" concept. This is said to put an end to traditional classrooms. Students can watch videos or carry out homework where the teacher's physical presences are not really needed. But they do need to be available to help the students understand an issue and the means to solving them. By being a facilitator, the teacher can efficiently spend time in helping individual students. Initially, it is very essential to review a number of literatures in the field of technology and learning. Reviewing the literature will give an indication on the views and ideas of numerous authors on the subject (Harris, et al., 2016). The technology, however, should not replace the teacher or dictate to him a teaching method. On the contrary, it must be allowed to gain autonomy and pedagogical inventiveness. Teachers should take the digital technology and use it in the sense of a greater autonomy. Digital requirements vary considerably from one discipline to another. This makes researchers little reluctant about a model to be laid down first, because the disciplines have to adapt. It is a must to start from disciplines. Digital can allow a less compartmentalization of disciplines.

3. Education and technology

3.1 The influence of new technologies

The influence of new technologies, primarily the computer and the internet, is increasing at the present time in all areas of our lives. Education of course is not exempt from this influence, so it could be said that new technologies have come to revolutionize many fundamental aspects of this. It is mentioned that the new technologies open the possibility of greater student participation in the construction and development of the curriculum (Higgins, 2012). The convergence of these two technologies requires understanding the impact and the transformation they cause in education. This provides researchers and teachers to take the best advantage of these technologies in order to achieve a greater and better teaching-learning process. They grow also more likely to address the challenges and problems that the merger causes. And this requires researchers and teachers to propose creative solutions for use in the educational process (Flanagan, 2008). Today, there is a great diversity of literature about new technologies that can be used for educational purposes. The importance of adopting the changes and technological advances in the education system is fundamental to facilitate a better understanding of the modern world where technology occupies a fundamental place in the productive system and in everyday life in general. For such a reason, this highlights the importance of always being at the forefront. Educational technology has been defined as a set of "teaching aids", such as language laboratories, projectors, fixed view, TV, radio and 16mm film. That is, it has been identified as a set of physical means of material equipment that can be used by the teacher in the teaching process (Jhurree, 2005).

3.2 Transformation of education-based technology

Nowadays, the use of computers and the internet in education has transformed the relationship between the elements in the teaching-learning process. They encourage the construction of new concepts and interpretations of the conception of educational work, school organization in consideration of the conditions, which these two technologies impose. They also strongly influence the presentation of new proposals enriching the educational process and the design of new products that revolve around them, such as the interactive whiteboard (Lister, 2015).

This way of conceiving the educational technology can be characterized as an "approach of hardware", since it is defined only in terms of physical means. People who conceive of it thus criticize the traditional way of teaching that consists in the mere dictation of classes by the teacher, which would lead to verbalism and academic memories in which the student does not perceive the concrete meaning of the utterances made by the teacher. In order to overcome these barriers, they recommend the use of machines or audio-visual media as a teaching aid (Wajszczyk, 2014).

3.3 Limitation of conventional education methods

For those who believe that "an image worth more than a thousand words “and who are faced with abstract, verbal classes, the image is regarded as a carrier for the didactic value of concretion. Undoubtedly, this is a narrow, limited or partial way of considering Educational Technology (Sutton, 2013). This is because it leaves aside what refers to what can be called "Curricular Technology. This is everything related to the formulation of curricular objectives, selection and content organization, methodological or didactic aspect and the relation to the evaluation (Seoane & Rodríguez, 2014). In addition, it is a technology cantered on the teacher, and not on the student. Most of all, it unalterably maintains the traditional concept of education, despite the criticisms they make to the education of their time teaching aid (Ross, et al., 2010). It is essential then to ask an important question which is “What would education be without technology and what is the use of technological tools in education?” Education in general must evolve according to demand. It is not a satisfactory thing that only a few students are attracted to classes while the majority of them get bored, find it difficult and lose their enthusiasm (Delgado, et al., 2015). In many countries, there has been evidence of the low academic level of students that currently exist (Alroaini, 2012). For this reason, it is intended to apply and train teachers on the use of this new work tool which seeks to increase the level of school use, dynamism in learning and interest and enthusiasm.

3.4 Future outlook

The future is nearing, technology and the innovations are supposed to change the way things can be done. So, the question is; what are the futuristic means of communications that can be used. It will not be long until these things evolve. Innovation has changed as much in technological devices as televisions have been innovated for a better quality of life (Sutton, 2013). So far it has evolved a lot when it comes to education and teaching. Teachers now moved to smart boards where multimedia is more accessible, thus enhancing the way information may be accessed and then delivered. Another technology that is used in the teaching and learning process is the tablet. It is used to for in-class activities where students performance. Books are uploaded on such devices and thus the heavy backpacks can be replaced. Certainly, teachers are satisfied with the exploitation of such devices including boards or slates through which everything is done electronically by touch. As a part of the recent technologies employed in the teaching and learning process, classroom boards have evolved, so it became less common to see a teacher who leaves with clothes and hands covered with dust as a result of using chalk. The present time boards are no longer black. They are electronic ones of adequate size that are used, to enhance the learning experience (Backåberg, 2016). It is acknowledged that the electronic whiteboard is a tool that allows teachers to manipulate the available computer software on any type of flat surface, whether it is a blackboard, a board, a wall or the like. In it, teachers can make notes, presentations, and record classes and even, depending on the model, write directly with your finger (Sung, et al., 2016). Accordingly, classes turned to be a more interesting place where teachers are capable of capturing their students’ attention. The ease of presenting videos, images and other relative material aid them to build a more interactive environment in their classrooms (Mahwah, et al., 2013). Additionally, according to the findings of a recent research, is indicated that “learning outcomes are positively associated with the student-instructor motivation/reason for communication”. Therefore, the instructor can avail the use of videos, simulations or games, and other content that can help encourage students to interact (Razzaque, 2016).

3.5 New emerging education-based technologies

Even with all the great benefits technology could provide in the field of education, if the valuable and right content is missing, then this technology can be considered as a useless thing. Nevertheless, offering reliable information is aligned with good technology enables teachers to make the best use of the teaching time, process and student conceptualization of the taught material. Technology on its own cannot produce a positive impact, but human resources will make it effective (Spector, et al., 2014). It is indicated that there is still a plenty of time for technologists to launch electronic devices with flexible displays. At this time, the American company is "making a great effort" to convince "very large companies" that they should protect the screens of their devices using Willow Glass, reinforcing the idea of the development of these devices and of the crystal itself (Baran, 2014).

One of the most prevailing technologies in the field of education is mobile-learning. It is a fact that during the past twenty years, the vast majority of technology devices turned to be mobile, portable and networked. This has actually made such devices to pervasive in everyday life. Exploiting mobile devices is currently common amongst the majority of the existing age groups owing to its affordability and availability (Bates & Martin, 2013). Many of the most significant investments are carried out in order to provide infrastructure, content, and resources that enhance the processes of integrating mobile devices into the school environments for better, more interesting, and more effective learning outcomes. In spite of the significance of mobile-learning, there numerous limitations including shortage of theoretical and pedagogical underpinnings, sustainable integration into formal educational contexts, and, particularly, lack of teacher support and training (Cochrane, 2012). It is accepted that diversity of the research that addressed the topic of mobile-learning created a perceived difficulty to reach an agreement on one single definition for the concept of in order to identify the most well-defined benefits added by mobile-learning for the learning process. The most accepted definitions for the concept of mobile learning assure: mobility, accessibility, immediacy, adequacy, convenience, and conceptuality (Baran, 2014). The most outstanding added value of mobile learning together with PC learning occurs through recognizing that this type of learning creates an extension for the classroom and motivates the process of interaction with other areas through the networks of communication. The latest developments including imbedded sensors, cameras, motion detection, location awareness, social networks, web searching, and augmented reality present the potential to enhance the learning process and engagement via different physical, conceptual, and social spaces, both indoors and out. Mobile learning enables teachers and learners' ubiquitous and seamless access to information, and convenience, expediency, and immediacy are valuable to teachers and enhance students' learning. These features provide opportunities for individualized, situated, collaborative, and informal learning without being limited to classroom contexts (Cohen, et al., 2013).

3.6 Long-Distance learning

Long distance learning via internet introduced a new light in the field of education and higher professional education. Students no longer are required to be physically present in the classrooms. Schools can offer online courses for others to join in. Many schools and colleges provide online assignments. Students can submit their homework and test tasks via the Internet. Many colleges provide online educational services allowing students interact with their teachers from the comfort of their homes! Bringing in technology in education has made learning as well as the sharing of knowledge quite interactive as well as fun (Razzaque & Moylan, 2015).

4. Ways to improve educational technology

The role of the teacher is now more to help create the conditions for independence, the emergence of motivation and personal interest in education. The teacher gives an incentive to find a correlation between what you read and what you see in life. Even if now we do not understand how to apply this knowledge in professional practice, you should understand that this knowledge will somehow be handled. The formation of this understanding is worth doing (Lister, 2015). In the next century, the physical form of schools will cease to exist. Instead, they will have highly digitalized community centres, working 7 days a week, 24 hours a day. Distance learning will not replace the full-time, but it will become an educational standard and students will be able to study at a convenient time for them and make long-term cognitive journeys. Periodic visits to educational centres will remain mandatory for the formation, consolidation and development of social skills. Such transitions actually began earlier, although they were experimental schools and classes, but the achieved experience can confirm that such training method is effective (Arukaroon & Krairti, 2017). For example, in 1998, in Australia, an experimental school called Seashore Primary School became like a "hi tech" for classes, i.e. teachers and students used laptops. Teachers listened to voice messages and answered calls using a special telephone system. Students used phones to find information and communicate with experts. Multidisciplinary principle is consistent with the educational super-trend for a high-tech holistic education. For every student in the experimental Seashore Primary School, the teachers compiled up an individual plan. The laptop was for the students of this school, a library, a tool for doing homework, a data warehouse and a means of communication

(Wajszczyk, 2014). Nowadays only technological realities have changed from phones and laptops to smart phones, tablets and school LMS (Learning Management System). That is, the very basic principles of "next generation education" are confirmed by many years of testing around the world. It is interesting that schools will cease to exist in the sense of architecture and design. In the world, there are already schools with high-class architecture. Not only technology companies, but also architectural bureaus become "agents of influence" in the process of the slow global evolution of education (Cohen, et al., 2013). In recent years, video games have been positioned in an important part of children's daily lives of as well as adolescents and adults. The video game has become a widely profitable business which is based on high rates of consumption. At present, the word game is not exclusively used by children, which means that these computers are taken into account by technological equipment as an option in the educational field. Acquiring digital skills clearly proves the effect of educational video games. Many children, start off with video games and were able to skilfully learn how to operate a computer, knowing how to surf the web and multimedia content .There is a great variety of video games and it is complex to establish categories, since day to day different types arise, and for this situation it is better to speak of genres such as sports, adventure or simulation just to mention a few. The use of video games within the educational process tends to lean towards strategy games, dexterity and simulators (Hanus & Fox, 2015). In addition, the utilization of simulators is a new way to improve education. Simulators or "Sims", are a computer tool (hardware or software) that allow students to recreate a real physical scenario. Simulation allows real world situations artificially experienced by the students, this allows the student gain theoretical and practical knowledge, as it is experienced at first hand. Simulators are called virtual tools in education, they constitute a procedure that allows the formation of concepts and builds knowledge and its application to new contexts to which, for various reasons, the student cannot be accessed from the methodological context in which learning takes place (Cochrane, 2012).

5. Conclusion

From this literature review, the researchers concluded that the great technological advances constitute an important support in the development of the humanity. Therefore, this support can be transferred to the education and thus to achieve ample improvement of the educational process. The use of ICT in education is a key point to significantly improve the results of the teaching-learning process and based on constructivist theories and the development of skills enables both teachers and students to reap great benefits from their use. The implementation of these technological tools will lead to taking theory and practice more dynamically in a classroom (Bates & Martin, 2013). It was also concluded that the "modern" school, concept is too much different from the traditional school. This because the integration of technology primarily leads to make best use of time when it comes to teaching. This means, more efficient use of scheduling, and venue a flexible nine-month academic year (Hanus & Fox, 2015). The schools of the future are to be flexible enough to facilitate the creation of diverse groups or multitudes that can work on the topics of their interest (Ismail, et al., 2013). However, this could turn out to be an administrative challenge. The amount of data shared and other tools utilized in this new global school is similar to a science laboratory, and therefore require a huge data centre to accommodate the sharing of multimedia and other resources that a "global classroom" would need (Xu, et al., 2011). The modern school is designed as an "expanded school", whose boundaries are not limited by the walls of the premises, but rather articulated with the homes of the students, the parents' offices, the companies, the information and research centres of all the world, etc. In this scenario, part of the time that students and teachers spend in conventional schools is spent working with computers in their homes, connected by phone to send information and exchange resources (Jhurree, 2005). Moreover, to manage "modern" school, there are not only trained teachers who have opportunities for permanent updating, but especially an imaginative and creative director, capable of leading an institution with so many degrees of freedom and complexity.

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e-Design Education Using a 3D Printer Based on Design Thinking at Primary School

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Abstract: In the field of business and education, "Design Thinking" has become popular over the last few decades. Design thinking is a methodology which seeks to understand users, challenge assumptions, redefine problems and create innovative solutions to prototype and test. In the case of business, it sets out to define how an enterprise creates, delivers and captures market value. The interrelationship between those three facets is a key to understanding how a business design model can be invented to define a new venture. In the case of education, on the other hand, design thinking helps learners develop a growth mindset and important problem solving, analytical and spatial thinking skills. In this paper, we introduce the concept of design thinking to a design class at primary school. Primary school students will be introduced to innovation skills such as creativity, critical thinking, problem solving, communication and collaboration through design thinking. According to the Stanford d.school, the design thinking process comprises five stages: empathize, define, ideate, prototype, and test. However, our design thinking process for primary school students comprises four stages: Definition, Ideation, Prototype, and Test. In the Definition stage, three to four students form a group in the class. Then, a tutor provides two tasks related to 3D modelling. Each group chooses one task. In the Ideation stage, each student draws his/her image for the task on rough papers. The drawings are compared among students, and several drawings are selected by argument. In the Prototype stage, selected drawings are designed by the CAD software Autodesk Fusion 360, which is easy to use for primary school students. The students do not need to add colour on Fusion 360 as it is not important. After the design of the drawings on Fusion 360, these drawings are realised by a 3D printer. Then, students paint their 3D objects using paint-box and then these objects are compared and discussed. As a result of the discussion, they come back to 'Ideation' or 'Prototype', and modify the objects.

Keywords: education, design thinking, 3D CAD, 3D printer, primary school

1. Introduction

Design thinking has been attracting attention in the field of business and education. Design thinking is practical processes developed by designers and a design team. For example, the processes are composed of the following steps: context analysis, problem finding, framing, ideation, solution generating, creative thinking, sketching, drawing, modelling, prototyping, testing and evaluating (Cross, 2011).

Design thinking is applicable to not only design work, but also business and education. Vianna, et al. (2014) show examples of creating a business consultancy based on design thinking in Brazil. In Bhutan, the Royal Civil Service Commission (RCSC) organised the "Design Thinking for Public Sector Innovation Programme" from June 2016 till June 2017. With the help of the programme, the public sector in Bhutan learnt to apply design thinking to nudge behavioural change, simplify and solve complex problems such as promoting management innovations (Royal Civil Service Commission, 2017). Also Geissdoerfer, Bocken and Hultink (2016) stated that value ideation could support sustainable business modelling, which was developed from value mapping and design thinking.

Moved to the education field, design thinking is useful for education. Introducing project-based learning and design thinking into first-year engineering classes at several universities, for example, appeared to improve retention, student satisfaction, diversity, and student learning (Dym, et al., 2005). Also Smith, Iversen and Hjorth (2015) argued that digital fabrication in education benefitted from design thinking, to understand digital fabrication processes more profoundly among students. Lor (2017) offered a critical review and analysis of over 68 journal articles, books and reports on design thinking in education. In the case of primary school, Noel and Liub (2017) sought to demonstrate how design thinking based education for primary school students could be a very useful paradigm to be adopted. In addition, Gerstein (2016) used design activities to introduce primary school students to the design thinking process. The ultimate goal was for the learners to work on their own, using self-selected problems in which they would apply the design thinking. We especially refer to these activities in this paper.

In this paper, we introduce the concept of design thinking to a design class at primary school as a case study. Section 2 is an explanation of design thinking. In section 3, we describe the design thinking process using a 3D printer for a design class composed of primary school students. Section 4 is students' feedback on the design thinking process. Advantages and disadvantages of design thinking in e-design education are discussed in section 5. The conclusion is given in section 6.

2. What is design thinking?

The term "Design Thinking" first appeared as a book title (Rowe, 1987). In this book, the author provided a systematic account of the process of designing in architecture and urban planning, which was design thinking. Design thinking became popular in the first decade of the 21st century, because the term was often used in the field of business and management (Martin, 2009; Boland and Collopy, 2004).

Design Thinking is a human-centred creative problem-solving process by which design concepts are developed by designers and a design team. At present, the five stage design thinking model proposed by the Hasso-Plattner Institute of Design at Stanford University (d.school) is the best known method in a variety of design thinking methods (Redesigning Theater, 2012; Wise, 2016; Oceanit, 2019). According to d.school, the design thinking process consists of the following five steps, as Figure 1 shows:

- 1. Empathise: Understand the user for whom you are designing.
- 2. Define: Define the work you are taking on, based on what you have learned about the user and about the context.
- 3. Ideate: Generate a variety of possible solutions for the defined work. This process is called brainstorming.
- 4. Prototype: Build your ideas from brainstorming into a real form. Also learn and develop more empathy.
- 5. Test: Receive the user's feedback to refine the prototypes, and refine your original point of view.

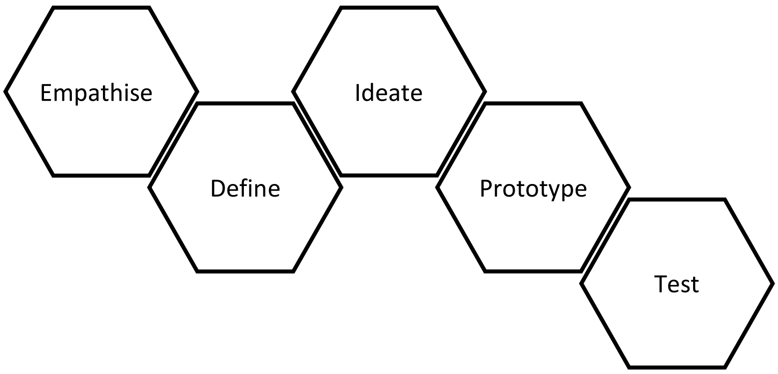

Figure 1: Design thinking process proposed by the Hasso-Plattner Institute of Design at Stanford University

One of the merits of design thinking in education is that students improve problem solving skills in the second stage, Ideate. Another merit is that students cultivate their creativity as they receive the feedback from the point of view of the other students in the fifth stage, Test.

In this paper, we modify the above-mentioned five steps design thinking process, referring to Gerstein (2016).

3. Design thinking process using a 3D printer

In this section, we describe the design thinking process using a 3D printer for primary school students, step by step. Referring to Gerstein (2016), our design thinking process consists of four stages: Definition, Ideation, Prototype and Test, as Figure 2 shows.

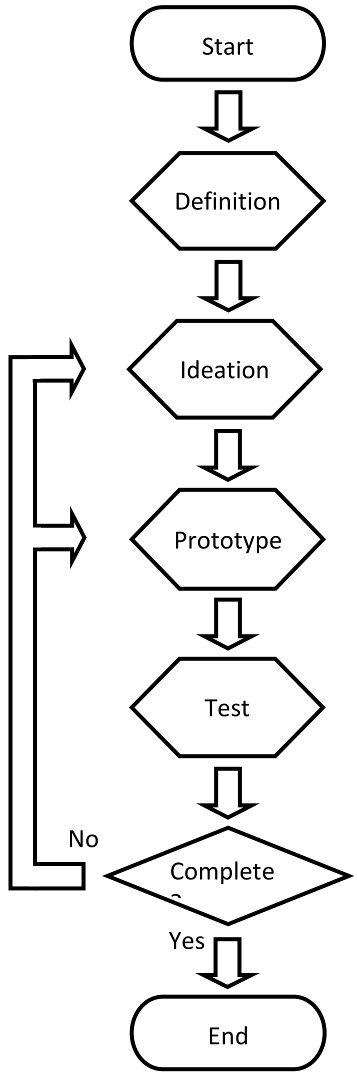

Figure 2: Design thinking process for primary school students

We remove 'Empathise' in the design thinking process proposed by d.school, because empathising is to consider what are good design tasks for primary school students in this case. This process should be done by tutors. We focus on students' activity in this case study, so we remove the emphasising process in Figure 2.

In Figure 2, the Definition mode is to identify a design task. Really several tasks which are suitable for primary school students are given by tutors at the Definition mode. The students choose one of the tasks. They create their ideas for the task individually at the Ideation mode. Rough ideas are enough, and the number of ideas is important. At the Prototype mode, firstly one idea is selected from many rough ideas through discussion among the students. Next, each student creates a 3D model based on the selected idea by the use of 3D CAD software. Finally the 3D models are realised as a 3D object by a 3D printer at the Test mode. The students compare their 3D objects and give feedback to each other. According to the feedback, they repeat the design thinking process from the Ideation mode or the Prototype mode till the 3D objects are complete.

3.1 Definition: Choice of a task

First of all, five students of class 4-6 form a group. Then, a tutor gives two tasks as follows. The group chooses one task from the two tasks.

- a. "What types of fruits do you like? Let's make your favourite fruits using a 3D printer and paints."
- b. "Basic 3D shapes are shown. Let's make your house of cylinder, cube, cuboid, cone, pyramid, sphere, hemisphere, and triangular prism."

Figure 3: The first stage, Definition, in design thinking process

In this case study, the students chose the first task; a. the favourite fruits.

3.2 Ideation: A variety of possible solutions

Secondly, each student makes several sketches of favourite fruits on rough papers, which is a kind of brainstorming. They draw as many of their favourite fruits as possible. See Figure 4.

Figure 4: The second stage, Ideation, in design thinking process

3.3 Prototype: Realisation of selected solution

Thirdly, the drawings are compared among students, and several drawings are selected by argument. Then, he/she creates a 3D model of the selected sketch using the CAD software, Autodesk Fusion 360, as shown in Figure 5.

Figure 5: The third stage, Prototype, the 3D model designed by the CAD software Fusion 360

After 3D modelling on Autodesk Fusion 360, the model is printed out by the 3D printer, da Vinci miniMaker. Figure 6 shows.

Figure 6: The third stage, Prototype, printing by the 3D printer

Next, the students paint the printed objects to resemble real fruits, as shown in Figure 7. They may use papers for fruit leaves.

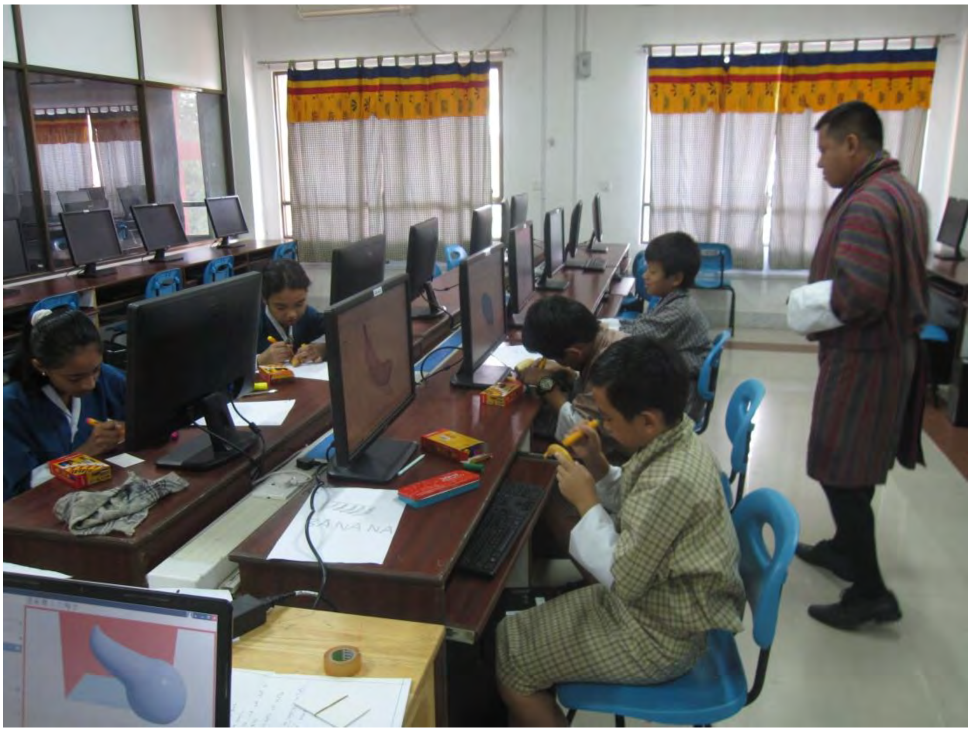

Figure 7: The third stage, Prototype, painting the 3D object

3.4 Test: Feedback from the other students

Finally, the students compare their 3D objects, and give both positive and negative feedback to each other. See Figure 8. If they think that modification to their 3D objects is needed due to the feedback, they go back to the second stage, Ideation or the third stage, Prototype, and repeat the design thinking process.

Figure 8: The fourth stage, Test, giving feeding back to each other

When the students are satisfied with their objects, the design activity will be completed.

4. Students' feedback on the design thinking process

After the students completed the design activity, they gave feedback on the design thinking process. One example of positive feedback is that their designs on rough papers and CAD software are realised by the 3D printer. This 3D printing is exciting because 3D printing brings their images or designs to the real world.

On the other hand, negative feedback is that the printing speed of the 3D printer is slow. The students must wait about five hours to print out five 3D objects which they designed. This situation makes it difficult to complete the design activity within a day.

5. Advantages and disadvantages of the design thinking process

One of the advantages of the design thinking process is that tutors can flexibly customise the design thinking process in their own contexts (Wise, 2016; Dam and Siang, 2019). In our case study, we modify the design thinking process from Figure 1 to Figure 2. Namely, we remove the first step, Empathise, and repeat from the second step, Ideate to the fifth step, Test in Figure 1. Thus, we can give e-design education based on the design thinking process, which is appropriate to the primary school students.

As described in section 4, the disadvantage of our design thinking process is the slow speed of the 3D printer (Muramatsu and Wangmo, 2017). The students must wait for a long time to print out the 3D objects. In addition, the objects made by the 3D printer are limited in size. In the case of the da Vinci miniMaker, the maximum build volume is 15 x 15 x 15 cm. There are 3D printers that are able to build larger objects, but they are more expensive.

6. Conclusion

In this paper, we introduced the design thinking process to e-design education for primary school students as a case study. The design thinking process is flexible, so we modified it to be suitable for e-design education at primary school. Also we used a 3D printer in the above-mentioned e-design education. The 3D printer excited the primary school students, because it realises the 3D objects made by the students. In this paper, we introduced the design thinking as a case study. However, we plan to introduce it to real design education at primary school in the near future. Then, we will be able to confirm the effectiveness of the design thinking more realistically.

Acknowledgements

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Interaction and Group Work in Blended Synchronous Higher Education: Exploring Effects on Learning Outcomes, Satisfaction and Retention

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Abstract: Technology enhanced learning is today a part of most university courses and pure traditional face-to-face courses are rare. Modern blended learning has evolved from an asynchronous design to involve a blend of technology enhanced synchronous activities. To address the identified problems with feelings of loneliness, confusion and low motivation blended learning must also be designed to support collaboration, rich teacher-student and student-student interaction. The aim of this study was to explore the relationship between collaborative learning, retention rates and learning outcomes in university courses given in blended synchronous mode. The important main research questions to answer were: "What is the relationship between student satisfaction, student interaction, learning outcomes and retention rates?, and: "What kind of variables could be used to describe how group work is being conducted? The overall research strategy was a case study approach with data collected from multiple sources. Teachers from 37 courses in two bachelor programmes answered an online survey to investigate the relations between student collaboration, student interaction, pass rates and students- overall impression of courses. Survey answers were analysed and compared to answers in course evaluations and results in national study documentation system. Findings indicate that there is a correlation between students' overall impression of a course and the pass rate, where students' overall impressions are based on the course evaluation. There is also a correlation between students' interactions in a course and students' overall impression of a course, where a high degree of student interactions results in a more positive overall impression. There were no correlations regarding student grades, and the various types of group work and the design differences between the two programmes require further analyses.

Keywords: collaborative learning, student retention, learning outcomes, blended synchronous learning, higher education

1. Introduction

Technology enhanced learning has been an emerging and inevitable trend in the 21st century and it is today rare to find university courses given in traditional face-to-face mode only (Garrison & Kanuka, 2004; Picciano et al., 2013). Technology that earlier was used mainly in experimental distance education courses has now become part of mainstream education with blended learning defined as a continuum between traditional face-to-face teaching and pure distance education (Watson, 2008). To avoid the early identified problems with feelings of loneliness, confusion and low motivation (Brown, 1996; Hara & Kling, 2000; Keller & Suzuki, 2004) blended learning has evolved from an asynchronous design to involve synchronous activities. Several studies recommend a blend between traditional synchronous activities and technology enhanced asynchronous online activities (Watson, 2008; Allen & Seaman, 2014; Garner & Rouser, 2016).

In more recent years, a specific type of blended learning – blended synchronous learning – in which both campus students and online students are taught simultaneously, have received increased interest (Hrastinski, 2019). Blended synchronous learning emphasizes teaching and learning that occur in real-time and include both campus and online students. It has been defined as follows: "Learning and teaching where remote students participate in face-to-face classes by means of rich-media synchronous technologies such as video conferencing, web conferencing, or virtual worlds" (Bower et al. 2015, p. 1). It is characterized by using different technologies to support synchronous class discussion, problem solving and collaboration, and student interaction (Bower et al. 2014). Blended synchronous learning includes varying degrees of technological complexity, ranging from

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inviting online students to participate in scheduled campus classes via Skype on iPads and laptops (Cunningham, 2014) to collaborative learning across physical and virtual worlds (Bower et al., 2017).

This paper is based on the informatics and computer science programs at Mid Sweden University, where we have conducted blended synchronous learning during the recent years. We revisit classic variables, i.e. student satisfaction, student interaction, learning outcomes and retention rates, in the emerging blended synchronous learning setting. We are especially interested in the use of group work when face-to-face and online learning is being combined.

It has been known for many years that interaction with teachers, and between students, significantly influence perceived learning. For examples, "[a] study [of 73 courses in higher education] found that three general factors – clarity of design, interaction with instructors, and active discussion among course participants – significantly influenced students' satisfaction and perceived learning" (Swan, 2001). In a survey completed by 1,406 online students at the State University of New York, it was concluded that the results that stand out most clearly for learning effectiveness were: (1) interaction with the teachers; (2) levels of participation compared to classroom; and (3) interaction with classmates (Fredericksen et al., 2000). Learning effectiveness was measured as perceived learning by students. Based on three studies conducted over five years on 26 online courses at the New Jersey Institute of Technology, it was concluded that student participation in collaborative or group learning were related with as high or higher learning outcomes as those in traditional settings. However, when "simply receiving posted material and sending back individual work, the results are poorer than in traditional classrooms" (Hiltz et al., 2000, p. 120). Learning outcomes were measured as perceived learning by students and teachers, grades and quality assessment of assignments.

Rich teacher-student and student-student interaction in blended learning processes have been the recommended strategy to improve student satisfaction (Rhem, 2012; Chen & Yao, 2016). So & Brush (2008) found that students with high perceptions of collaboration in blended learning activities also perceived high social presence. According to Picciano (2002), "both students and faculty typically report increased satisfaction in online courses depending on the quality and quantity of interaction" (p. 22). Strong evidence was presented based on a survey completed by 52,218 students at the University of Central Florida, in which Picciano's statement was found statistically significant for all types of education examined, i.e. online, mixed mode and web-enhanced courses (Dziuban & Moskal, 2001).

On the basis of a literature review, Rovai (2002) discusses reasons why retention rates often is lower in online learning. Apart from the fact that some adults enrol to obtain knowledge rather than credit, most factors seem to be related with student interaction. The physical separation seems to reduce students' sense of community. It makes them feel disconnected and isolated, and lack personal attention. In fact, an analysis of over 28,000 student records and survey data showed that retention rates can be explained by indicators of social presence (Boston et al., 2009). For example, the response to one of the Community of inquiry items ("Online or web-based communication is an excellent medium for social interaction") accounted for "over 18% of the variance associated with whether a student returned to studies in the semester subsequent to completing the survey" (p. 77).

1.1 Aim and research questions

The aim of the study is to explore the relationship between student satisfaction (overall impression), student interaction, learning outcomes (grades) and retention rates in blended synchronous courses in informatics and computer science. In particular, we explore the use of group work in informatics. The paper addresses the following research questions:

- What is the relationship between student satisfaction, student interaction, learning outcomes and retention rates?
- What kind of variables could be used to describe how group work is being conducted?

2. Method and data collection

The overall research strategy was a case study approach with data collected from multiple sources. The data have been collected from 37 courses in two bachelor programmes. These 37 courses is the total amount of courses during one year. All the data are based on courses that ran 2017. The teachers answered an online survey where they did estimations and filled in data from other sources. The online survey was designed with Google Forms and distributed in the beginning of 2018. Respondents were course responsible teachers in the two bachelor programs "Software Engineering" and "Informatics with focus on systems development". The main subject area in the software engineering program is computer science. Both program runs in blended learning format that follows the definition in Bower et al. 2015, p.1 "Learning and teaching where remote students participate in face-to-face classes by means of rich-media synchronous technologies such as video conferencing, web conferencing, or virtual worlds". Data about courses such as course id and number of credits that included group work was collected from the syllabuses. Data that concerns retention and grading was retrieved from the national study documentation system LADOK. Retention is the number of students that have passed all assignments in a particular course, divided with the number of registered students. The grading was coded in the statistical program SPSS where A = 5, B = 4, C = 3, D = 2, and E = 1. Data was also retrieved from the course Evaluation system EVASYS. The evaluation is governed at a central level at the university and all courses are evaluated following the same process. The survey is sent out to the students in the end of the course (by e-mail) and one reminder is sent out. The course evaluation includes a set of standard questions and some examples are; the overall impression of the course, what kind of resources that the student used during the course, if the content is aligned with the learning outcomes, if the interaction with the teacher have been sufficient and if it has been possible to take part of the course on equal terms. Two evaluation questions from EVASYS were used: "What is your overall impression of the course" (Variable Overall), and "To what extent do you feel that the interaction with other course participants have stimulated your learning?" (Variable Student Interaction). Finally, the survey also includes a set of questions were the teachers made estimations about their courses. Those questions concerned group work and included questions about the grouping process, the size of the groups, what kind of concepts that best describe the collaboration during group work, if the students show up during the tutoring sessions and if the groups were homogenous or heterogenous. Most of the questions had answer alternative in a likert scale 1-5. Others were answered by a number of fixed alternatives ranging from for example; if the tutoring of the students were scheduled by the teachers and mandatory, not mandatory and based on initiation by the students, combinations of mandatory and not mandatory or if the teacher did not offer any tutoring. Teachers involved in courses that included group work only filled in those estimation questions.

The survey has been influenced by earlier research that points out that social presence and interaction are important when it comes to influence perceived learning (se for example Swan, 2001 and Fredericksen et al., 2000). Since group work has potential in breaking the isolation we decided to operationalize group work and variables that might describe how the group work have been performed. Those variables were derived from the author's own experiences of running courses with group work.

The data was analysed using SPSS (for correlations analysis) and spreadsheet for descriptive statistics. Since the dataset is small the analysis was based on both quantitative and qualitative traditions. Quantitative when it comes to the correlation analysis and descriptive statistics but qualitative when it comes to the variables that might describe group work. This reason for the latter is the low amount of data for this part of the survey.

3. Results

3.1 Descriptive statistics for 37 courses

There are only five variables (overall impression, student interaction, grading, retention and number of credits point that include group work) where the data is complete. This since the results shows an underlying difference between the pedagogical design for the two academic subjects (informatics and computer science). Informatics have a lot of group work included in their courses (11 of 15 have credits points that include group work). The study shows that there are no courses in computer science that include group work. This means that the operationalization of group work has only been used for the informatics courses.

Table 1: Means for four of the variables

	Overall Impression	Student interaction	Retention	Grading
Means (n=37)	3,63 (out of 5)	3,48 (out of 5)	75% (out of 100%)	3,02 (out of 5)

When it comes to the data, there are no historical data or data from others departments to compare except when it comes to retention. Retention has for a long period been one of the main quality metrics that have been used both at this local university both also at a national level. There is data available on national level for 2015/2016 and that data shows that the mean value for all universities in Sweden when it comes to retention (for online learning) is 71%. Informatics have a mean value during 2017 at 84% and the corresponding mean value for computer science was 66%. Important to notice is though that both the informatics and computer science programme run in a blended format since 2015. This means that there are a mix of students at campus and online. However, the proportion of campus students is low and have so far never been more than 30%. The national statistics also include all credits in their calculation of retention. In this article, the calculation is based upon that a course is completely settled. This probably means that the man values for retention is even higher for both informatics and computer science.

A remark when it comes to the data that are based on the course evaluation is that the response rate is low and it varies.

3.2 Correlation analysis

Correlations

		Studentintera ktion	Helhetsintryck	Medelbetyg	Genomström ning
Studentinteraktion	Pearson Correlation	1	,432**	-,204	,321
	Sig. (2-tailed)		,009	,233	,057
	N	37	36	36	36
Helhetsintryck	Pearson Correlation	,432**	1	,208	,519**
	Sig. (2-tailed)	,009		,230	,001
	N	36	36	35	35
Medelbetyg	Pearson Correlation	-,204	,208	1	,167
	Sig. (2-tailed)	,233	,230		,331
	N	36	35	36	36
Genomströmning	Pearson Correlation	,321	,519**	,167	1
	Sig. (2-tailed)	,057	,001	,331	
	N	36	35	36	36

**. Correlation is significant at the 0.01 level (2-tailed).

Figure 1: Correlation analysis

Findings indicate that there is a correlation between students' overall impression (helhetsintryck in original language) of a course and the retention (genomströmning), where students overall impressions are based on the course evaluation. There is also a correlation between students' interactions (studentinteraktion) in a course and students' overall impression of a course, where a high degree of student interactions results in a more positive overall impression.

There were no correlations regarding student grades (medelbetyg in original language).

3.3 Group work

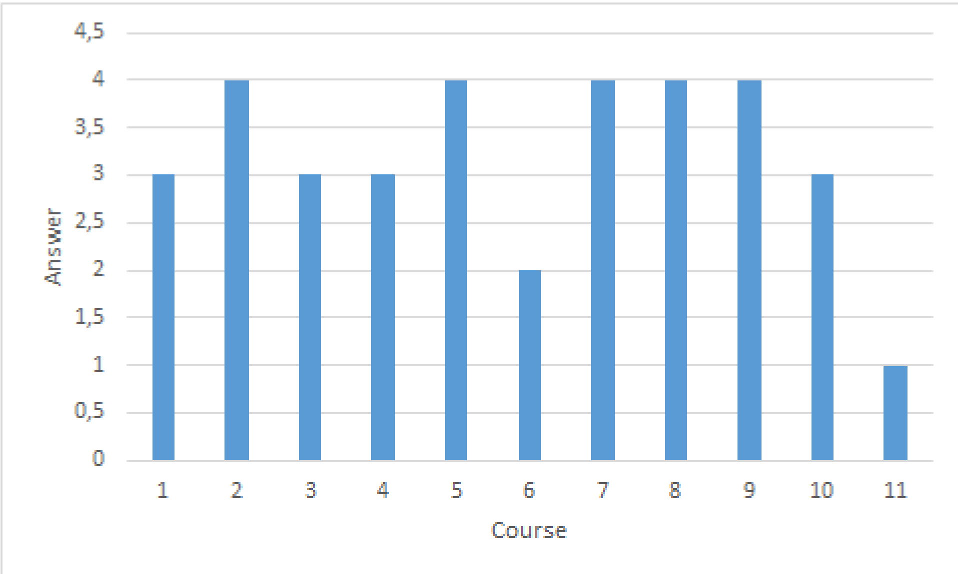
11 out of 15 informatics courses include credit points that are group based. This section of the paper present data that concern those 11 courses. The data shows that there are examples of courses where group work is predominant but also one course where only one credit is group based. This variable was however easy to operationalize since it was restricted to the syllabus and only credits that was describes as project or group based was counted.

3.3.1 Basic prerequisites

One question concerned the grouping process. There were examples of all variants since there were examples where the teacher did the grouping, the students did the grouping and some examples where the students could influence the grouping. Since the data is limited to 11 it is not possible to see any patterns. Related to this question was a question about group size where the teachers were supposed to fill in the average of the group size. Within the data sample, the number of students varied between two and seven and it seems like three to four members is the most common group size. In order to catch how much time each teacher had for their groups there was one question were the teacher should estimate the number of groups that they have tutored (in average). This question was very hard to interpret and which is obvious looking into the data. The answers vary between three and fifteen. The latter is probably explained by the fact that the course only had one teacher that was supervising all of the groups. The results indicate that this question might not be that interesting since it does not contribute to answer any of our research questions.

The answers to the question - *Structure of the group work (student initiated or teacher governed)* varies along the scale. Which means that there are courses where the students are responsible of the process and that the groups work independent (three courses have been categorized in this way). But there are also three courses that have been categorized as that the process of the group work is governed by the teacher or the supervisor. The other courses have been categorized as between those extreme values. The 11 courses show a great variation.

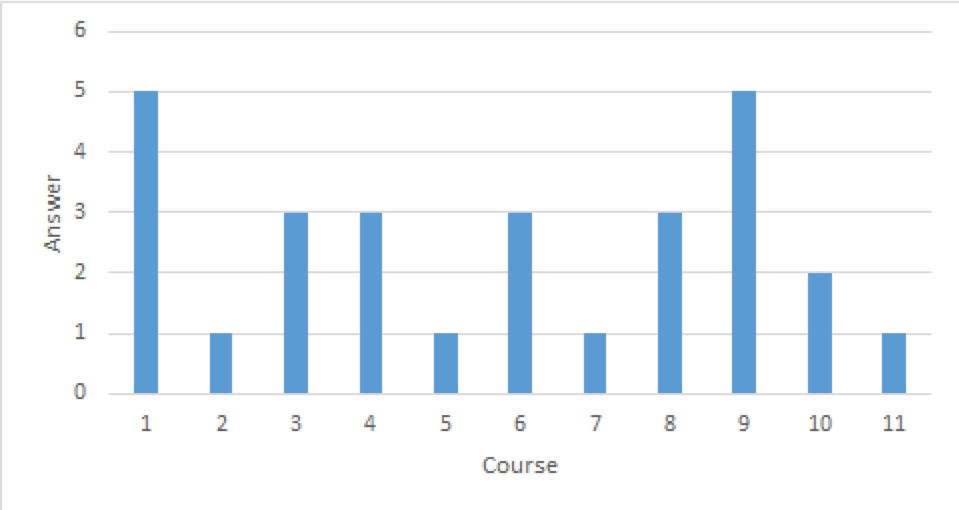
3.3.2 Collaboration



Graph 1: What is the overall feeling of how the group work have been performed?

The teachers were asked to make an estimation regarding their overall feeling of how the group worked had been conducted. Answer 1 has been described as: “The students have distributed the assignments but then solved them on an individual basis without any further cooperation” and alternative 5 was described as: “The students have indeed collaborated and solved the assignments together”. As shown in graph 1 the answers vary so there are courses that makes the student to work together but also courses where the students solve their assignments more individually. Following the ideas of Michaelsen, Fink and Knight (1997) this probably can be described by how the group work have been designed. They have presented ideas for how to design group work to make sure that the students interact. But our survey did not include any follow up questions to the teachers so it is not possible to know If the teacher aimed for high or low interaction. There is only one teacher that have used alternative 1 and noticeable is that the group work in this course is only 1 credit out of 7,5. It might be the teacher did not expect the students to reach something else since the group-based assignment was a limited part of the course.

The teachers also made estimations that regarded which principle that best describe the composition of the groups. Alternative 1 was representing that the principle was very homogenous groups and alternative 5 was representing the principle of heterogeneous group. The question also included a number of examples namely; age, background and gender. The answers are as shown in graph 2. Interesting here is that there is only two courses where the teachers estimate that the heterogeneous principle is used to a full extent. Those two courses are also the only ones where the students have not been able to influence the grouping process. The four courses that been totally guided by the homogenous principle is where the students make the groups themselves. One interpretation is that the teacher's estimation is that when they are involved the groups will be more heterogeneous. Here it would have been interesting to use descriptive data about the students to see if the teacher's estimations is aligned with the actual grouping. There are no follow up questions when it comes to grouping when it comes to what kind of variables that the teachers use when they make the groups. How can they make sure that the groups are heterogeneous?



Graph 2: Homogenous or heterogeneous group composition

The teachers were also asked to choose which of the following concepts that best describe the group work in their course. The concept that they could choose among were: dialogue, generation of ideas, write together, distribute tasks, structure, and flexibility. Distribute tasks (9 out of 11) and write together (8 out of 11) were the two concepts that seems to be the ones that describes the group work best. In three courses the group work seems to influence the structure of the work and in two cases the group work is characterized by flexibility. In one course, it seems like the group work includes all of the concepts. This course has a high amount of credit points that are group based and that course have a very special pedagogical design. The course has been designed based on an agile method called SCRUM and the students have daily meetings with a scrum master (one of the teachers). The course has been described in Söderback, Hrastinski, Öberg (2016).

3.3.3 Tutoring

The teachers were asked to describe if the tutoring of the students were scheduled by the teachers and mandatory, not mandatory and based on initiation by the students, combinations of mandatory and not mandatory or if the teacher did not offer any tutoring. All variants exist in the data that was collected and it is not possible to say which variant that is the most common one. The last question in the survey regarded if all the students were present during the tutoring. The data shows that the teachers view is that it is unusual that students do not show up. So even if it is not mandatory (se question above) the student seems to prioritize the tutoring.

3.3.4 Group work and retention

The overall correlation analysis shows no correlation between group work and retention. An analysis of the mean values using the data that covers the informatics courses shows that the mean value for retention for courses where the group work is less than 50% of the course is 79%. The corresponding mean value for courses that were group work composes more than 50% of the credits is 91%. Important to notice is that the data is very limited and that those differences are based on descriptive statistics.

4. Discussion and conclusions

This paper has focused on two research questions. The first regarded what is the relationship between student satisfaction, student interaction, learning outcomes and retention rates. The findings indicate that there is a correlation between students' overall impression of a course and the pass rate, where students' overall impressions are based on the course evaluation. There is also a correlation between students' interactions in a course and students' overall impression of a course, where a high degree of student interactions results in a more positive overall impression. The studies by So and Brush (2008) and Kim, Kwon and Cho (2011) found that interactivity creates high social presence, but not necessarily learning satisfaction if the interactive sessions lack alignment to meaningful learning activities (Rovai, 2003; Kim, Kwon and Cho, 2011). The recommendation from So and Brush (2008) to achieve meaningfulness is to design courses that include authentic and problem-based tasks. There were no correlations regarding student grades, and the various types of group work and the design differences between the two programmes require further analyses.

The second research question was focusing on what kind of variables could be used to describe how group work is being conducted. Earlier research has shown that retention is lower in online education. This research has been conducted in a blended learning context and show high levels of retention. There are interesting data showing that group work might be valuable because it could have a positive effect on the retention. This is aligned with research emphasizing the importance of student interaction and social presence to diverge the isolation (Rhem, 2012; Chen & Yao, 2016). It is however not possible to know based on the data in this article if it matters how the group work is performed or how the grouping process is done or what the effects the blended learning context is. Therefore, the variables that was used in this study can describe how the group work was conducted but not explain possible relationships between the design and for example the retention.

From a blended learning perspective, it would be useful to develop the variables. One suggestion based on this study is to dig further into the variable that concern homogeneity and heterogeneity. Here could blended also be used as one of the values. It is interesting to investigate whether or not blended group have a correlation with for example retention or student interaction. As stated in the result section another interesting study could be to study if there are any differences when it comes to grouping, homogenous, and heterogeneous groups. The data in this paper shows that it seems like the teachers think that they are better in making heterogeneous group that the students are. The data set that was used to answer the second question was very small and it is therefore necessary to find other courses that also consist of group work to be able to identify and confirm variables that could be used to describe how group work is conducted.

The combination of different type of data from multiple sources is seen as interesting and promising. The survey has potential and could build a base for how to evaluate if the design of a group-based assignment will have effects on learning outcomes, satisfaction and retention. A future study on how group-based instructional methods better should be used to support desirable educational outcomes, might be based on the critical factors that have been identified by Michaelsen, Knight and Fink (2004). Two fundamental factors discussed in the study by Michaelsen, Fink, & Black (1996) are students' tendency to social loafing, and the importance of carefully designed learner group assignments. Another challenge would be to investigate what Michaelsen, Fink and Knight (1997) call creation of cohesive learning groups, and how to achieve this in contemporary blended synchronous learning settings.

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Using YouTube Analytics to Investigate Instructional Video Viewing Patterns

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Abstract: In recent years, there has been a growing interest in learning analytics and educational data mining in the higher education sector. Learning analytics data can be used to identify at-risk students and to help instructors identify how students are engaging with their online course materials. Despite the popularity of video-based instruction in higher education, there is limited research to-date on how instructors can use analytics data to investigate video viewing patterns, with a view to determining the efficacy of those videos. Analysing video-watching patterns provides a unique opportunity to appreciate how, and if, students learn more effectively via video. To that end, this case study explores the video viewing patterns of a cohort of 348 undergraduate business students taking a business-oriented IT module. The students had access to a series of 17 videos, spanning five practical Microsoft Excel topics, which were developed specifically for a module entitled 'Business Information Management'. Students attended two one-hour lectures per week and five one-hour computer labs over the semester. In addition to an end-of-term theory exam, there was also a one-hour end-of-term practical spreadsheet exam. This case study answers the following questions: To what extent do students use instructional videos as a tool for initial learning and revision for the end of term practical exam? Does the difficulty of the material affect video viewing patterns? How much [what proportion] of the videos are watched? Does the difficulty of the material affect how much [what proportion] of the videos are watched? To what extent do students watch a series of videos on a topic? The paper demonstrates the nature of data that can be freely obtained from YouTube analytics and how it can be further exploited to determine how instructional videos are being used (how many students access the videos, for how long, and when). The paper also highlights the importance of undertaking a deeper analysis of the data, as the initial summary data may be misleading.

Keywords: learning analytics, YouTube videos, video-based instruction, viewing patterns, videos

1. Introduction

In recent years, there has been a growing interest and awareness of learning analytics and educational data mining in the higher education sector (Siemens & Baker, 2012). Tools such as YouTube analytics enable instructors to identify the usage patterns of their instructional videos, thereby gaining insight into their effectiveness. Arnold and Pistilli (2012) suggest learning analytics data can also be of significant use to students by reporting on their individual progress. Consequently, traditional on-campus institutions are availing of technological advances to offer a richer student experience. One such advance, which has gained momentum in recent times, is video-based instruction (Greenberg & Zanetis, 2012). It is used extensively in a flipped classroom environment whereby course materials are provided to students in advance of the face-to-face (f2f) session allowing traditional home activities to be undertaken during class time, under the direction of the teacher (European Commission, 2014; Yarbro, Arfstrom, McKnight & McKnight, 2014).

Studies carried out to date in the area of learning analytics in higher education are somewhat limited in their usage of data analytics, particularly with regards to exploiting data available from sources such as Google/YouTube. This paper attempts to bridge this gap and is novel in that it explores how teachers can use freely available data extracted from YouTube Analytics to evaluate students' video viewing patterns.

2. Background context

2.1 Use of video in higher education

In recent years, media, and video in particular, has dramatically changed the educational landscape. The effective use of video can transform the way we teach, learn, study, communicate, and work. YouTube is one of the most popular websites on the internet, with over 100 hours of video being uploaded every minute (Buzzetto-More, 2015). One billion hours of video are watched on YouTube every day and more than half of YouTube views come from mobile devices (YouTube, 2019).

Thanks to Virtual Learning Environments (VLEs), disseminating videos or URL links to videos has become much simpler. Links to YouTube videos can be embedded into course material, discussion forums, and targeted learning objects. However, according to Hansch et al. (2015), the production of quality video content still remains a significant expense. Anything that can make the production of video less expensive will enable its increased and more effective growth in higher education environments (Bakel & Groot-Kormelink, 2011; Panopto, 2014).

Buzzetto-More's (2015) research into student attitudes towards the integration of YouTube in higher education found that incorporating targeted YouTube videos significantly enhances students' perception of learning efficacy and increases engagement, so much so that its continued usage should be fostered. De Boer (2013) identified a number of patterns about how students view video material. Some students watch the complete video in one non-stop 'sitting' while others watch multiple times; some students repeatedly select specific sections (perhaps due to more challenging content), whereas others move quickly through the video jumping from one section to another. In many cases there remains a discrepancy between the way that students report how they view videos, and what the data collected from servers indicates (Gorissen, 2013; Sutherland-van den Heuvel, 2015). It must be noted, however, that it is not straightforward to track the learning process of students. Just because a video is streaming to a student's computer, it does not mean that the video is being watched, or what, if any, kind of learning is taking place.

2.2 Video and learning analytics

Several studies have explored when and how students use online instructional videos. Schiltz (2015) used Google Analytics to examine usage patterns of video tutorials created to supplement introductory physics lectures for engineering students. Interestingly, they found that although not compulsory, most students used the video tutorials and showed a high level of engagement with the materials. While students viewed video tutorials throughout the term, a significant number of students also used them as a revision aid for exams later in the term. Metz (2013) investigated the impact of (short) assigned online videos on student learning in an introductory biology programme. By tracking access, the data showed that in a 'flipped' classroom environment, video watching was consistently above 80%, suggesting that videos work well in supporting learning outside of the classroom, freeing-up precious class time. They also found that if the 'viewing burden' is heavy and students are not incentivised, videos tend not be as well received.

Brady, Wong, and Newton (2013) measured attendance and online lecture video accesses to determine if students use online recordings of live lectures to catch-up after missing a class and also, more importantly, within what timeframe. They found students tended to use the videos variably, but when an exam is forthcoming, access patterns, particularly amongst absentees, showed a significant increase. This finding is consistent with earlier findings by Brotherton and Abowd (2004) who found a peak in access occurs around exam time.

Analysing video-watching patterns provides a unique opportunity to appreciate how, and if, students learn more effectively via video. Kim et al., (2014) carried out a large-scale analysis of in-video drop-outs and peaks in viewership and student activity using data mined from 862 videos across four different MOOCs. They found that when videos were too long, students tended to abandon them. Points of interest and/or possible points of confusion were indicated by re-watching common sections of video (peaks). Kim et al. examined these peaks further and attempted to identify explanatory student activity patterns.

2.3 Summary

Despite the growing literature on the benefits of video-based instruction, there is limited research on how instructors can use YouTube Analytics data to inform their teaching approaches. With that in mind, this study attempts to answer the following questions:

- To what extent do students use videos as a tool for (a) initial learning (b) revision?
- Does the difficulty of the material affect video viewing patterns?
- How much [what proportion] of the videos are watched?
- Does the difficulty of the material affect how much [what proportion] of the videos are watched?

- To what extent do students watch a series of videos on a topic?

3. Methodology

This section describes the characteristics of the instructional videos, the data collected, and the rationale for the data analysis method employed. Expanding on studies carried out to date and leveraging the growing body of data that can be captured via analytics, this study seeks to investigate and probe a milieu of behaviours and usage patterns–for example, exploring the significance of the difficulty of the video content.

3.1 Module description

A series of instructional videos were developed specifically for a module entitled 'Business Information Management' that covered both Information Systems theory and practical spreadsheet skills using Microsoft Excel. It was a mandatory module for first-year undergraduate students taking a Bachelor of Business Studies degree. The module assumed no prior knowledge of the material though some students had previously used spreadsheets. Students attended two one-hour lectures per week and five one-hour computer labs over the semester. In addition to an end-of-term theory exam, there was also a one-hour end-of-term practical spreadsheet exam.

Before each lab session, students were provided with the following resources:

- links to the relevant YouTube videos
- a spreadsheet containing data required for the weekly topic
- a worksheet with questions that required students to apply concepts covered by the video material, by modifying the spreadsheet data

Students attended a lecture the week before they attended the lab and the supplementary videos covered material that related to the lecture material. Additional support was provided in the five weekly computer labs during which students could work on their worksheet, ask questions of the teaching assistant, and receive individual feedback. Teaching assistants did not provide an outline of the concepts required, as students were expected to have engaged with this material prior to the lab. Students were not permitted to watch the videos during the labs. At the end of each week, an 'answer' spreadsheet was posted online. No marks for attendance were allocated and the practical component was assessed using only an end-of-term practical exam.

3.2 The video tutorials

The videos covered five topics and demonstrated how certain tasks were implemented using Microsoft Excel. The videos were recorded using 'CamStudio' and included an audio commentary. At the time of recording, the maximum length of video that could be uploaded to YouTube was 15 minutes. Therefore, longer videos had to be segmented to meet this technical constraint. In total, there were 17 videos with 7,460 views over the semester. It should be noted that a 'view' is similar to a 'hit' for a website; once a video is accessed, for whatever length of time, it is counted as a view. Comprehensive video details are provided in Table 1.

The videos were intentionally unlisted on YouTube with links provided only through the university virtual learning environment (VLE) to ensure only course participants accessed the videos. The number of hits verified that views were only logged while the courses were running.

As outlined in Table 1, each weekly topic comprised between two and four videos. These videos were intentionally not linked using a YouTube playlist to eliminate the possibility of students clicking on the first video and, without further action on their part, viewing other related videos. To view each video, students had to purposefully click on a new link.

3.3 Data collection and analysis

Data on video usage is collected automatically by YouTube and made available to YouTube channel owners. It is possible to generate specific reports in YouTube within defined time periods; given the module ran on a weekly basis, report data were summarised weekly. The data fields available for each week included:

- Number of views

- Estimated number of minutes watched
- Average view duration (in minutes)
- Average percentage viewed
- Unique views (Web only)

The weekly reports were downloaded, and the data fields were then summarised for each video based on three time periods:

- *Lab-related period*: As links to the videos were made available in the week prior to the practical laboratory classes, data was included for both weeks.
- *Exam-related period*: As we were also interested in the use of videos as a revision aid, we included the week the exams took place as well as the week preceding the exam.
- *Interval-related period*: this data summarised the period between the lab period and the exam period.

The data for each of these time periods (for each separate video) were then collated in one data file and used for the analysis presented in the next section.

4. Results and discussion

As outlined in Table 1, five weekly topics comprising 17 videos were made available to students.

Table 1: Detailed breakdown of instructional videos

Weekly Video Topic	Series of Videos in Each Topic	Video Topic Number	Video Length (min:sec)	Sum of Unique Views *
Topic 1: Data Filtering and Totalling **(Easy)**	Data Filtering	1	14:10	504
	Data Sorting	2	13:27	607
	Data Outlining & Subtotalling (Part 1)	3	10:14	511
	Data Outlining & Subtotalling (Part 2)	4	5:26	457
Topic 2: Data Reporting and Visualisation **(Easy)**	Pivot Tables	1	10:58	510
	Conditional Formatting	2	12:50	454
Topic 3: Logical Statements **(Difficult)**	AND/OR	1	14:49	459
	IF	2	6:15	522
	Nested Statements (Part 1)	3	8:37	438
	Nested Statements (Part 2)	4	8:35	388
Topic 4: Cashflow Statements for Businesses **(Easy)**	Cashflow (Part 1)	1	12:40	411
	Cashflow (Part 2)	2	15:00	350
	Cashflow-Goalseek	3	8:14	340
	Cashflow-Scenarios	4	7:53	317
Topic 5: Linear Programming **(Difficult)**	Solver (Part 1)	1	7:53	316
	Solver (Part 2)	2	14:27	397
	Solver (Part 3)	3	8:49	370
Total		17		7,460

** When videos were watched from a PC, unique cookies were used, which meant that if a video was watched multiple times on that PC, only one view was counted. This feature removed the risk of a small number of people* *skewing the data, if they watched videos repeatedly. However, it was not possible to eliminate this risk when the views came from a mobile device.*

The remainder of this section discusses the findings for each of the following research questions:

- To what extent do students use videos as a tool for (a) initial learning (b) revision?
- Does the difficulty of the material affect video viewing patterns?
- How much [what proportion] of the videos are watched?
- Does the difficulty of the material affect how much [what proportion] of the videos are watched?
- To what extent do students watch a series of videos on a topic?

Research Question 1: *To what extent do students use videos as a tool for (a) initial learning (b) revision?*

When examining views per student by time period the videos were used more as a revision aid prior to the exam. Students tended to access the videos more during the exam period than during the lab period. These access patterns during the exam period correlate with findings by Brady et al. (2013) and Brotherton and Abowd (2004), who found that access rates increased significantly around exam time.

Table 2: Number of unique views

Unique views per student (and proportion of views)	**Number**
For the Semester	21.44
In the Lab period	6.35 (30%)
In the Exam Period	11.84 (70%)

It should be noted that, given the available data, it was not possible to relate individual students to specific views. Therefore, it was possible that some students viewed videos during the lab period and during the exam period, while others did not view any videos. It was not possible to identify the degree to which this occurred.

Research Question 2: *Does the difficulty of the material affect video viewing patterns?*

As the number of videos per topic varied, the *average* views per student per video (Table 3) was used to provide comparable figures. Two topics, logical operators (topic 3) and linear programming (topic 5), were identified as difficult both by the researchers and teaching colleagues.

Table 3: Average views by topic (per student per video)

	Lab Period	**Exam Period**
Topic 1: Data Filtering and Totalling **(Easy)**	0.34	0.71
Topic 2: Data Reporting and Visualisation **(Easy)**	0.32	0.72
Topic 3: Logical Statements **(Difficult)**	**0.47**	**0.63**
Topic 4: Cashflow Statements for Businesses **(Easy)**	**0.20**	0.82
Topic 5: Linear Programming **(Difficult)**	**0.55**	**0.59**

As shown in the table above, the more difficult topics (topics 3 & 5) were viewed most during the lab period (0.47 and 0.55) while the easiest topics (topics 1, 2, and 4) were viewed least. One possible explanation could be that the lecture alerted students to the relative difficulty of material; consequently, students were more likely to watch videos on topics that they knew to be difficult, during the lab period. When it came to using the videos during the exam period, students viewed the more difficult topics (0.63 and 0.59) least.

Research Question 3: *How much [what proportion] of the videos are watched?*

The number of minutes each video was watched was also examined. This was useful as such data has not been explored in related studies in this field. Studies that rely on the number of views as a measure of engagement have limited value as an additional view is counted regardless of whether one second or the entire video was subsequently watched. By analysing the number of minutes watched, we can also determine the *extent* of the viewing. Table 4 presents the number of minutes watched per topic.

Table 4: Minutes watched per topic

Topic	Minutes
Topic 1: Data Filtering and Totaling **(Easy)**	17,403
Topic 2: Data Reporting and Visualisation **(Easy)**	8,661
Topic 3: Logical Statements **(Difficult)**	12,224
Topic 4: Cashflow Statements for Businesses **(Easy)**	10,827
Topic 5: Linear Programming **(Difficult)**	8,777
Total	**57,892**

Table 5 shows the average minutes watched per student.

Table 5: Average minutes watched per student

Topic	Average Minutes
Topic 1: Data Filtering and Totalling **(Easy)**	50.01
Topic 2: Data Reporting and Visualisation **(Easy)**	24.89
Topic 3: Logical Statements **(Difficult)**	35.13
Topic 4: Cashflow Statements for Businesses **(Easy)**	31.11
Topic 5: Linear Programming **(Difficult)**	25.22

Delving deeper, the average number of minutes watched per student per time period was also examined. Table 6 shows that the average number of minutes viewed during the exam period (column 4) was greater than during the lab period (column 2), for all 5 topics.

Table 6: Average minutes watched per student per time period

Topic	Lab Period	Exam Period
Topic 1: Data Filtering and Totaling **(Easy)**	9.95	25.14
Topic 2: Data Reporting and Visualisation **(Easy)**	5.17	13.27
Topic 3: Logical Statements **(Difficult)**	12.49	16.43
Topic 4: Cashflow Statements for Businesses **(Easy)**	6.31	24.80
Topic 5: Linear Programming **(Difficult)**	12.41	12.81

The relatively short length of the videos is possibly a contributing factor in the viewing rates, which corresponds to findings by Kim et al. (2014) who found that students tend to abandon long videos.

Research Question 4: *Does the difficulty of the material affect how much [what proportion] of the videos are watched?*

In Table 6 it can be seen that during the lab period the more difficult topics (topics 3 and 5) were watched for longer (12.49 and 12.41 minutes on average) than the easier topics (topic 1, 2, and 4) (9.95, 5.17, and 6.31 minutes on average, respectively). One reason for this may be that the advance lecture alerted students to the relative ease or difficulty of the topic. Furthermore, despite receiving a lecture on the topic, students watched the more difficult videos for a longer period (12.49 and 12.41). For some students it seems the videos were used to reinforce the lecture content. However, during the exam period the more difficult topics (3 and 5) were watched for longer (16.43 and 12.81 minutes on average). This again suggests that the lecture alerted students to more difficult topics.

Another way of analysing the data was to look at the proportion of minutes viewed in the lab period compared to the exam period. Table 7 illustrates a number of interesting trends. The proportion of minutes watched overall indicate that the videos were used primarily as a revision aid (overall 67% of the minutes viewed were during the exam period).

Table 7: Proportion of minutes watched per time period

Topic	Lab Period	Exam Period
Topic 1: Data Filtering and Totalling **(Easy)**	28%	72%
Topic 2: Data Reporting and Visualisation **(Easy)**	28%	72%
Topic 3: Logical Statements **(Difficult)**	43%	57%
Topic 4: Cashflow Statements for Businesses **(Easy)**	20%	80%
Topic 5: Linear Programming **(Difficult)**	49%	51%
Overall	**33%**	**67%**

Research Question 5: *To what extent do students watch a series of videos on a topic?*

Given the number of views and the number of minutes watched per video, it was possible to calculate the average minutes watched per view, both for the lab and exam time periods (Table 8). If students were going to 'give up' on a topic, it is reasonable to assume that they would likely watch the first in a series of videos for a topic and then stop watching the rest of the series; in other words, the proportion of videos watched should decrease over the series. For example, we can see that for topic 2 (easy), video 1 was watched for longer than video 2 (63% viewed on average vs. 54%), during the lab and exam periods.

Table 8: Average percentage of the video viewed

Series of Videos in Each Topic	Lab Period	Exam Period
Topic 1: Data Filtering and Totalling (Easy)		
Data Filtering	55%	62%
Data Sorting	51%	60%
Data Outlining & Subtotalling (Part 1)	53%	68%
Data Outlining & Subtotalling (Part 2)	47%	71%
Topic 2: Data Reporting and Visualisation (Easy)		
Pivot Tables	63%	67%
Conditional Formatting	54%	58%
Topic 3: Logical Statements (Difficult)		
AND/OR	61%	54%
IF	58%	57%
Nested Statements (Part 1)	55%	62%
Nested Statements (Part 2)	54%	57%
Topic 4: Cashflow Statements for Businesses (Easy)		
Cashflow (Part 1)	56%	55%
Cashflow (Part 2)	47%	52%
Cashflow-Goalseek	54%	56%
Cashflow- Scenarios	58%	55%
Topic 5: Linear Programming (Difficult)		
Solver (Part 1)	59%	56%
Solver (Part 2)	61%	51%
Solver (Part 3)	58%	59%

5. Conclusions, limitations, and recommendations for future work

5.1 Conclusions

When we examined *when* students used the videos (i.e. was it during the lab period or as a revision aid prior to the exam), we found that the videos were used more as a revision aid prior to the exam, suggesting a preference for using the videos more as a revision resource. This is an important finding, and one that would not have been apparent had we simply analysed the total or unique number of views.

We also examined the data for different video topics, to determine if the difficulty level of the topic affected viewing patterns during the lab and exam periods. We first examined views during the lab period with the more difficult topics being viewed more than the easiest topics, suggesting that the lecture was useful as it alerted students to difficult topics. When we analysed the *average* number of minutes that were watched during the lab and exam periods, we found that students spent longer watching each topic during the exam period, than during the lab period.

We also found that, during the lab period, the more difficult topics were watched for longer than the easier topics and during the exam period, difficult topics were watched for longer. When we examined the proportion of minutes watched per time period, we found that proportionately, students watched the videos for longer during the exam period than during the lab period.

Finally, when we examined which videos students tended to watch, we found that for topic 2 (easy), video 1 was watched for longer than video 2 during the lab and exam periods.

These findings have implications for how we might analyse video use moving forward. For example, rather than reviewing the data at the end of a module, it would be worthwhile to monitor video access rates at key points throughout the term, to identify levels of engagement with individual videos and topics. This deeper analysis is also useful to determine the extent of engagement (e.g. length of viewing time) with individual videos, and when students actually view the videos (e.g. during the lab period or during the exam period). It also points to the usefulness of lectures to supplement video resources.

5.2 Limitations

Because YouTube analytics did not enable us to identify individual students using multiple devices to watch the same video, the study instead focused on the number of unique views, which accounted for multiple views from the same PC (cookies were tracked). Unfortunately, it is not currently possible to calculate the number of multiple views from mobile devices (e.g. smartphones and tablet devices), so students viewing a video multiple times from a mobile device could not be accounted for.

As it was not possible to identify individual students, it is possible that some students viewed videos during the lab period and during the exam period, while others did not view any videos. It was not possible to identify the degree to which this occurred. It was also possible that a video could be accessed and allowed to play to the end, without actually reviewing the content.

5.3 Recommendations for future work

For future work, we are interested in conducting further analyses to determine:

- The number of views at each point in time in the video. For example, are there peak and trough viewing points within each video and can we identify possible reasons for those e.g. are there threshold concepts that may require further exploration in the classroom? This level of analysis would greatly facilitate further refinement of the instructional videos.
- Who watches the videos through the end - those who tended to watch the videos during the lab weeks or those who tended to watch the videos immediately prior to the exam?
- Of those who tended to watch the videos immediately prior to the exam, are they viewing the videos for the first time or as a revision aid?

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Dissemination of Distance Teaching Practice

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Abstract: The obligation for professional education is to understand and utilise connections between theory and practice. This continues to be a puzzling task. The topic for this paper is how teacher students bring learning from their education to their subsequent everyday practice as school teachers. The paper presents results from an action research project, which follows the dissemination of distance teaching practices from the teacher education to teaching in schools, in the subject crafting and design. The project was very successful in terms of providing teaching which fulfils learning goals in crafting and design. The action research showed distance teaching as very relevant for teaching crafting and design. The question for this paper is how qualifying a competent distance teacher took place. The teacher education in Greenland is exploring the didactical concept of students as didactical designers. The method is to invite teacher students to discuss what they experience in their education and to invite them to take part in planning and executing their own learning processes. This is expected to integrate didactical reflection and creativity ready to ignite when teaching in schools. A similar method relevant for exploration is demonstrating exemplary teaching practices in the teacher education. The method called modelling is intentionally to work with transmission of relevant tacit knowledge from student to professional life. Modelling and the role of students as didactical designers are concepts examined in this research project. Based on research on distance teaching in crafting and design the paper provides a discussion on transmission of competencies and skills for professional distance teaching in schools.

Keywords: teacher education, distance teaching, distance education, praxeology, didactical designers, crafting and design

1. Introduction

For many years distance teaching and distance education have been met with high expectations in Greenland. When radio was introduced in 1958 this technology was expected to help resolve the shortage of qualified teachers in schools through distance teaching via radio (Gjerløff et al, 2014, pp. 180). But teaching that defies the huge geographical distances in the country has not yet become a significant part of the educational system (Øgaard, 2015). The need for solutions for school teaching is evident; it continues to be a challenge for small schools to provide qualified teachers to teach all subjects. Subjects that involves skills like crafting or playing an instrument accentuate the challenge. These subjects require a teacher who is trained in a craft and who can take didactical responsibility for a workshop.

Institute for Learning at Ilisimatusarfik, University of Greenland, is in the process of incorporating digital technology into didactical thinking and practice in the teacher education. This commitment follows a political investment in tablets as the future dominant learning tools in Greenlandic schools. Following this investment is a wish to utilise distance teaching to a greater extent in schools, and in the educational system in general (Digitaliseringsstyrelsen, 2018) (Naalakkersuisut, 2018, pp. 23).

The institute enrolls around forty students every year. All students choose three main subjects to follow. As a result of this structure, some classes only consists of two or three students, which is an organisational challenge. The solution for the subject of Crafting and design has been to appoint a distance teacher from Denmark.

This research project collaborated with the educator from Denmark and one of the students who took the subject of crafting and design as a distance education course. After graduation, the research project connected the teacher to a school in a remote settlement to teach crafting and design through distance teaching.

The subject for this research project is distance teaching in crafting and design. The project aims in part to provide more knowledge about the possibilities of distance teaching in schools. The communication of bodily embedded knowledge and skills cannot rely on textual dialogue alone. Teaching crafting and design should force distance teaching practices to meet or transgress boundaries and limitations. The project is expected to detect general characteristics of distance teaching solutions in schools by researching crafting and design instruction as distance teaching. Part of the project has focus on understanding how teacher education can create development in schools and bring distance teaching solutions into the Greenlandic educational system. This is the part presented in this paper.

Research question

How can teacher education provide relevant qualifications for distance teaching in crafting and design in schools?

2. Crafting and design

The subject of crafting and design is defined by woodworking. The subject also entails working with other materials- metals, concrete and stone- but wood is traditionally used as the main material and medium. Understanding how materials, mainly wood, can be used for crafting is an important learning goal for crafting and design, and this understanding is referred to as material knowledge (Knøss, Petersen & Skibelund, 2007).

Another important learning goal is knowledge and understanding of tools, mainly those used for woodworking. Crafting and design builds on a long tradition of woodworking in the pre-industrial society, and many woodworking tools have deep historical roots. The knowledge base for this subject is taken from these woodworking traditions (Knøss, Petersen & Skibelund, 2007).

Crafting and design also entail the skills used to choose and employ the relevant tools for an assignment. An important part of crafting and design is learning how to plan and communicate solutions and how to cooperate with peers and teachers on construction designs and processes. Reflection and discussion have become an important part of crafting, and the design process is core of the subject.

The teaching traditions of crafting and design are rooted in the Scandinavian school system (Knøss, Petersen & Skibelund, 2007). Following pedagogical reforms and the development of progressive pedagogical thinking in Scandinavia, individual design processes have become an important part of crafting and design. The reproduction and acquisition of woodworking traditions are balanced by personal development and incentives to be creative and original.

In Greenland, crafting and design entail a commitment to disseminating national culture by being part of the broader subject named local choices. When Greenlandic politicians passed a new school act in 2002 the aim was to put the individual child first and to support critical and independent thinking combined with competencies for collaboration. The aim was also to provide children with an understanding of Greenlandic ethnic and cultural heritage. One of the subjects in the new curriculum is local choices which also includes music, arts, architecture, sports and outdoor activities (Inatsisartutlov nr. 15 af 3. December 2012 om folkeskolen). Cultural history sums up the curricula for crafting and design, a rich teaching subject rooted in crafting traditions and in pupils´ own design processes and crafting activities.

3. Distance teaching theory

When working with distance teaching, it is important to separate two forms of communication. When participants meet during an agreed upon timeframe and establish an online classroom or online lecture, the contact is synchronous. Asynchronous contact and communication are not restricted by shared timeframes; rather they are displaced in time, typically through written communication in emails or on shared digital platforms. Asynchronous communication follows the participants' individual initiatives, and contact can be expanded in time.

These two forms of communication give distance teaching a variety of didactical possibilities. Conventional teacher-led classroom teaching is possible, as well as communities of enquiry relying more on independent and self-reliant- as well as collaborative- learner behaviours (Øgaard, 2018) (Garrison, 2017).

Research on distance teaching in Greenland suggests a potential for pro-active and competent learner roles within distance teaching (Øgaard, 2015). The geographical separation of teacher and learner seems to demand more visibility and more presence from learners. In a physical school situation, attendance is sufficient for teachers and students to accept the situation as teaching, but in a virtual school situation, active participation from learners becomes essential and defining.

Adding to this are results showing a very direct and firm contact between teachers and learners. Via distance education teachers get a good sense of students competencies and skills and an accurate sense of their progress (Øgaard, 2015). Especially the extensive use of written communication- usually for asynchronous contact- is found to enhance learner focus and reflection with the learner (Garrison, 2017, pp. 20).

Teaching that is dependent on digital media as a consequence of geographical distances supports focused dialogue and focused interaction. Under these conditions, it is logical to expect a learning environment that fosters self-reliance, independence and collaboration. These are learning goals in the Greenlandic School Act, and this way researching the use of distance teaching in schools is therefore highly relevant.

4. The theory-practice dichotomy

Understanding how teacher education and school development are related has been defined as the Holy Grail among researchers (Korthagen, 2016). The challenge is described as the need to connect theory and practice. When working with teacher education, this dichotomy becomes even more pronounced, as the institution is all about understanding what learning is and about managing learning. Teacher education entails an obligation to master the learning taking place in the education, and to qualify convincingly for a certain field of practice.

But transfer between practice fields is a persistent puzzling pedagogical challenge. Pierre Bourdieu has suggested a differentiated understanding of practice (Bourdieu, 1973). It seems relevant to break down the theory-practice dichotomy, which can be done by examining how theory includes practice. The work of researchers and scientists is immersed in theory, but it also has its own practices. And practice entails theoretical assumptions and practical knowledge exclusive to practice. The concept of tacit knowledge describes the theory embedded in practice, but this theory defies intellectual explication.

Bourdieu defines theory in practice as a practical sense (Bourdieu, 1973). Professions demand elaborate and competent reactions and behaviour compatible with a certain field of practice. And every field of practice is dominated by a relevant practical sense. When leaving the field of education and stepping into a professional field, qualitatively different theoretical understandings and habits replace educational training. Expecting transfer from the practice field of theoretical thinking and reasoning typically found in education to a professional practice field might be a misunderstanding.

5. Students as didactical designers

If we turn to research made in the tradition of Gene Lave and Etienne Wenger relevant empirical evidence suggests how practice fields are related (Lave & Wenger, 2003) (Nielsen & Kvale, 1999) (Nielsen & Kvale, 2003). The theory of situated learning points to the inseparable connections between context and learning. From this theoretical concept, it becomes relevant to view arenas for learning as communities of practice. Teacher education can be observed as a defined and unique community of practice. Learning in the context of teacher education is situated in activities, traditions and relations to educators and peers exclusive to the field of teacher education. Practice in the field and the appropriate, and relevant learning in the field are about preparing for this particularly field of practice, not for other fields of practice such as teaching in schools.

Bourdieu's praxeology and the theory of situated learning confronts educational activity in an effort to prepare students for a world outside of the campus. If different fields of practice cannot be expected to be commensurable, what then are relevant activities in the teacher education?

As expressed by Russell, the teaching students experience throughout their teacher education will likely be the main approach they adopt (Russell, 1997). This point emphasises the importance of educators' exemplary behaviour. Modelling is a suggested method for dealing with the theory-practice dichotomy and the challenges of situated learning (Korthagen, 2016). Educators can work deliberately with exemplary teaching. Modelling takes this principle a step further and suggests that students are invited to know the thoughts and principles behind their educators' planning and to reflect on the teaching they experience themselves (Korthagen, 2016). According to Korthagen, the effects of modelling have not been the subject of research (Korthagen, 2016). However it seems like a productive approach relevant for teacher education research.

In 2016, the teacher education in Greenland was evaluated and criticised for cultivating outdated and inadequate ways of teaching (Danmarks Evalueringsinstitut, 2016). The recommendation was to be more aware of the transmission of teaching methods and to demonstrate awareness of how educators exert influence as role models. The critique has led to thorough and extensive self-reflection and changes in the education. Birgitte Holm Sørensen introduces the concept of students as didactical designers (Sørensen & Levinsen, 2014) (Sørensen, 2018). This concept highlights the benefits of inviting learners to take part in planning and executing the teaching activities they experience. As with modelling, the selection of content, methods and materials is made explicit to invite student to participate in the practice of building teaching strategies. The principle of students as didactical designers is expected to infuse a practical sense into the organisation of teaching and learning that is solid and compatible enough to cross the threshold between education and professional life.

In the course of a lifespan education and professional life is very related. But as should be clear from this theoretical discussion, the connection is rich, complex and complicated. The issue is not how one practical sense integrated within a specific field of practice is abandoned and replaced by another practical sense from another field of practice. This is sometimes understood by the term ‘practice shock’, and the teacher education is at risk of being rejected as detached from the reality in schools and basically irrelevant. The issue is to capture and understand transmissions, transformations and transgressions in personal learning trajectories.

Modelling and students as didactical designers are the most important didactical and theoretical concepts in this research project. The research presented concerns adjustments and solutions that emerge or disappear when a student shifts from distance teaching as a student to engaging as a distance teacher in a school setting.

6. Research design and data

The method for this research project was action research and intervention in schools. The project was shaped through discussions about distance teaching didactics between Assistant Professor Anders Øgaard and educator in crafting and design Peter Hersted. Øgaard, Hersted and a former student of Hersted, Miki Olsen- who is now working as a school teacher- collaborated on the design of the research project. The intention was to see how it was possible to teach crafting and design as distance teaching in schools. The intention was also to see if and how the distance education Olsen had been through had qualified him as a crafting and design distance teacher in school.

The research project was planned as an intervention in a small village school. Olsen was given teaching lessons in crafting and design with a class of six pupils from the fifth and sixth grades. The intervention was prepared over two workshops, in which Hersted and Olsen met for these workshops. Hersted acted as a consultant with regard to crafting and design content. Hersted presented different designs for woodworking. When a design was decided upon, Olsen produced short videoclips demonstrating how to work through the design. Short clips where also made of Olsen demonstrating how to use the tools. All the tutorials where put on iPads.

Hersted developed a prototype of a small workbench, designed for distance teaching in crafting and design. The workbenches where designed for teaching crafting and design without a dedicated workshop and without the need for a physically present teacher. Three workbenches where build and equipped with tools and one iPad each.

The workbenches and iPads where shipped to the village school. Daily planning and execution was then up to Olsen. Hersted continued to participate as a consultant ready to support Olsen. However, the intervention was dependent on Olsen embracing the role of a distance teacher.

The intervention had a timeframe determined by funding for the research project. Olsen was paid a salary for three months, and the project was scheduled to end in December of 2018. When funding was running out, the head teacher at the village school asked the head teacher from the district to continue the distance teaching in crafting and design. Beginning in January of 2019, distance education in crafting and design became a permanent solution. Olsen’s salary is now paid by the school district, and the pupils at the village school continues to be taught crafting and design as distance teaching.

The permanent solution caused the research project to evolve into action research. A real implementation had taken place. The practice field had adopted a viable solution for distance teaching in schools. The data collection was postponed to allow the distance teaching to proceed further, to make routines and permanent solutions become more solid and detectable.

The data collected is qualitative and was sourced using a variety of data collection methods. The crafting and design lessons in the workshop in the village were observed. Øgaard was there for the first two lessons and observed two lessons again eight months later. Observations were also made from the two preparatory workshops, in which the consultant and the distance teacher developed and produced materials for the distance teaching in the village school.

Video recordings on iPads made by the distance teacher, the head teacher and Øgaard during the course of the distance teaching period provide data on the competencies demonstrated by pupils in the village school and on how these competencies changed and developed over time.

Øgaard conducted four open interviews with the consultant and with the distance teacher individually, and two as focus group interviews with them both. One open interview was conducted with the head teacher at the village school. The interviews were conducted throughout the course of the intervention as part of the action research process. The interviews have also served as evaluations and support for the consultant and the distance teacher.

Unusual data for this research project is the physical wear and tear on tools used by the pupils in the village school. Wear and tear show how the pupils have made use of the tools and how much activity has been generated during the course of the distance teaching.

7. Findings

Distance teaching sessions for crafting and design in the village school were scheduled for two lessons every Friday morning. The distance teaching was based on synchronous online contact. When the lessons began, the local teacher welcomed the pupils in the workshop at the school. The pupils then fetched the workbenches and called the distance teacher to talk about their individual assignments for the day. The distance teacher was present with support and inspiration as the lessons began and remained on demand during the lessons. Instructional clips on iPads where frequently consulted during the first lessons. Observations later in the process indicated that the tool instructions on the iPads had been replaced by habits of constant trial and error with the tools.

In the beginning, the distance teaching went through three defined wood constructions: a traditional Greenlandic game, a handgun and a ship. Gradually, the pupils proceeded with their own construction ideas, following a method for design planning introduced by the distance teacher. Starting with a drawing on construction paper, the process continued by choosing materials, then giving materials shape and size, and gradually assemble them by using nails, screws and glue. The balance between obligatory subject matter- mainly knowledge of materials and knowledge of a variety of tools and the skills required to use them- and subject matter open for the pupils' interests was inspiring and stimulating.

The constructions the pupils chose to make were mainly small boats in different shapes and sizes. These constructions were obviously inspired by the surroundings of a small isolated fishing community. One pupil took the initiative to build an iPad stand to use for the crafting and design lessons. This also show as a construction inspired by the local conditions.

These designs follow the intention with the broader subject local choices, the aim of which is to connect the curriculum to local culture and local conditions. However, the result is not cultivation of traditional Inuit culture, which might have been part of the intentions.

Core to the subject of crafting and design is knowledge of materials and tools. During this study, pupils displayed a high degree of correct use of tools and materials. The distance teaching clearly achieved many important learning goals from the curriculum. According to the teacher, the consultant and head teachers, the distance teaching in crafting and design has been successful.

The distance teacher stated that his distance teaching in the village is working better than his crafting and design teaching at the town school. He indicated that teaching crafting and design is made easy through distance teaching. The pupils are alone in the workshop, which gives them stimulating freedom and responsibility. This supports more sensitive evaluation of their level of competence, their interests and their progression.

7.1 Parallels between distance teaching arenas

Activities were organized as individual tasks, with each pupil working on his or her own task, receiving from time to time help from classmates or the teacher. The distance teacher did not plan or motivate group work or building projects for pupils to collaborate on. When the tradition with individual tasks was commented on in an interview, the distance teacher said that this was not a practice coming from deliberate or thorough reflection. The individualised didactics came from tradition and routine.

The distance teacher expressed that he was very confident when using iPads and the internet to communicate with his pupils. This experience is backed by observations from his teaching. Observations and the instructional clips made for his distance teaching show great confidence and well-developed routine in the relevant use of digital technology. Again, this behaviour seems to be defined by confident routine.

When Olsen and Hersted gathered for the preparatory workshops their roles where exchanged. Olsen was no longer a student but had been a teacher for a year. Hersted had joined as a consultant and his agenda was now to make the intervention work.

The endeavour of teaching crafting and design via distance teaching in school was new to all. The preparatory workshops did not have a clear agenda. The goal of the workshops was very open: to plan and produce materials for distance teaching.

Hersted brought woodworking objects to the workshop. These where meant as a suggested building project to use with school children. The expectation was that Olsen would choose objects and start outlining and designing the building processes. After some hanging around in the workshop the distance teacher chose objects and embarked on the process of outlining the activities for his distance pupils. This was done through his production of tutorials to put on iPads. In these videoclips, he demonstrated the use of different tools and went through the different building projects. Hersted also brought his prototype workbenches to the workshops. Olsen took the initiative to organise and assemble the workbenches.

In interviews, the distance teacher expressed complete confidence with the assignment to teach crafting and design via distance teaching. Observations detected no fumbling or insecurity when he engaged in distance teaching. The process of planning and executing qualified and professional distance teaching was carried out with excellence and energy by a confident crafting and design distance teacher.

8. Discussion and conclusion

The distance teaching in the village school reflected the distance education the distance teacher had been through. In both cases, the teaching was organised as synchronous meetings in a defined timespan. The primary activity was working with individual assignments at each student's own pace. In both cases, video tutorials where used to introduce subject matter. The educator/ teacher took part as an instructor and adviser, and he organised the defined timespan by welcoming and closing the sessions. Asynchronous preparation- like homework or contact via email- was not in any of the cases part of the distance teaching, or just used to a minimum.

The distance teacher brought a lot of his experience to the distance teaching in school. He was able to reflect on his choices and to relate his teaching to the curriculum. But his confidence seems to come from habitual and tacit knowledge about the workings of distance teaching in crafting and design.

The preparatory workshops revealed as important arenas bridging teacher education and working as a teacher. These where not organized as education. The workshops had an open structure, and a great deal of time was devoted to collaboration and preparing the distance teaching initiative in the village. The consultant wanted the distance teacher to go through the building processes as a method to prepare the distance teaching. This was not explained during the course of the workshops, but gradually, the distance teacher acted.

Time in the workshops was time in familiar and safe surroundings. Many hours of companionship supported the transfer of responsibility to the distance teacher and a change of roles. The collaboration and division of labour supported a subtle process in which the consultant supported his former student to become an acknowledged colleague. The meeting was not about educating but about collaborating on a shared professional assignment. The workshops became steppingstones and catalysts for a pedagogical development that bridged teacher education and professional life.

It is not possible to say whether the workshops could have been held without physical meetings and thus whether the process this way could have been carried out strictly through distance education. This question demands more research. But this project reveals the need to look at steppingstones in between the two arenas for practice: teacher education and teaching in schools.

The incorporation of distance teaching into the Greenlandic educational system poses a serious challenge, as is evident from the many years it has been a political wish without becoming a viable reality. Bourdieu's praxeology provides a theoretical understanding of why distance teaching in Greenland seems to be stuck in a utopian dream and political discourse instead of becoming an everyday practice in schools and educational fields. Fields of practice in the Greenlandic educational system do not provide the understanding, methods and discourse embedded in a practical sense ready to seize distance teaching solutions.

This paper sums up experiences from modelling and working with teacher-students as didactical designers. Bridging different fields of practice seems possible when implementing these adult education principles.

Giving distance teachers personal experience as distance students and the opportunity to use steppingstones in the form of preparatory workshops might infuse a relevant practical sense for distance teaching into schools.

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Investigating the use of Moodle at a PBL University: Design Factors and Experiences

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Abstract: This paper presents an empirical study and the resulting design choices from a problem-based learning (PBL) development project at Aalborg University (AAU) entitled "Learner-Centred Moodle Course Design: Design Factors, Differences in Perceptions and Best Practices." In relation to this study, the following research questions are explored: What characterises the current use of Moodle at AAU? How can teachers use Moodle to support PBL activities? The empirical investigation took place in 2018 and was comprised of a literature review; a survey of 345 students' experiences of Moodle in conjunction with a nomination for the best Moodle course; an analysis of the 178 nominated courses; and interviews with four university teachers, about their use of Moodle. During the investigation, it was found that many existing activities at AAU focus more on sharing information and teaching materials and less on the students' PBL activities and projects. This finding is intriguing, as PBL comprise the pedagogical foundation of AAU, but use of Moodle does not reflect this. The investigation found several reasons for the lack of PBL in Moodle, and explore them in full in the paper.

Keywords: Moodle, problem-based learning, higher education, design, literature review, empirical findings

1. Introduction

Problem-based learning (PBL) encompasses numerous types of problems and practices. As an analytical framework, Sipes (2017) provides an overview of various PBL practices, and shows that there is a wide variety of PBL types, ranging from the use of small case examples presented in lectures, to students working on a given design or policy problem to what he refers to as close-looped PBL, where students solve problems and reflect on their problem-solving process. Jonassen and Hung (2015) review several aspects of problems in PBL and show how problems with, for example, varying complexity levels, require different levels of knowledge. The authors argue for more attentions to the problem difficulty-level when designing PBL activities. In a similar vein, Savin-Baden (2007) identifies a number of ways in which to work with PBL. These methods include working on the solutions to a problem in a teacher-defined way to whole educations that apply problem orientation. In relation to PBL, Aalborg University (AAU) uses the latter method.

AAU was established in 1974 in rural Denmark and expanded to the capital, Copenhagen, in 2003. The university employs approximately 2,500 academics, who conduct research in their respective fields and teach more than 20,000 students. AAU consists of the following faculties: the humanities, social sciences, engineering and science, medicine, information technology (IT) and design. As most universities AAU collaborates with external organisations, both private and public. However, as AAU applies the pedagogical approach of problem and project-based learning, known as the "Aalborg PBL Model" (Barge 2010), the collaboration is not only between researchers and the external organisations, but also between the organisations and the students during semester projects. The learning management system used at AAU, is Moodle.

The Aalborg PB Model requires student learning to be based in real-life situations, often within external organisations. This concept is similar to what Sipes (2017) referred to as authentic problems. Students perceive the problem through the lens of their curriculum when they formulate a question (i.e. the problem definition) that addresses the real-life situation. They approach the question through relevant theories, and they select relevant methods to gather empirical data. Their analysis and conclusions should answer the initial question / problem definition by providing solutions, which are often presented to the external organisation.

PBL requires that students have or gain insights into subject matter theories and methods through the PBL process (Jonassen & Hung 2015). Semesters at AAU, are predominantly divided into traditional modules that focus on subject matter and a semester-project module that work across modules. PBL activities may take place in both modules. For example, during a module on software development, students may be given a set of predefined and relatively small programme dilemmas to solve through a few lines of code, whereas in the semester-project, they may have to contact a company, define an area of potential development and develop as well as theoretically address the chosen solution in the project report. During the traditional modules, the ordinary full time students typically attend lectures and classes about +20 hours per week, and during the semester-project, they take responsibility for their learning by working on their problem in groups, with no or few lectures, but through supervision meetings, and sometimes plenary Q&A and peer-feedback sessions.

2. Project scope, research question and research design

The project "Learner-Centred Moodle Course Design: Design Factors, Differences in Perceptions and Best Practices" was a PBL development project run by AAU. In this paper, it is referred to as the Moodle Course Design (MCD) project. AAU funded the project from January 1, 2018, to December 31, 2018, and in the first months of 2019, the first version of an online resource was finalised.

The objective of the project was to create "multimedia resources demonstrating Moodle courses and activities as the best cases nominated by the students across study programs" (from the project application). The intention of the project was to create materials that would facilitate the professional development of AAU teachers, for example during the university pedagogy course for assistant professors at AAU. In relation to this, the following research questions are presented and explored in this paper: What characterises the current use of Moodle at AAU? How can teachers use Moodle to support PBL activities?

The research design for the MCD project comprised of the following elements: First, a systematic literature review (Hart 2018) was conducted that identified the challenges, potential benefits and useful pointers for using Moodle in PBL teaching. Second, four in-depth interviews (Brinkmann & Tanggaard 2010; Kvale 1997) with AAU-teachers were held, where the project members investigated, in collaboration with the teachers, their design and use strategies for Moodle. Third, a survey (SurveyXact) was conducted, where students nominated their best Moodle course and their motivation for their choice - 345 students participated. And fourth, an analysis (Brandi & Sprogøe 2019) of the nominated Moodle courses and students answers was done in order to investigate how the courses were designed in Moodle, why the students liked them and if the students had any negative aspects of the courses. In addition, the project members wanted to include experiences and materials from other sources rather than exclusively relying on knowledge from journal and similar academic research-publications. The team therefore searched for online and existing practical materials at AAU and on the internet that could support AAU teachers when using Moodle for PBL activities. As well as visited another university, where a recorded interview was carried out and edited, to inspire towards strategies for implementing and supporting faculty members in their use of Moodle. The university chosen for this purpose was Delft University of Technology (TU Delft).

Generally, these investigations provided information about the use of Moodle in relation to PBL teaching and, on a more specific level, about the implementation strategies of AAU teachers and coordinators and about how these strategies was perceived by AAU students.

3. Literature review

Two types of searches were performed: A library database search using ProQuest, and a Google Scholar search using Harzing's Publish or Perish software. To ensure that the review would be useful for AAU teachers, the included papers had to contain up-to-date research that investigated the most recent versions of Moodle. The systematic searches were therefore restricted to six years (2013-2018incl). This was also done with the intention of keeping the review at a manageable size, given the MCD project size and timeframe. As a result, the searches went through a number of iterations and were narrowed down to papers that included in their title and subtitles "Moodle" and "problem-based learning" (plus variations of these wordings). The results provided only a few research papers that had concrete examples of the relationship between Moodle and PBL: Several papers investigated Moodle as a technologically enhanced educational tool, but almost none specifically investigated PBL use in Moodle. Similarly, numerous papers existed on PBL and university teaching, but little on the practical level of design and implementation of PBL in Moodle. The findings of the literature review are divided into three categories: the challenges, the potential benefits, and useful pointers for utilising Moodle for PBL.

3.1 The challenges of utilising Moodle for PBL

Mbuva (2015) points to the following challenges associated with online teaching – namely, hidden costs, lack of computer literacy; lack of self-discipline; unsuitability for every style of learning; minimal social interaction;

difficulties in staying motivated; difficulties in improving oral communication; technical problems; and lack of adequate training for faculty members. In general, there is a need for faculty members to receive more training, but also onsite support and reliable internet connections are important for both students and teachers (Mbuva 2015).

When students begin to use Moodle, they are not pleased with the experience at first. However, this changes as they become more familiar with the functions and structures of Moodle. Research shows that the more experienced students are with using the internet, the faster they can familiarize themselves with Moodle (Mbuva 2015; Orfanou, Tselios & Katsanos 2015).

Most learning management systems, including Moodle, are designed with traditional lecture-based instruction in mind, even if they do support dialogue. Thus, they are not intrinsically conducive to a PBL approach (Ali, Dous & Samaka 2015). When teaching is exclusively online (i.e. not blended), non-verbal and informal communication are often missing (Stockleben et al. 2017), and with no physical presence in a classroom, students find it challenging to collaborate online and ask teachers for help, guidance and supervision (O'Sullivan & Krewer 2015). So, when online communication occurs as a one-way communication system (i.e. from the teacher to the students), it becomes difficult for students to receive meaningful feedback from teachers and fellow students (Yu & Lee 2016). Combining synchronized and asynchronous teaching can be difficult, but several studies show that synchronized teaching is important, as it reduces the rate of dropouts and has a positive impact on exam results (Moreillon 2015).

In relation to project and problem-solving activities online, it appears that teachers find it difficult to define, design and structure the specification of such activities. As a result, students can find it difficult to understand the goal or purpose of the project and/or activities. If they have difficulty in understanding the project, case and/or task, it can also be difficult for teachers to engage the students in the associated online activities, which again leads to difficulties for the teacher in terms of following the students' progression and offering relevant feedback (Agüera et al. 2015; O'Sullivan & Krewer 2015). Moodle is open source and allows for the inclusion and development of plug-ins. However, creating a full PBL environment that is contained in one plug-in for Moodle is also made difficult by the variations in the PBL models used by educators (Ali et al. 2015).

3.2 The potential benefits of utilising Moodle for PBL

When creating and using modules based on metacognitive, conceptual, strategic and procedural scaffolding, Moodle can be designed to support students in a PBL environment and enable activities that promote the development of certain skills pertaining to problem-solving (Tiantong & Teemuangsai 2013). Brabazon et al. (2012) have developed a plug-in that supports PBL by providing personalized and context-specific learning episodes. Based on searches using Semantic and Social Web, and learning composition technology, students can supposedly get the knowledge they need to solve the problem they are faced with. Others find, that essential tools for PBL environments, such as collaborative and communicative tools, are already available in the core Moodle system. These tools have been found to be the best for building learning environments that benefit from the hundreds of freely available plug-ins created by the Moodle community (Ali et al. 2015).

Online activities can support students in their reflections and provide teachers with insight into their students' progression. This requires the teacher to be present (visible and active) on Moodle (Mbuva 2015). For example, if the teacher, through Moodle, becomes aware of students or groups who are lacking knowledge about a subject, they can then add additional material for the specific student or group to address the situation (Orfanou et al. 2015). When study activities are independent of time and space, students can access the resources and participate in learning activities at their leisure. This also enables the teacher to make themselves or materials available at times outside of traditional teaching hours. When students have easy access to teaching materials and use said materials on a frequent basis, it appears that their grades improve (Cardozo de Castro Junior et al. 2017). Feedback can be in faster loops in Moodle, and long email correspondence can be replaced with discussion forums (Mbuva 2015). According to Yu and Lee, "Research shows that online peer feedback provides a less threatening environment that encourages greater and more equal member participation than face-to-face peer feedback" (2016 p.469). Students then perceive online feedback as being less stressful due to the lack of non-verbal communication, because they can read the feedback multiple times and have more time to reflect on the feedback given. The results of the majority of these studies show that Moodle can offer considerable support to students in terms of their learning (Cardozo de Castro Junior et al. 2017), when PBL pedagogies are applied and when the teacher acts as a facilitator of a learning space by applying a democratic learning approach (Stockleben et al. 2017).

3.3 Useful pointers for utilising Moodle for PBL

Moodle supports various types of tools, and it is relatively straightforward to link to other external tools from within Moodle. Teachers should explore the possibilities in Moodle that best support their teaching (e.g. quizzes for training-specific terminologies, wikis and blogs where students can share additional literature, YouTube videos) (Moreillon 2015). Teachers could also experiment with Moodle together with their students so that said students can become inspired to try it themselves without fear of failing (Moreillon 2015). Depending on the nature of the course and project work, it is recommended that teachers give students an opportunity to be co-designers of the Moodle space. This may increase their motivation and use of the materials and tools applied (Stockleben et al. 2017). Teachers need to design the Moodle rooms in a way that allows them to track the students' progression in various projects and give feedback. It may also be an advantage if students can provide each other with feedback and learn from each other's writings (O'Sullivan & Krewer, 2015).

According to Ali et al, there are advantages associated with using the existing features and developing PBL plug-ins. First, the PBL approach benefits from Moodle's existing infrastructure, tools and features. Second, development efforts and resources are minimised. Third, the development process can benefit from the internal IT support that Moodle offers. Fourth, the approach can potentially be disseminated to other institutions (Ali et al. 2015).

Students should have access to Moodle before, during and after the teaching period. There may be some materials, such as slides or weekly assignments, that are uploaded as the course progresses. However, the teaching goals, project information, course structure, dates and deadlines need to be communicated clearly, preferably from the beginning of the course (O'Sullivan & Krewer 2015). When activities take place online, it is important that there is a facilitator present to support and move activities in the desired direction (Stockleben et al. 2017), for example, being active in the students' discussion forums, which also provides the teacher with insights into the students' progression. When students get to choose tools to solve PBL exercises, write PBL reports, etc., this may motivate them to take responsibility for their own learning process. Teachers also need to foster open dialogue, where students feel welcome to give and receive feedback, build on each other's statements and come up with wild ideas (Stockleben et al. 2017). In this vein, the teacher should be equally explorative in their approach. For instance, instead of presenting in class, the students can prior to the session prepare video presentations, and the fellow students can watch the videos multiple times, which can lead to feedback that has been better formulated and reflected upon (Moreillon 2015).

In summary, the literature review shows that there are a number of factors that teachers could consider when designing and carrying out their teaching process. However, the review also found that some actions may lead to varied results, depending on the context in which they are placed. For example, inviting to participate in a dialog as a teacher may not in itself foster a dialog. In some situations, where the objective is unclear or where the predominant culture of the course is comprised of one-way communication, students can be reluctant to engage in a dialog. In other situations, if the teacher's pedagogical style in their face-to-face teaching and Moodle activities seeks student involvement, then students may respond in a more active way to such an invitation. All in all, the pedagogical choices and strategies needs to be clear and explained.

4. Results of the empirical study at AAU

4.1 Findings from the teachers

The first phase of the MCD project was an empirical investigation, with the objective to find out more about existing teaching practices at AAU, and the teachers motivations for their design of specific Moodle modules at AAU, and their experiences during and after the module took place. The intention was to hear from teachers, who were employed at AAU recently, thus, teachers from different faculties who were in the midst of or had just finished their pedagogical work as assistant professors were interviewed. In total, four in-depth interviews were conducted, including talks about and post-analysis of these teacher's Moodle rooms. The interviews showed: First, the interviewed teachers lacked information about Moodle in terms of its features and what is possible in the specific AAU version (each organisation decides, which elements are installed into their Moodle version). They also lacked knowledge or inspiration about how to work with these features pedagogically and within PBL thinking. Second, the teachers felt quite alone in terms of designing their own Moodle room, and in co-teaching situations, the previous year's module structure was often re-used. Third, the teachers were not always aware of the benefits of using Moodle for more than information dissemination, as they meet up with their students on campus on a regular basis.

Though these findings are not generalisable to every staff member at AAU, the interviewed teachers noted that the issues they have with Moodle are similar to those of their fellow colleagues and similar to what the MCD project members had heard as teachers and supervisors for assistant professors throughout the years.

4.2 Findings from the students

The second phase of the project was comprised of obtaining a more detailed understanding of Moodle use and students experiences. In order to do this, the project members, in collaboration with the IT department at AAU, arranged a nomination campaign. The campaign was run as a SurveyXact questionnaire, which had a banner on the AAU Moodle page in June 2018. By clicking and filling out this questionnaire, students could nominate their favourite Moodle course and present an argument as to why this course was the best. These written arguments provided insights into the students' priorities in relation to the use of courses on Moodle. In total, 345 students completed the questionnaire, and 178 Moodle courses were nominated. The nominated courses were exceptionally varied in their subject matter, faculty, length, class and ECTS size. Although the nominations provided a large amount of data, the nominations may not be statistically representative of the 20,000 students at AAU. However, they do provide in-depth understandings of the elements of AAU Moodle courses that students like and find meaningful.

The students written arguments were analysed, and in this paper, as a way of dissemination, these arguments were inserted into a word cloud generator called Wordle. The generator created word clouds that are presented in Figures 2a and 2b, based on the top 150 words from these arguments (excluding the vast majority of common words, which had been removed manually). Figure 2a illustrates the results of all the arguments for the total 178 nominated modules, and Figure 2b presents the arguments listed in the eight courses that received the most nominations. In the figures, the size of the word reflects the frequency with which it was used (the bigger the word, the more it was used) to describe why the given Moodle course was their favourite. The most-used words are "quiz," "clear," "easy," "use," "used," "find," "teacher" and "teaching". The words "clear," "find" and "easy" highlight how students need easy access to learning resources and a logically structured Moodle course room. The word "teacher" is also common, while the words "use" and "used" highlight the importance of student activitivating features, such as quizzes. Quiz is a method and a plugin in Moodle, and the analysis showed that when a more active online pedagogy had been used, it was this function that was used frequently at AAU.

2. a

2. b

Figure 2: The most commonly occurring words in the students' nominations (from Wordle)

"Good" and "Moodle" are the predominant words in both figures. From a scientific perspective, this shows that the majority of students understood the objective of the survey – namely, to nominate good Moodle courses. However, when looking into the specifics, it is seen that some students are also critical. One student wrote: *"This way of collecting information is biased. You only want positive feedback. Moodle works very badly. There is not one single module where Moodle is used well."* Another student stated: "*None of them [teachers] have used it much, and none of them have done it well. Therefore, no module can be nominated.*" In the preliminary analysis of Moodle courses, it became obvious that there were courses where there were almost no activity, or where there were activities, which were not explicitly presented (with purpose or introduction), nor did they appear pedagogically designed. Rather than investigating time into those modules that did not work, the team was interested in further identifying and analysing the courses that worked well.

Other students had quite positive experiences of Moodle. One claimed that "*I have used Moodle during all of my semesters, and in my opinion, the teachers use Moodle diligently and effectively for the benefit of my learning experience.*" Another wrote, "*Most courses used it well. Can't really pick ONE since most people structured the courses in lectures (some with dates) and gave the course materials under each lecture*". The analysis also showed that some students did not recommend a single course but highlighted a specific teacher or group of teachers. In this regard, the students commented on said teachers' excellent pedagogical skills in general and not really on the Moodle use.

4.3 Findings from the nominated courses

At AAU, Moodle rooms are used for courses that contain small-scale PBL activities and exercises and for large-scale semester projects. Some of the Moodle rooms, related to the traditional modules contain PDFs, PowerPoints and links to digital tools and exercises that support the subject matter of the course through teacher-defined problems and exercises. However, these activities do not seem to be present on Moodle in relation to the large-scale semester projects, and knowledge-sharing between students and teachers primarily takes place on campus or perhaps through other platforms, as facebook, without links to this in Moodle.

When the students nominated a course, they often in fact nominate their teacher(s). The analysis evidenced that nominated Moodle rooms did not necessarily display an advanced use of Moodle or its use in relation to student-oriented PBL activities. The students were generally motivated by teachers who communicated clearly, structured the course plan in relation to its learning objectives and organised materials and formulated assignments and other activities according to this plan. The students also appreciated the use of a wide range of Moodle activities, such as discussion forums, quizzes and interactive videos. Only a very few of the Moodle room applied external links to other activities, as further interactive materials, collaborative resources as google documents or similar external activities.

The analysis shows, that in general, the AAU courses do not make use of activities that can activate and inspire students activities, and almost none used collaborative or peer-to-peer activities. The vast majority of the Moodle rooms are used to give students an overview of the course and predominantly work as one-way communication channels. Most rooms also have a forum where teachers can broadcast messages to all students enrolled in the course. However, only a few rooms have communication "loops", where students can interact with the teacher and other students, ask questions and receive responses and evaluations. Barely any rooms have collaborative communication patterns in place to allow students answer other students' questions and comments and partake in dialogue.

5. What was developed

Communicating the findings and results of this study to AAU teachers and programme coordinators was a central goal of the project. Consequently, an online resource was developed by the project team in Moodle, as a Moodle room called: ""How to do PBL in Moodle ". This online resource address some of the issues and needs encountered during the research process. Figure 3 presents a poster that illustrates the project and resulting Moodle resources generated. The Moodle room was designed with the intent to work as a place for inspiration for teachers in designing their courses on Moodle and in other pedagogical activities, as AAU pedagogical courses or one-to-one sessions between teachers and IT-pedagogical consultants. The design is based on a micro-pedagogical perspective that focuses on how Moodle and its functions can be used in relation to the findings of the literature review (Section 3) and the analysis of the empirical data (Section 4).

With permission from the nominated teachers, the Moodle room contains direct links to the eight Moodle courses that received the most nominations, thus enabling other AAU teachers and coordinators to view and draw inspiration from these real cases. The project members also looked for materials and developed some videos and texts, which illustrates how to utilise specific Moodle functions and tools for student-oriented activities and PBL activities (e.g. blended learning formats and digitally supported campus teaching), as these elements were not prevalent in the nominated modules. Some of the materials in the room link to existing internal and external AAU sources, while other materials draw on the experiences of the project members' own use of PBL-supporting activities in Moodle. The Moodle room also includes results and findings from the investigations and videos from the project members' visit to TU Delft.

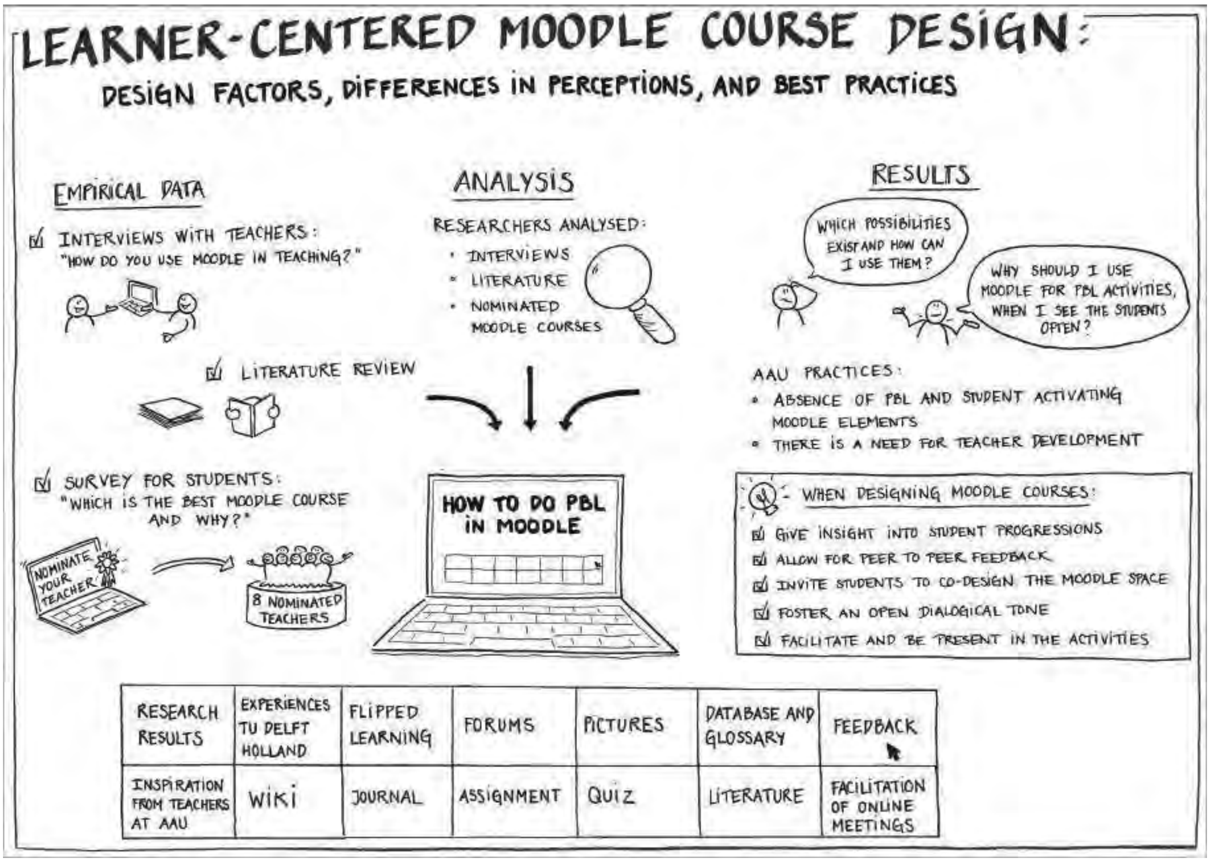

Figure 3: The MCD project, process and products [source: created through a graphic facilitation process by Heidi Hautopp and the team]

6. Discussion

The analysis of the MCD empirical material shows that many AAU Moodle rooms do not use student-based or PBL-inclusive activities. Instead, the rooms are mere content holders. This is perhaps a consequence of what Ali et al. (2015) discuss – namely, that Moodle was designed with traditional teaching in mind, and that this traditional teaching does not necessarily adapt well to PBL approaches. It also may be due to that Moodle is in particular used at the traditional module level. Students at AAU, during their large-scale semester projects, are supposed to utilise knowledge from smaller traditional modules. However, it is not possible to easily locate knowledge across different Moodle modules and semesters. This poses a challenge for both teachers and students and is similar to what Ryberg, Buus and Georgsen (2011) refer to as content silos, which promote teacher-centred pedagogies, not collaborative learning and project-based pedagogies.

Thus, there are opportunities and challenges present in the application of PBL activities to Moodle. If teachers feel competent using Moodle tools and can foresee a meaningful strategy for said tools within their teaching, then Moodle can work as a supporter of their overall learning approach, as highlighted by Cardozo de Castro Junior et al. (2017), and as a place that provides a meaningful space for students' PBL activities. The "How to do PBL in Moodle" room is small first-version initiative towards a strategy to ensure the professional development of university teachers (Mbuva 2015) and facilitate AAU teachers in designing PBL activities in Moodle.

However, the empirical data raise the question of how Moodle can be used for PBL activities when many educational programmes at AAU are full-time day-studies. It does not seem to be a natural choice for teachers to employ technologically enhanced learning via Moodle for their PBL activities when they teach and meet with students in real life. At AAU, students visit the campus almost every day during the semester. Teachers may find that the physical presence of students makes them reluctant to utilise Moodle to a greater extent. Also, a large proportion of the teaching at AAU takes the form of supervisory teachings due to the PBL model. Though some use Skype or similar tools, supervision primarily takes place on campus.

Thus, it would be fruitful for the AAU study boards, programs, and semester coordinators, to discuss the identified challenges and opportunities presented in here, in order to investigate how the future use of Moodle from a PBL perspective can be utilised in their specific programme. Such developments should rely on knowledge of the subject matter and a close theory–practice relationship as well as knowledge of IT-based learning pedagogies and learning design processes, to scaffold the students' progress (Tiantong & Teemuangsai 2013).

During the MCD project, a number of local AAU-developed guidelines and experiences was found on use of Moodle – both technical materials (for example at the IT support website) and pedagogical materials (in particular from previous AAU PBL development projects). It appeared that relatively few staff members knew about these materials and they appear unused. From our research conducted with other universities and educational institutions, national and internationally, we found that this example is not the exception, but rather the norm. It seems that while these materials are sometimes known to management, teachers are not aware of them. This raises a need to discuss and decide upon a strategy for how to assemble, communicate and make the most of such initiatives

7. Conclusion

Based on the research questions: What characterises the current use of Moodle at AAU? How can teachers use Moodle to support PBL activities? An important finding from the project is that regardless of which Moodle course design or activities teachers choose, said choice must be rooted in pedagogical reflection, as highlighted by Tiantong and Teemuangsai (2013), and the content and activities used in Moodle must be clearly communicated. That is, not only to have clear objectives and expectations of students work, but also to show these to the students in Moodle as suggested in O'Sullivan & Krewer (2015).

The paper presents insights into teachers' and students' experiences using Moodle, especially in relation to PBL-activities at universities. The discussion also raises questions of concern, as to how the organisation can support faculty members in using Moodle for PBL activities (Tiantong & Teemuangsai (2013), Brabazon et. al. (2012)) and for AAU in particular in relation to the traditional modules, the semester-projects, and across modules and semesters. Similarly, there is a need to discuss, if the university wants to address those teachers, who do not see the need Moodle, as they meet with their students so often on campus, that they can better support PBL activities there. Finally, the paper provide other higher-educational institutions with knowledge on, what is on stake and which issues to raise in faculty discussions, competence-development initiatives and design strategies.

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Meeting Online to Reduce Carbon Emissions and to Emphasise Values in Life and at Work

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Abstract: In today's media, we often read about how much energy digital services consume, with streaming services, such as Netflix, and social media hosting, such as Facebook, in the spotlight. Though these are certainly serious issues that we as a society must address, there are also opportunities for using digital and online technologies to help organisations respond to the sustainability imperative by reducing their carbon footprints. For example, as researchers working with online leadership, collaboration and learning, we often hear organisations address the need for meeting online from a cost-effective perspective, such as reducing travelling costs, reducing time spent on meetings and reducing the necessary preparation time. Though we do not generally disagree with this practice, we find that a similar perspective regarding environmental issues could prove beneficial, shifting the focus from a time and cost-effective ideal to a new value-driven perspective on life and work. Thus, the questions become how can we use digital services, such as online video conferencing, to yield meaningful results for the organisation and the environment and how can we create organisational incentives to identify and apply these online alternatives to benefit the organisation and society at large. This may also provide a new set of dynamics for motivating employees, students and others to partake in such digitalisation strategies if they are associated with concern for the environment. In this paper, we address in more detail the arguments for a sustainability perspective to online leadership, collaboration and learning rooted in the literature and the daily news, and we discuss cases from our own settings to provide suggestions for working with the positively charged concept of Environmental Conversion Value; however, this remains a complex arena with multiple considerations and concerns.

Keywords: video conference, carbon emissions, online activities, environment, sustainability

1. Introduction

According to the United Nations (2019), 'Climate Change is the defining issue of our time and we are at a defining moment'. The main cause of climate change and global warming is greenhouse gas (GHG) emissions: 'Over the past 10 years, the energy sector has remained the largest contributor to emissions over any other sector, representing 72 percent of global emissions in 2013' (Friedrich, Ge and Pickens, 2017). According to the United States Environmental Protection Agency transportation, including business trips, caused 29% of GHG emissions in 2017, and electricity caused 28% (EPA 2019). Large corporations' worldwide have committed to reduce GHG emissions, with incentives, such as the recent Climate Action 100+, promoting community and individual commitment to reduce emissions (Climate Action, 2019). However, the drive towards globalisation in the private and public sectors, as well as in domestic leisure time, has created a significant rise in travel, including air travel (see Figure 1). Travelling for collaboration, learning and governance can be essential, yet the brief note on the CO^2 cost at the bottom of the flight ticket is proof of the negative environmental imprint, which counteracts the espoused environmental concerns.

A large number of studies and papers in the general media landscape work on when, where and how a technologically supported initiative, such as videoconferencing, may work as a substitute and, thus, a greener solution (e.g. Julsrud, Hjorthol and Denstadli, 2012; Lindeblad et al., 2016; Ong, Moors and Sivaraman, 2014; Poom, Orru and Ahas, 2017). However, as previously mentioned, energy consumption is another significant factor for GHG emissions; thus, technological energy consumption and other factors related to video conferencing must be considered. In a paper comparing the energy, carbon and time costs of videoconferencing and in-person meetings, Ong, Moors and Sivaraman (2014) provided an impressive all-inclusive calculation, showing that not only is the energy consumption when using videoconferencing software and technologies high, but that the devices production and life-span issues (including the devices used by the meeting participants—computers, mobile phones, screens and LAN/Wi-Fi services, as well as the servers hosting the meeting, the software, etc.) all contribute significantly to this calculus. However, Ong, Moors and Sivaraman (2014) only considered the marginal costs, as devices are used for many other things in a lifespan. In their estimation of how videoconferencing compared to travel, they not only considered air travel but also train and car travel, and the estimate was based on various distances (Ong, Moors and Sivaraman, 2014). Ong, Moors and Sivaraman (2014) concluded that video conferencing consumes approximately 7% of the energy/carbon of an in-person meeting, taking into account the variations in distance travelled, meeting duration and technologies used. However, they also argued that video communication potentially has a lower efficacy, as it could take longer to achieve the same outcome in a video conference as compared to an in-person meeting, and they referred to other studies that found many perceive video conferences as being less effective, as groups working at a distance experience weaker social ties and less co-presence between participants (Ong, Moors and Sivaraman, 2014, p. 90).

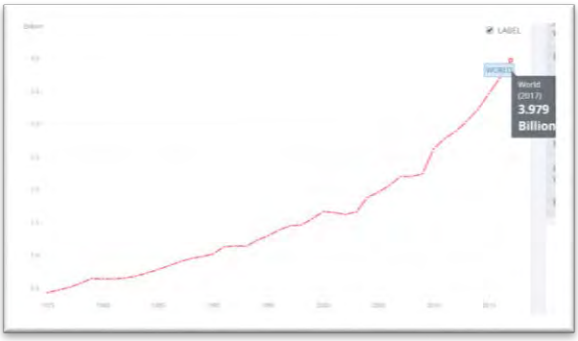

Figure 1: Number of air travel passengers (domestic and international) 1975–2017 (source: https://data.worldbank.org/indicator/IS.AIR.PSGR?end=2017&start=1975&view=chart)

Other research studies have investigated broader perspectives concerning environmentally sustainable solutions. In addition to reducing GHG, these studies have also explored videoconferencing for supporting such issues as increased social and personal wellbeing, equity and democracy. For example, videoconferencing provides the possibility to interact with war-torn locations, politically unstable territories or environmental catastrophes, gives people equal access to knowledgeable experts, provides people with disabilities or other challenges the possibility to work, presents people's views even if they are not physically or psychologically able to participate in person or simply provides a better quality of life and less polluted cities for those who spend extensive time commuting (e.g. Akbari and Hopkins, 2019; Mark and Semaan, 2008; McWhorter, Robers and Mancuso, 2014).

In this position paper, we take a point of departure from the perspective, which is also shown in the above studies, that videoconferencing is a carbon-effective choice. We are certainly not on a mission to bring 'flight shame' to new levels. There can be good and profound reasons for traveling. Rather, we want to elaborate on, and if not disprove then at least nuance, the claim that videoconferencing is less effective than face-to-face meetings and activities. We also discuss some of the obstacles on an organisational/management and personal level. Just as there are many factors that interplay with the energy consumption of video conferences, there are many factors that influence how this meeting form impacts the organisational and the personal levels when it comes to online leadership, collaboration and learning. Consequently, we methodologically applied both a discussion of the existing literature and explore the identified factors via examples from our own research practice. In our qualitative literature review process, we found it difficult to determine appropriate search strings/keywords. Researchers apply various terms in these discussions, such as climate, carbon footprint and carbon emission, green technology, sustainability, etc. We found that within our research scope of online work and meetings and videoconferencing, carbon emission is a common term; however, we used word combinations in our searches. We searched systematically using ProQuest and Google Scholar, and from these results we selected relevant papers, primarily using a forward snowballing process and focusing on relatively new literature (10–12 years). Our analyses of the papers were listed in logs containing the papers' relevant information. To further ground the findings in relation to how online meetings can support qualitative values in life and at work, we turned to findings from one of our own researches that relates to the field of collaboration and pedagogical perspectives around videoconferencing at Aalborg University, which mainly studied larger campus-to-campus teaching but also included smaller-scale supervision and meetings. The investigation took place over a couple of years and was completed in 2017 (Ørngreen and Henningsen, 2017). Researchers/teachers, students and study board members were interviewed, some through workshops/focus groups; teachings and meetings were observed, and two surveys, one among staff and students (with 1843 respondents in the winter of 2015/16) and one among students (with 345 answers from the spring of 2017), were conducted. We ended this paper with a suggestion to investigate online meetings in a more positively charged argumentation form through the introduction of what we call the Environmental Conversion Value.

2. Videoconferencing for leadership, collaboration and learning

There is a substantial body of literature on videoconferencing in the public sector, such as from the higher educational arena, as research work and teaching via video, or from the health sector's use of videoconferencing in a learning and communication perspective, as in telemedicine, online patient support and online knowledge sharing networks. The previously mentioned Ong, Moors and Sivaraman (2014) study detailed abstract calculations and lacked some of the concreteness of actual practices in the specific domains, in this case eLearning, eCollaboration and eLeadership. A survey at the South West Wales Cancer Network showed that videoconferencing saved substantially on carbon and travel costs (Lewis, Tranter and Axford, 2009). In 2006, 60 people attended 21 meetings, saved 18,000 km of car travel and £4400 in travelling expenses, equivalent to 1696 kg of CO2 emissions (Lewis, Tranter and Axford, 2009). In 2007, these numbers increased to 90 people, 30 meetings, saving 20,800 km in car travel, £5100 in travelling expenses and 2590 kg of CO2 emissions (Lewis, Tranter and Axford, 2009). From the paper, it is impossible to determine if the increased use was due to a governmental or management decision or to the people who used it finding it effective; however, given the technological development at the time, the fact they made videoconferencing work and spread seems to indicate there was an organisational learning process occurring.

In this domain, travels have often been discussed from a cost-effective perspective. As this paper's introduction established, videoconferencing produces fewer carbon emissions; however, there is some reluctance to claim videoconferences themselves effective, then cost-effective studies are also relevant to consider, if the concept of effectiveness, includes investigating the quality of, how well the video conference performs, as opposed to only how much money is saved. In a new study, Buvik et al. (2019) investigated cost-effectiveness in remote orthopaedic consultations in northern Norway through randomised controlled trials and found that the video-assisted consultations taking place between a remote clinic in northern Norway and a hospital 148 km away were cost-effective from both a societal and a health sector perspective. Furthermore, when they examined other studies in the same area, they found the works 'reported a reduction in the number of referrals to the specialist because of a learning effect' (Buvik et al., 2019, p. 11).

Another way of considering impact is by evaluating if the current travel practice adds value. For example, a study of air travel practises at the University of British Columbia used publicly available information about the length and number of travels made versus academic positions held, salaries, gender and publication h-index (Wynes et al., 2019). The authors found that travels were unrelated to academic productivity (h-index) and that academics with more seniority and higher salaries took more flights (Wynes et al., 2019). Though there are of course variations in the study and interpretations to discuss, the results are interesting in relation to today's public media debate: the researchers' noted there was a self-perception, then in order to do one's work well, there is a need to travel, to sustain high research productivity, to maintain and create research collaborations, to perform field work and to physically participate in networking/conferences. While perhaps a small percentage of travels supports this notion, many travels do not, and this could be relevant to investigate, though also difficult due to the numerous influential factors. It is also noteworthy that Lindeblad et al (2016) in their review on organisational effects of videoconferencing (or what they call virtual meetings), they showed that video conference meetings may in fact also have the opposite effect, namely that online meetings may enable people over larger distances to work together and, thus, increase the number of collaborations, but then also sparking the need to have in-person meetings as well.

In public and highly regulated institutions, such as learning institutions and universities, policies often govern actions. In an investigation at the policy level of Australian universities, Glover, Strengers and Lewis (2018) found that the university's environmental sustainability goals often relate to green solutions, including green technologies, with the strategic areas of recycling and reducing water and electricity consumption on campus. Such initiatives were part of almost all the Australian universities' policies. However, in relation to travel, they identified three groups. The first group was 'Air Travel Ignorers', who have no sustainability policy nor recognised air travel as a source of greenhouse gas emissions (this was the case in 23 out of the 43 Australian universities [53%]; Glover, Strengers and Lewis, 2018). The second group was 'Recognition without Intervention', who mentioned carbon footprint in relation to air travel but offered no actions for how to reduce it (seven universities were in this category; Glover, Strengers and Lewis, 2018). The third group, known as 'Air Travel Substituters', had a strategy for how to substitute (Glover, Strengers and Lewis, 2018).

Lindeblad et al. (2016) conducted an empirical work that concentrated on interviews and a survey with people from Swedish public agencies at the national level, which have many similarities to knowledge organisations in the private sector. The analysis confirmed previous works that showed virtual meetings change the organisational structure in positive ways: they can increase the frequency of communication, change work processes, provide flexibility, better use skills and expertise and involve co-workers and external resources at multiple locations (Lindeblad et al., 2016). However, the interviews revealed that virtual meetings can be a challenge for managers and people in leadership positions, as it is difficult to oversee and follow up on work and to handle conflicts, personnel and personal matters (Lindeblad et al., 2016). The survey asked 493 respondents if the use of online meetings influenced their productivity at work, and 78% agreed fully or to some extent that this is the case; however, the interviews also showed some found it less efficient, as there is a risk of misunderstandings, unfairness, cultural considerations and technical hassle (Lindeblad et al., 2016).

Regarding leadership, it has been established that leaders have an essential role in promoting the transition to online mediated working habits, and they influence the way other organisational members perceive technology (Avolio et al., 2014; Lindeblad et al, 2016; Van Heck, 2012). Technology has also influenced leadership. Social, mobile and networking technologies have created distributed and two-way leadership styles, enabling members of a virtual group to display transformative leadership qualities when performing collaboratively towards a common objective (Avolio et al., 2014). On a similar note, Lindeblad et al. (2016), with reference to the work of Wallström, noted that technologies also change individuals' perceptions about meetings, from meetings as isolated events in time and space to meetings that are a continuous, asynchronous sharing of work.

However, not every organisation works this way. In addressing the imperative to take action regarding today's environmental demands by making global operations more green, Colfax et al. (2009) stressed the need to adopt and expand online leadership and communication and to use virtual teams, thus transitioning to a new virtual organisational management paradigm. This requires a sustained effort to train managers on e-leadership skills, including the means to build trust and to promote effective communication and mutual commitment among team members. In terms of leadership styles in an online environment, Hambleya, O'Neil and Kline (2006) studied elements of transactional and transformational leadership online and concluded there were no significant differences from leading face-to-face, as long as managers employed effective communication media to ensure team cohesion and collaboration. Dasgupta (2011) referred to a study by Purvanovaa and Bono that stated transformational leadership is more effective, with virtual teams leading to high performativity. This might indicate that, in the absence of physical interaction, leadership and collaboration can potentially focus on the task itself rather than interpersonal dynamics, which may play a bigger role in face-to-face collaboration. However, some of the participants interviewed in the Lindeblad et al. (2016) study mentioned it was difficult to 'read' interpersonal relations and dynamics when leading a group in online settings, which again illustrates the necessity for having competences to navigate videoconferencing settings.

Some of the central conditions for making online leadership work require promoting effective communication, building trust to and among organisational members, creating presence and enthusiasm, mentoring and monitoring employee performance, ensuring a lack of technological competence does not affect performance and helping members maintain work-life balance in a ubiquitously connected paradigm (DasGupta, 2011).

3. Samples of experiences from our own research practices

In our research project introduced earlier that focused on the pedagogical issues related to videoconferencing at Aalborg University in Denmark (Ørngreen and Henningsen, 2017), we explored the challenges and ways forward.

Our study identified that the users, in this case teachers and students, experienced effectiveness and satisfaction around smaller-scale online teaching and collaboration setups. For example, both educators and students favoured one-on-one supervision, as the students expressed that these one-on-one online dialogue strengthen their relationship with the supervisor because they feel they are explicitly 'talked to'. The teachers also expressed that one-on-one online supervision provides flexibility for shorter and more frequent meetings with students and colleagues. Furthermore, our study identified that the distributed online teaching and meeting platforms in which participants are represented via a small video of their upper body and face was pinpointed as a good for online communication. Some students stated that they would prefer this type of online meeting because they experienced equal access to the teacher, and the educators found that some students who normally do not engage in dialogues are more willingly involved.

In relation to larger-scale, campus-to-campus teaching setups, the students in our study expressed a motivation towards experiencing and training in these situations because they expected their future work life to include similar setups. The students also pointed to the potential to access experts with specific academic knowledge, as well as the flexibility to access teaching sessions when not being physically on campus.

Challenges were also pinpointed. Some students found that the teachers, when practicing in these large-scale, campus-to-campus setups, lacked pedagogical competencies, which caused the students feeling being put into a passive TV-watching mode, making them feel uninvolved and unengaged. The teachers expressed a similar lack of pedagogical competences and a lack of tools to navigate these (for them sometimes unknown) campus-to-campus online learning setups. These results indicate the need for competence development among the teachers in these online teaching settings with larger groups of students positioned in different locations.

Some teachers also expressed a resistance towards using campus-to-campus teaching setups due to a top-down agenda from management to use videoconferencing, due to technical obstacles and an experience of feeling restricted in their pedagogical space. Among some teachers, this created the narrative that teaching campus-to-campus through videoconferencing was troublesome. Various initiatives were implemented in the organisation to twist this internal narrative, such as highlighting smaller successes as possible trails for teachers and students towards new narratives and offering workshop-based courses focusing on pedagogical opportunities in campus-to-campus setups among teachers.

We want to emphasise that the concern for environmental issues could potentially motivate staff members to rethink the negative narratives around campus-to-campus videoconferencing and thereby potentially be motivated to develop their technical and pedagogical toolbox. In Denmark, concern for environmental issues and sustainability perspectives among staff and students is increasing at universities and in society in general (Minter, 2018). Particularly within the last two years (2017–2019), a growing number of educators, students and in some levels of management has advocated for environmentally sustainable strategies concerning travelling and waste sorting at Aalborg University. New committees at different organisational levels have been established to focus on green and environmental initiatives. So, there is potential for a new dynamic to motivate members of the work community to partake in digitalisation strategies once these strategies are linked and associated with environmental concern, a possible green workplace and a personal value for the employees. Similarly, Van Heck et al. (2012) found that knowledge workers' mindsets tend to be more inclined towards the value-adding aspects of work.

As could be seen from the literature (e.g. Avolio et al., 2014; Lindeblad et al, 2016) technology impacts the ways we perform leadership, collaboration and learning, thus changing the structural conditions of organisations. In our research, we have seen how everyday practice in the public and private sectors has progressed from thinking of working in person or online to hybrid cultures. Hybrid in the sense that there are varied forms of participation. Some connect by meeting a couple of persons at a local base, while others connect from a desktop in their home or via mobile devices while on the go; however, all participate in the same online meeting. Some individuals may be simultaneously working on one document, while others are sharing a drawing pad or writing their own personal notes. Some individuals may be connecting using company-dedicated software, while others connect via their own personal devices (BYOD).

However, even if there is an increased awareness on academics' travel practice for their research collaborations and for teaching at different campuses, for such cultures to change, it may be vital that management support these changes with visible initiatives, as e.g. the policy level by being an "Air Travel Substituter" (Glover, Strengers and Lewis, 2018), both in respect to choosing greener travel solutions and to choosing to support video conference modes. In our department, we manage work, lead personnel, collaborate and teach/learn online. However, many programmes at the university level do not have a specific department policy or study regulation that supports this practice, and many of the arguments behind this concern cost-effectiveness. This low adoption rate is not necessarily due to the nature of the work tasks themselves but to managerial decisions. Today, many employees would like to choose more sustainable solutions if they are supported by management and if they factor in both the carbon emission perspective as well as the organisational and personal impacts such choices can have, such as the effect on work/life quality and productivity.

4. Proposal and discussion – the environmental conversion value (ECV)

We would at this stage like to advance the argument for building an environmentally sustainable rationale by introducing the notion of a positively charged Environmental Conversion Value (ECV) when opting for an environmentally friendly online working solution, as opposed to the negative conditioning of increasing the carbon imprint and, thus, the consequences of not choosing otherwise. We claim that ECV presents certain invitational qualities when considering viable solutions to supporting electronically mediated leadership, collaboration and learning by enlarging the efficiency rationale to include a sustainability perspective into the digitalisation strategy.

Much has been said about maintaining the life-work balance, particularly for knowledge workers in high-performance work environments (e.g. Akbari and Hopkins, 2019; Barratt, Millar and Bristow, 2015). A different approach is to emphasise important life values at work in the form of motivating incentives that energise and inspire employees. The pervasiveness of climate concerns has given rise to various corporate responsibility initiatives, which send reassuring signals to the surrounding society. However, there is an increasing potential in disseminating the corporate responsibility inside organisations by cultivating a bottom-up approach to empower the workforce towards more sustainable work methods. Van Heck et al. (2012) argued this may be particularly important for knowledge workers, who tend to be more inclined towards the value-adding aspects of work, in this case supporting more climate-friendly initiatives. Reporting on the integration of various technologies to create a mobile and green high-performance workplace, the authors stressed the importance of launching an organisation-wide change incentive, which combines top-down vision in the form of direct engagement of the CEO with bottom-up engagement by respected members of the work community (Van Heck et al., 2012). It is equally necessary to invite and process the challenges encountered by the employees as they transition into a green high-performance workplace. While mobile communication technologies are crucial in diminishing travelling and commuting, they also alter the way people work. Therefore, the change processes involved refer as much to a change of mindset as to the reorganisation of work.

Ruepert et al. (2016) have proposed a value-identity-norms model, according to which values, as biospheric values, that reflect general concerns about the environment, are reflected in certain identity beliefs, in the form of an environmental self-identity. The intention is to support personal norms, to act pro-environmentally. The authors define pro-environmental behaviour as a set of behaviours that harm the environment as little as possible or even benefit it (p.6). The authors envision three areas of concern, when it comes to increasing environmentally friendly affordances in organizations, i.e. “facilitate or at least not inhibit pro-environmental behaviour” (p.7). The first is related to the lack of autonomy of employees to make such choices; and hence the need to increase employee autonomy to act according to their values and norms. The second area of concern is with the economic profitability, which is ruling principle in many organizations, and may therefore inhibit pro-environmental behaviour, if this delays or reduces profitability. Finally, the authors point at the reduced self-control of employees associated with sustained periods of cognitive overload, which may limit employee surplus in terms of considering pro-environmental alternatives to routine ways of managing workload. Arguably, making environmental gains more visible through a calculation of ECV, that have a positive connotation, each time organizational members succeed in choosing an environmentally friendly alternative, might have a motivating effect on employees, gradually expanding pro-environmental behaviors in organizations. It might, on the one hand, afford individual members more autonomy, and on the other provide a more visible argument against the economic rationale. A visible ECV might have an appeasing effect in situations of cognitive overload, but could also, on a more critical note, be perceived as ‘yet another performance-monitoring’ tool at work. So whether this is ultimately designed as a tool for discussion or something that is measured throughout the organisation at individual level, needs more research.

Greening the workplace is ultimately relying of each single employee making up their mind to contribute in any way possible to reduce the carbon footprint and the various types of waste at work and elsewhere. It has been suggested that such strategic initiatives can only be implemented in holistic ways, as they depend on the active support of the individual employees (Süßbauer and Schäfer, 2019). Sustainable behaviour in the workplace must be embedded in various social practices to promote waste prevention and to reduce the energy use and environmental strain caused by commuting and travelling. Organisations that provide specific enabling structures, ranging from identifying opportunities, providing space for experimentation and stabilisation and encouraging participation, do indeed transform organisational practice. The holistic, coherent type of organisational greening incentives show increased satisfaction among employees, particularly when combined with participatory or coaching leadership styles, which makes employees feel their ideas are more appreciated (Süßbauer & Schäfer, 2019; Van Heck, 2012).

Certainly, an approach that factors in quality of life and work perspective makes it possible for employees to choose such options, not only in long-distance meetings but also on an everyday basis, when it is a meaningful choice. However, Akbari and Hopkins (2019) emphasised that it is ultimately a management issue to provide such possibilities. The authors conducted a survey in Ho Chi Minh City with 200 employees across sectors, and 74% of commuters wanted the possibility of anywhere working practices but only 41% were permitted, and interestingly 29% did not know if they were allowed to work in this way (Akbari and Hopkins, 2019).

The notion of quality of life at work fits with the notion of extending a more sustainable lifestyle across the boundary between the private domain and work. Arguably, this pro-environmental behaviour at work contributes to raising the perception of quality at, and likely of, work. In this perspective, replacing travelling and commuting with technology-mediated work activities would add value and act as an incentive to increase the quality of working online. The discussion seeks to transcend the economic rationale for the online conversion of work activities to include employee wellbeing and social sustainability. Therefore, it is not our intention to suggest that people should never meet, nor move out of their own spheres; rather, our position is to reduce unnecessary travel when there is no immediately positive gain from travelling, perhaps creating a more positive work-life balance and quality of work.

5. Conclusions

Meetings online are associated with cost-effective ways to manage collaboration and learning across locations. Arguably, IT and various collaborative software make it possible to move beyond a mere economic incentive and to implement an intentionally sustainable strategy for an online meeting culture that is more environmentally sustainable, initiated both at the employee and management levels. Through this position paper, we aim to encourage employees and management towards pro-environmental conscious actions that include life and work factors and and consider to develop these practices into an explicit repertoire for the organisation.

Our research, presented in this paper, argues that online work and collaborations over distance (globally and locally) are potentially more effective than in-person meetings. However, in our experience, there is a need for organisations to establish 'good experiences', required competences and cultural and policy-level support systems.

This results in a set of considerations formulated as a suggestion towards working with the positively charged concept of Environmental Conversion Value (ECV); however, this remains a complex arena, with multiple considerations and concerns. ECV would be an expression of the extra value gained from reducing travelling and supporting a beneficial work-life balance. Future research will entail identifying the technological and pedagogical affordances for transforming the perception of presence and work in distributed collaborative settings and determining meaningful ways of working with ECV at the organisational and personal levels in life and at work.

We find that it is not always a straightforward equation to think in terms of digital sustainable measures; however, this is something we need to do. As researchers in digital processes, we contribute to how we understand and develop the implementation and operationalisation of online meetings, which reduce carbon emissions and emphasise the values in life and at work.

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Understanding the Urgency and Complexities of the Energy Transition Through Serious Gaming

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Abstract: To have sustainable societies, we need to accelerate the energy transition towards clean energy solutions, however, awareness and understanding of the process is still limited, especially among young people. In addition, the topic has mainly been approached from an engineering angle, ignoring the social challenges: lack of public support for solar farms and large wind turbines could stop the need to act. An optimal balance considering the point of view from all parties involved is out of sight without a focus on social structures and a dialogue among all parties. In this context, universities have a critical role to play: these institutions build capacity through the development of new knowledge, new understanding and new insights, and can therefore provide effective solutions to complex societal challenges. In search of innovative approaches to reach young people, whose communicative paradigm has become more interactive and participatory, the use of serious gaming in formal education is gaining attention among scholars and practitioners: they can foster skills and abilities, contribute to content development of complex issues by integrating insights from different disciplines, and permit learning experiences that are not possible in real life. In this paper, we introduce "We-Energy Game", which aims to create understanding on the urgency and complexities in the provision of affordable energy from renewable sources for an entire town. During the game, players negotiate, from their respective roles, which energy source they want to employ and on which location, with the goal to make a village or city energy neutral. Then, we present findings from a pre-test and post-test completed by a hundred university students in The Netherlands to analyze the effects of the game on players awareness and understanding. Results reveal positive outcomes on awareness, as well as understanding of the complexity of energy transition and the importance (and difficulty) of collaboration among stakeholders.

Keywords: serious games, education, youth, sustainability, energy transition

1. Introduction

In respond to the complex challenges introduced by the climate emergency, the European Union have set ambitious but urgent goals: to create a transition of the energy system by improving energy efficiency and increasing the share of renewable energy in ways that would be compatible with increasing competitiveness and security of supply, and reducing greenhouse gas emissions by 80–95% by 2050, when compared to 1990 levels (EU, 2018). That means that involvement from all parties is necessary to reach those goals, from local governments to private sector and citizens; their awareness and understanding of the process is needed, however, communication and education efforts is an often-neglected pillar, especially among younger generations whose support is a significant driver in the short, medium and long term. In this context, universities have a critical role to play: these institutions build capacity through the development of new knowledge and insights and can therefore provide effective solutions to complex problems. They also produce a regular supply of highly educated, skilled people who will soon develop and implement solutions to present challenges. In words of Marie Sklodowska Curie: "nothing in life is to be feared, it is only to be understood. Now is the time to understand more, so that we may fear less" (EUA, 2017).

To reach young people, traditional communicative paradigms need to be revised towards new formats that facilitate a natural interaction between the person, the interface, and the environment. In search of innovative strategies, games are gaining attention among researchers and practitioners in high education, as a tool to raise awareness and understanding on sustainability and energy transition. Games that are intended to fulfil a purpose, convey ideas and values, and sometimes, to influence the players' thoughts and actions in real life have received the name of "serious" games (Frasca, 2007). When used in formal education, these games can foster awareness, skills and abilities, contribute to content development, and allow experiential learning.

In this paper we introduce "We-Energy Game" as a case study: a serious game which aims to create awareness and understanding on the urgency and complexities in the provision of affordable energy from renewable sources for an entire town. The game has been used among international students in higher education institutions in The Netherlands. In this paper we also present findings from a pre-test and post-test to analyze the effects of the game on players.

2. Games and education

While youth shows a growing interest for video games, educators are observing a declining motivation for school (Kemp, 2006). Scholars have found out that games appear to have high intrinsic motivation assets, and this has been the basis for research conducted in the field of (video) games and education. One of the earliest works in intrinsic motivation was carried out by Malone and Lepper (1987); they studied what makes computer games interesting and exciting, establishing a taxonomy of intrinsic motivation.

In the last years, the interest in studying the potential of games beyond their motivational value for learning has produced an increasing number of papers and conferences proceedings (Turkay et al., 2014). According to Squire (2006), one of the emerging ideas is to think of games as "designed experiences in which participants learn through a grammar of doing and being". In the same line, Gee (2004) talks of games as enablers of "situated language and learning", an idea related to theories in situated cognition, which suggests that learning is tied to the authentic activity, context, and culture within which knowledge is developed.

The field of game-based learning and serious games in the education sector have also seen an increasing number of studies related to effectiveness, advancing knowledge of the challenges and possibilities of creating, evaluating, and implementing games in the education sector. Most studies have found positive changes in awareness (Van Pelt, 2015). Soekarjo and van Oostendorp (2015) have also found increased knowledge of players in five of the sixty games reviewed after playing them. However, less evidence is available on changes in attitudes and behaviours. According to a research conducted by Zhonggen (2019), one of the main reasons for the effectiveness of serious games in education may be related with the impact of these games on learners' mood: effective serious games try to create a positive mood in order to encourage players' interest in gameplay, as well as better academic performances.

However, in practice many education practitioners feel confused and lack guidance on how to evaluate quality of serious games that available for free online and on how to implement these games in class. When games are considered for instructional use, many factors must be weighed (Turkay et al., 2014). To bridge this gap, Ouariachi et al. (2019) developed an evaluation tool that presents a definition of quality and a scale of scores for each of the criteria, divided into five different categories (identification, narrative, contents, gameplay, and didactics), then the integration of the five dimensions provides quality scores that allow to determine the quality scenario of games (low quality, medium quality, and high quality). This tool can be used by teachers when deciding if certain serious games fit their needs to be implemented in class.

3. Energy-related serious games

Sustainability or energy literacy can play an important role in promoting political decisions and changes at the individual and collective levels; however, it is not easy or "attractive" to engage the public, especially young people, in these complex issues. Serious games make use of entertainment for educational purposes, facilitating the process in which players cultivate their knowledge and practice their skills in a subconscious way. Today, serious games are one of the growing areas in educational media; its market is expected to grow from 3.2 billion U.S. dollars in 2017, to 8.1 billion in 2022 (Statista, 2018).

Most of studies that map and explore serious games in the field of climate change or sustainability have found that mitigation is the main topic, understood by United Nations as efforts to reduce or prevent emission of greenhouse gases (Katsaliaki & Mustafee, 2014; Ouariachi et al., 2017). Mitigation can be understood as using new technologies and renewable energies, making older equipment more energy efficient, or changing management practices or consumer behaviour; it can be as complex as a planning a new city or as a simple as improvements to a cook stove design. Concretely, serious games on energy issues have grown and diversified exponentially over the last years but, especially, these types of games have experienced most progress in an online format.

Different web platforms are available to the public and for free that serve as a repository of these types of games, such as Games4Sustainability or Gamepedia, targeting academics, trainers, NGOs, teachers, students, and anyone interested in this topic. Examples of energy related serious games include "Enercities", a game in which the player is faced with the challenge of developing an eco-friendly city dealing with issues such as pollution, energy shortages, and renewable energy. Players place buildings on a grid to grow their city. They need to balance energy sources, cash flow, and the city's economy, wellbeing, and environment. Another example is WindMill Game, a strategy game about building wind farms to create clean energy profitably. Players fulfil a specified energy offset goal as quickly as possible by building turbines smartly, and research locations carefully for the best wind conditions, avoiding upsetting the local citizens by building turbines in undesirable places.

4. Case study: We-Energy Game

The We Energy Game (developed at EnTranCe the Center of Expertise Energy in Hanze University of Applied Sciences in Groningen, The Netherlands, under the project "From A to Sustainability") is a serious game aiming to create awareness and understanding on the urgency and the challenges in the provision of affordable energy from renewable sources for an entire town or city. The game can be played on board or on screen by a minimum of five players who take the roles of:

- Production: a project leader who needs to produce a certain amount of energy
- People: the citizens of the area where the game is played
- Planet: how green/clean is the energy production
- Profit: how much profit is made by the different projects
- Balance: how easy to work with is the energy source for the network-operator

The exact calculations and effects of the different options are based upon scientific research and the latest insights. While playing, players negotiate from their respective roles which energy source they want to employ and on which location. Once agreement is reached, they place the icon that represents that energy source on the map and they check the consequences for each of the roles (production, people, planet, profit and balance). Through playing the game, they will realize that without collaborating with the others, they will not be able to achieve their ultimate goal of creating a sustainable energy mix for their town or city. In the process, players also realize that there are many available solutions to reach an optimal balance, and that sustainability is not just a technical issue, but a social one as well. For example, even though there is great support for solar panels, the sun does not always shine, so other resources are needed; wind provides a lot of energy, but can also encounter protest by local residents; biomass could be a good solution, but its yields are less and its environmental footprint is greater.

Figure 1: One of the location representations of We-Energy Game

The image above (Figure 1) is an example of locations represented in We-Energy Game, using real data based on own research and an open street map. In the Netherlands, population ranges from 500–5000 inhabitants in a village to 10,000–50,000 inhabitants in a populated area, like a city. The game uses four levels of difficulty by making use of four different maps in The Netherlands, allowing players to experience the challenges of making different towns with different populations sizes and urban structures energy neutral: Diever (goal: 25 points), Meppel (50 points), Assen (75 points), Emmen (100 points). The goal of the gameplay is that players realize that the larger the locations are, the more challenging to achieve common goals and keep all characters satisfied. The scores are also based on realistic effects of each variable and refer to the amount of energy, emissions, and impact. The game finishes when all roles reach the total score for the selected town, maintaining a positive balance.

4.1 Implementation of the game in class

The We-Energy Game has been played by a variety of groups, such as energy cooperative members, business, municipality representatives, but also students. The game is suitable to be implemented in class for several reasons: on the one hand, it covers a variety of key competences and abilities. They can be integrated into XXI century skills—learning and innovation skills (critical thinking and problem solving), digital literacy skills, and career and life skills (adaptability, social interaction, accountability). On the other hand, the game is characterized to be interdisciplinary, which means that it can be used simultaneously for different disciplines, such as social studies or environmental studies, and to allow group work in class.

The game has been implemented with students in higher education institutions, such as Hanze University of Applied Sciences. Students were Dutch and international and they belong to different disciplines: marketing, international communication, engineering, etc. The game session is facilitated by an expert on energy transition together with a teacher from the respective class. Before starting, students are introduced to the game goals and rules, then they are split into groups of five. The length of the gameplay is about 30 minutes when playing two different maps, and therefore two different levels. As mentioned earlier, the educational objective is to raise the complexity once they are familiar with game mechanics in order to understand that the larger the locations are, the more challenging to achieve common goals and keep all roles satisfied. After playing the game, there is a debriefing session where information is shared and examined.

4.2 Analysis of the effects

4.2.1 Methodology

In search of evaluating the effects of the game on students' level of awareness and knowledge, we conducted a pilot study using a pretest-posttest design research. Participants' awareness and understanding are assessed by using a survey before playing the game and after playing the game, including as main questions (Table 1): how aware and informed do they feel about the energy transition, how much do they agree that there are many available solutions to reach an optimal sustainable energy mix for an entire town, and how much do they believe energy transition is a social, economic or technical issue. Respondents are asked to rate those statements on a four-point Likert scale ranging from respectively 'not at all' to 'a lot'. They are also asked in an open question what their main learning points are.

Table 1: Operationalization

Variable	Indicator	Measurement
Awareness	Perception on own information level	Four-point Likert scale
Knowledge	Availability of solutions	Four-point Likert scale
	Factors of energy transition	Four-point Likert scale
	New learning aspects	Open question

The researchers used Google Forms to compose and send the surveys online. We translated the students´ names into numbers to guarantee their anonymity. We also conducted a group discussion with a smaller group of students to understand their opinion about the game and to get more qualitative data about their interaction with the game. The discussion, facilitated by researchers just after playing the game, was aimed to be a collective exchange of ideas to share their opinions about the game and their main take-away. The sample of this study is composed by 100 bachelor (Dutch and international: German, Lithuanian, Czech, Azerbaijani, Bulgarian, British, Mexica, Chinese, Turkish, Ukrainian) students aged between 18 and 25 years old (67,6% female; 32,4% male), at Hanze University of Applied Sciences.

4.2.2 Findings

From the survey, results reveal an increase in awareness about the energy transition. Before playing, majority of students feel "not so much" aware and informed about energy transition, while after playing, majority of students feel "quite a lot" aware and informed about the topic. In total, before playing there are only 22,9% students feeling aware (quite a lot + a lot), and after playing there are 74,8% students. Therefore, there is an increase of 51,9% students feeling more aware after playing the game.

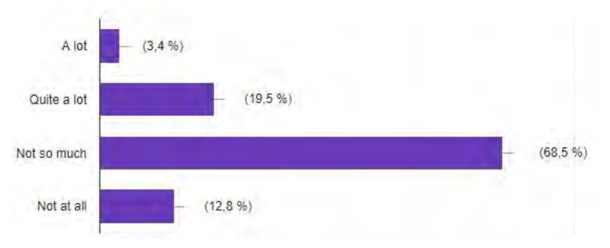

Figure 2: Pretest

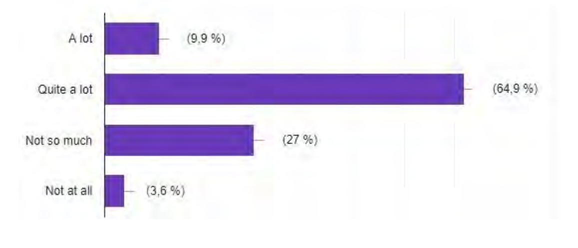

Figure 3: Posttest

When asked how much do they agree that there are many available solutions to reach an optimal sustainable energy mix for an entire town, there is an increase of 18,7% students who believe (quite a lot + a lot) that there are many available solutions comparing pretest and posttest. Lastly, to the question how much do they believe energy transition is a social, economic or technical issue, all three categories experience an increase after playing the game. In the open question, students acknowledge to understand the complexities of the energy transition but also the importance of collaboration and dialogue among different stakeholders to find solutions.

From the group discussion, findings reveal that students perceive the game as fun and that they prefer to have this type of interactive practice rather than a traditional class characterized by a unidirectional transmission of information. The discussion also shows how educational games have still a long way to go to achieve the high levels of engagement of commercial games which present better graphics, more challenges and different types of interactive mechanics.

5. Conclusions

Using We-Energy Game as a case study, this paper offers insights into the opportunities of using serious games in formal education, concretely in higher education institutions. It has contributed to raising awareness and understanding on the urgency and complexities of energy transition in an interactive, innovative and attractive way for young people. In accordance with other studies, serious games have potential in raising awareness and knowledge on complex issues -enhancing cognitive abilities, affect, and pleasant mood-, however, it remains to be seen to what extent these types of tools have also an impact on attitudes and behaviours.

In order to explore the impact of serious games on learning, different implications must be taken into account for educators and facilitators. From our experience, feedback, interaction among players, and debriefing. Zhonggen (2019), for instance, coincides in these three factors and adds backstory-production, realism, artificial intelligence-adaptivity in order to achieve success in learning. Other authors include the perceived usefulness of the game, ease of use, and goal clarity as indicators of satisfaction and effectiveness in use of serious games: when learners clearly predict the goals and ease of use, they tend to focus on the contents and enjoy themselves (Wang et al., 2017).

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Using OneNote as an ePortfolio: Promoting Experiential Learning and Self-Regulation

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Abstract: The pedagogical role of ePortfolios has been established in numerous studies. It has been suggested that ePortfolios facilitate deep learning, as they allow students to achieve a contextual understanding of their own learning. Other pedagogical advantages of ePortfolios are: enabling students to build a more holistic sense of their learning journey, enhancing learning outcomes and making learning visible. This study draws on previous research and develops the pedagogical potential of ePortfolios further. It presents a learning ePortfolio based on OneNote, the Self-Regulatory ePortfolio, where the pedagogical functions are embedded. The OneNote ePortfolio has been designed around a learning cycle based on experiential and self-regulation learning consisting of the functions: identify /plan/ action / record / review. This design of ePortfolio is much more than a tool to allow or catalyse a learning process, it is directly guiding students through the learning process and training them in self-regulative learning. This paper reports on this new model of Self-Regulatory ePortfolio and explains its structure and features within OneNote. It presents how it has been used at the Open University to work in languages and education modules in relation to Personal Development Planning (PDP) and as a Languages Portfolio in the context of the ECML (European Centre for Modern Languages). It reports on the promising results of pilot studies and scholarship projects carried out to evaluate this Self-Regulatory ePortfolio. It discusses the main findings of the studies and in particular the relation to students' experiences using it. This paper concludes by suggesting further ways to implement this learning ePortfolio in other contexts and platforms.

Keywords: self-regulatory ePortfolio, OneNote, personal development planning

1. Introduction: The pedagogical role of ePortfolios

Over the last decade, ePortfolios have become an increasingly common component of HE programmes. They serve as constructivist learning spaces where students can reflect on their learning journeys, where they can be assessed, collect their work and demonstrate their achievements to potential employers (Pengrum & Oakley, 2017). Chaudry & Cabau (2017) stress the recent saliency of ePortfolios, demonstrating in different contexts and across disciplines how they might fit with institutional objectives as well as allowing for a greater personalisation of learning. As Pengrum and Oakley state:

> *"It is suggested that ePortfolios may have a role to play in supporting a shift away from today's administratively oriented, pedagogically limited learning management systems (LMSs), and towards personal learning environments (PLEs) where students can engage in more individualised, autonomous learning practices" (Pengrum & Oakley, 2017, p.21)."*

The term 'ePortfolio' can mean different things to different people. While the overarching concept from the Joint Informations Systems Committee (JISC) (n.d.) is that an ePortfolio is a collection of digital artefacts created and collected by students as a record of their learning achievements, the term 'ePortfolio' can also refer to both product and process (JISC, 2008). Further, different types of ePortfolio have been identified such as Showcase, Development, Reflective and Assessment (Stefani *et al*, 2007) and Workspace or Showcase (Barrett, 2010).

My own research on ePortfolios confirmed its pedagogical advantages and its potential to foster personal learning environments and learner autonomy.

My interest with ePortfolios started with work on the European Language Portfolio (ELP). After designing and working with different electronic ELPs, I realised the pedagogical potential of ePortfolios had not been fully explored and acknowledged. Elsewhere I argued (Perez Cavana, 2012) for a 'soft portfolio'. With the word 'soft', I was not only referring to an electronic portfolio, but also to the pedagogical component of the ELP as opposed to the 'hard pages' or reporting function of the ELP. I showed how the ELP can foster strategic self-regulated learning and metacognitive knowledge.

Following this line of inquiry I have focused on the development of an ePortfolio in the context of implementing Personal Development Planning (PDP) at the Open University (OU), a distance university in the UK. In 2016 I lead an initial pilot implementing PDP in languages modules which clearly showed two main findings:

- the usefulness for students to engage with PDP and an ePortfolio
- the difficulty of finding an appropriate platform to deliver the ePorfolio

The platform used for the pilot was technically too complicated for some students and its cost and administrative workload could not be managed by our institution. As the OU were embarking of making office365 available to all studentsI decided to design an ePortfolio using OneNote. This paper describes the characteristics of this OneNote ePortfolio, it reports on three pilot studies and it discusses the strengths and weaknesses of this platform.

2. Developing a tailored ePortfolio for Personal Development Planning (PDP)

The origins of Personal Development Planning (PDP) and Progress Files can be traced back to several macro-socio-political and pedagogical debates that took place in the UK around 2000-2001 (Clegg, 2004). The main aim was to put the autonomous learner at the centre of Higher Education (HE) policy and practice. Numerous research studies suggest that an ePortfolio tool can enhance PDP. These include the contexts of staff development (Hoekstra and Crocker, 2015), children's classrooms (Barrett, 2005), postgraduate students (Marais and Perkins, 2012) and nursing undergraduate students (Howes et al., 2011; Toner and McDowall, 2015). While these contexts do not correlate directly to OU undergraduate language students, the findings appear to be consistent in suggesting that ePortfolios can encourage students to become aware of PDP in general, as well as encouraging them to reflect on areas needing improvement.

2.1 PDP: Definition and aims

PDP has been defined as a "structured and supported process undertaken by a learner to reflect upon their own learning, performance and/or achievement and to plan for their personal, educational and career development" (QAA, 2009, p.2). According to Gough et al. (2003) the primary objective for PDP is to improve the capacity of individuals to understand what and how they are learning, and to review, plan and take responsibility for their own learning.

PDP helps students:

- to become more effective, independent and confident self-directed learners
- to understand how they are learning and relate their learning to a wider context
- to improve their general skills for study and career management
- to articulate personal goals and evaluate progress towards their achievement
- to encourage a positive attitude to learning throughout life.

QAA (2009) suggests a cyclical process or learning cycle in relation to PDP, based on Kolb's (1984) experiential learning theory (Figure 1).

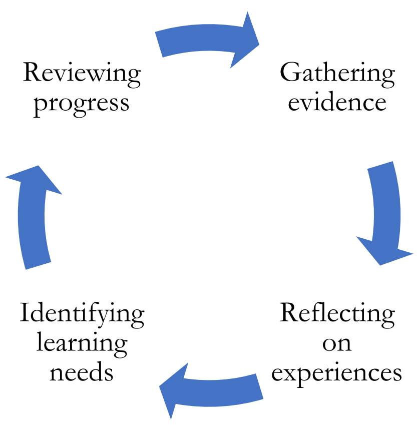

Figure 1: Cyclical model (Based on Kolb, 1984, adapted from QAA, 2009, p.6).

Like McEntee (2013), the OU defines five stages, as seen in Figure 2, provided to students via the OU Help centre in the section entitled 'Develop your career' (Open University, 2018).

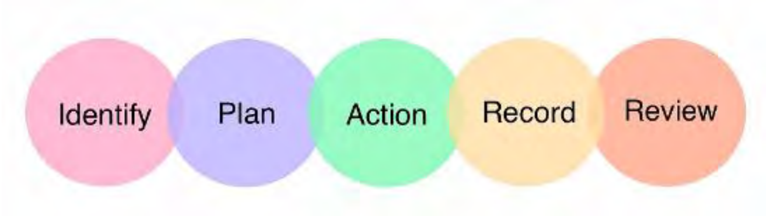

Figure 2: Stages within the OU PDP process

2.2 A tailored ePortfolio for PDP

From 2016-2018, I led an interdisciplinary team to pilot the implementation of a new approach to Personal Development Planning using the Three-layered model (Perez-Cavana and Lowe, 2018) in an ePortfolio. Through successive pilots we designed and refined our learning ePortfolio prototype. For the first pilot we used an ePortfolio developed by the University of Bremen called *EPOS*. Originally designed as a languages ePortfolio following the structure of the European Languages Portfolio, we adapted EPOS specifically for PDP at the OU by integrating the pedagogical functions (identify, plan, record, review) in the main tabs (see Figure 3) in order to facilitate the visualization of the pedagogical process.

Figure 3: The ePortfolio EPOS for PDP

The rationale behind inserting these PDP functions in the ePortfolio was twofold: cognitive, to help to understand what PDP is about, and practical, to facilitate the factual work with PDP (learning by doing)

At the time of the second pilot study, the OU was starting to provide students with Microsoft Office 365, a cloud-based suite of tools including OneNote. This aligned to Kim *et al.*'s (2010) proposal of a cloud-based approach for ePortfolios. We therefore piloted the use of OneNote as a means of supporting students in their PDP.

As advocated by Howes *et al*. (2011), we provided a structure within the 'ePortfolio' through the creation of a template in OneNote which we then made available to the students. Once set up with Office 365, students installed the OneNote template on their own devices. They had a choice of desktop version and cloud-based, potentially syncing the two and using both depending on their location and device to hand.

The template in OneNote (Figure 4) was a simplified version of the EPOS ePortfolio used in Pilot A (Figure 3) but maintaining the idea of the tabs to provide guidance through the stages of PDP (Identify, Plan, Record, Review). Under each of the tabs was space, in some cases with minimal scaffolding in the form of frameworks or prompt questions, and in other cases, space for students to use as they wish.

Figure 4: Tabs created within OneNote

One of the advantages of using OneNote was that it is very easy to customize by the users. Under the tabs and in their personal space, students were able to enter their thoughts as text, in paragraphs, in tables, in lists. They can upload photos of work done or inspirations, upload audio/video recordings of themselves reflecting, upload their assignments containing tutor feedback. They could make use of check boxes to help prioritise and to keep track of progress.

2.3 The OneNote Self-regulatory ePortfolio

Many teachers and educators have used or are recommending OneNote to work with their students to organise the work of students. There are a number of different YouTube videos and blogs (Cocklin, 2018), suggesting the use of OneNote as an ePortfolio, but to my knowledge it does not appear to have been used systematically in a HE institution. There are two main contributions from the work that we have been carrying out at the OU: firstly the implementation of OneNote and the data collection regarding usability, technical challenges and learner experiences and secondly, the pedagogical principles that have driven the development of this ePortfolio.

As mentioned above we integrated the pedagogical principles of the learning cycle in the ePortfolios used for PDP. This learning cycle (Figure 1) clearly represents the principles and philosophy of self-regulated learning.

Jackson (2005) has pointed out that Self-Regulated Learning (SRL) provides a research-based explanation of the processes that underlie PDP and helps us understand the dispositions, thinking and behaviours that PDP promotes.

There are different models of SRL. According to the cyclical model proposed by Zimmermann (2000) there are three phases in SRL: Forethought, Performance and Self-reflection. These phases closely match the PDP functions:

- Forethought – (Identifying / Planning)
- Performance – (Action, Recording)
- Self-reflection – (Reviewing, Evaluating).

When learners go through the learning cycle within their portfolio, they collect evidence of their work in the "Record" function. This way they can integrate the "Product" function within the "Process" function of their ePortfolio. This Self-regulatory ePortfolio facilitates the integration of those two aspects that have traditionally been considered conflicting.

3. The pilot studies

The Three-layered model described above was built on the data and experiences gathered from three pilot studies carried out at the Open University between 2016-2018. Table 1 provides a comparative overview.

Table 1: Overview of the three pilot studies

	Pilot A	Pilot B	Pilot C
Participants	Level 1 L161 Exploring languages and culture students (11 completed responses)	Level 2 Spanish alumni (15 completed responses)	Level 1 Languages, Level 2 Education, PG Education students (12 completed responses)
ePortfolio tool	EPOS (Mahara-based ePortfolio developed by the University of Bremen, Germany)	OneNote template (desktop and online versions, part of Microsoft Office 365)	OneNote template (desktop and online versions, part of Microsoft Office 365)
Data collection	Pre-survey questionnaire, post- survey questionnaire, open comments, interviews	Pre-survey questionnaire, post- survey questionnaire opencomments, interviews	Pre-survey questionnaire, post-survey questionnaire, open comments, interviews

The pilot studies carried out between 2016 and 2018 in the context of the implementation of PDP at the Open University using an ePortfolio have been thoroughly described elsewhere (Perez Cavana and Lowe, 2018, 2019). In this paper I will just briefly describe the data collection and I will report on the main findings.

3.1 Method: Data collection

We used a pre- and post-survey online questionnaire. Overall, 101 students were invited to take part in the three pilots by email and at the end of the surveys we collected 38 end-of-pilot survey responses (37.6 % response rate). Due to the low number of participants, the quantitative data in terms of percentages are not significant. However, as the questionnaires were semi-structured, we collected a significant number of open comments. We also carried out 17 in-depth interviews with students. The open comments and transcripts of the interviews were analysed using a procedure of four stages of thematic analysis as described by Bryman (2008). It should also be noted that, despite the low numbers, the student profiles reflected a typical range of OU language students.

3.2 Findings

The implementation of PDP, using a self-regulatory ePortfolio, enabled distance students to understand and experience a complex but very useful way of working, and to relate it holistically to their learning and to themselves as learners.

Students responded very positively to the Three-Layered Model (PDP, ePortfolio and activities)as it guided them through the PDP process. We e have grouped the comments around three main areas as they emerged from the interviews and open comments in the online surveys. We will discuss each in turn.

The three main areas emerging from the surveys are:

- 1. Enabling students to develop Self-Regulated Learning
- 2. Increase student motivation
- 3. Enabling students to develop a different view of their studies and themselves.

3.2.1 Developing self-regulated learning

Students reported that working with PDP enabled them to develop new competences. In particular they developed a sense of responsibility in relation to their learning. They were able to relate PDP to their life and to making progress in meeting personal goals. These new competences included the ability to identify their skills, the ability to critically reflect, to recognise things of importance and the ability to carry out self-analysis. They were able to give more in-depth responses and be more focussed on their study. One student said *"It does make me think about how I learn, and it makes me think where I want to go with my modules… I'm taking control of my learning rather than just going with the flow".*

Students developed a new awareness of their strengths and weaknesses, and of their limitations. They felt that their ability to clarify and identify weaknesses and strengths made their goals more achievable as they could see where they were going and how to get there. In this sense, some students reported that PDP "gave them self-confidence". They were able to identify where improvement was needed this made them feel more confident and focused as they realised the relevance of the activities. The students suggest having a better understanding of what they were doing and why was deemed helpful. Just the fact of understanding and realising made it more relevant for the students when looking into their goals and tasks, they were able to define exactly what they wanted, and to realise that these goals were more achievable. They also had the experience that when you learn to plan, goals seem to be more manageable and easier to reach. One student commented: "*The more conscious you are of your strengths, weaknesses and what experience has taught you, the more likely you are to make informed choices about what to pursue."*

Students felt that working with PDP was enabling and helpful in different areas. One aspect was in relation to managing their learning: it enabled them to revise and improve further helping them to orientate their thinking towards module content. Working with PDP enabled students to develop their metacognition, it helped them to critically analyse, carry out self-evaluations and review. It also helped them to organize their learning, to manage their time and make informed choices. One student wrote "*Some skills I had not previously been able to describe, and by seeing them written down in activities I was able to look at them from different perspectives*."

The students perceived that PDP allowed them to see connections between different goals and different areas of their lives – personal, academic and professional. Thinking about their goals in relation to each of the three areas and then seeing how the goals interrelate was an unexpected experience for some of the students as they had not had this opportunity before. They also realized how working towards one objective enhances the achievement of other objectives because they are often connected. In relation to this, two students wrote: "*Understanding connections of efforts can help achieve goals"; "I guess it was both motivating and as a consequence useful to become a more effective learner. It was interesting to see how one simple exercise could change the way of thinking and made me realise how connected the objectives are."*

The activities were divided into four steps: (A) Identify strengths and weaknesses in relation to the learning objectives; (B) Plan how to improve what was identified as a weak point; (C) Record evidence of strong points; and (D) Review the whole learning process. This step by step approach used in the PDP activities was perceived as very useful by most of the students (9 out of 10). One student wrote *"Interesting to break down in smaller mini-activities or mini-challenges. A good tool for future use".*

3.2.2 Increasing motivation

Different aspects of motivation were reported by students when describing their experiences working with PDP. These include:

- working with a new tool can increase motivation.
- Being able to see their own goals clearly and realise that they are achievable.
- Being able to revisit the initial reasons for study.
- Being able to set out what they want to get out of their learning journey.

Reflecting on goals and understanding them, as well as the experience of becoming a more effective learner were deemed motivating. The fact that PDP helps to make their learning goals clearer and more tangible motivates students to achieve them. One student said: "*It enables you to collect the evidence of competencies, achievements, feedback to look back [at] when you feel slightly demotivated or in need of a push*."

Students felt that putting everything in one place was a big advantage, as it helped them to develop and link their goals and experiences. Students also felt that the ePortfolio helped to structure their thinking. Being able to link self-evaluation and planning in EPOS was deemed very useful. It was also considered very useful in relation to employability, such as being able to articulate and present capabilities to an employer, and to apply for a job. One student wrote: *"I think that the ePortfolio is a great idea and enables you to put a full breakdown of your skills, development goals and experience in one place. Excellent for job applications and being able to better articulate your abilities to an employer."*

3.2.3 Developing a different view of their studies and themselves

Different perspectives

Working with PDP allowed students to see things from a different perspective. It showed them that there are many reasons to study, and it is possible to envisage and consider a career plan. They were able to make links between working independently and managing their time. It encouraged them to expand their thinking when completing assessment tasks and it showed them the advantages of this type of 'linking thinking' rather than considering the module materials in isolation. This was mind opening.

One student wrote about how working with PDP was life-changing for him: *"I wasn't expecting much from PDP, but I am so happy that I participated [in the pilot]. I was able to think about things I haven't thought [about] before. I started studying to escape from a difficult situation in my life and to keep my head busy, but through PDP I realised that I can make plans and relate to what I really want for my future. […] I am going to do my degree in languages to become a language teacher."*

Seeing the bigger picture

Several words related to 'seeing' were used to express how PDP enabled students to achieve clarity about different aspects of their learning, their strengths and their weaknesses. It enabled them to see the bigger picture in relation to their goals, keep track of progress and think about what to focus on.

One student wrote about their experience: "*It allows us as a student to see what we are capable of, what we have achieved and what we are competent in*".

The 'bigger picture' seems to refer to the fact that through PDP students develop the ability to look at the wider context of their learning, it broadens their field. It has to do with remembering why they are undertaking the module and connecting it with their long-term goals, but also with having a better understanding of the aspects they need to improve. One student commented: "*Identifying the goals and aims, breaking them into different categories and then seeing the bigger picture would allow me to better focus on the weak parts and find tools and strategies to improve them*."

Sense of direction

Students also reported that having a clear structured path helped with orientation, a 'reminder' about their learning objectives and their learning path. For example, "*Reflection can serve as a reminder when you lose your way on the learning journey and gives you motivation to keep going*".

The different steps of PDP helped them to learn how to be methodical in approaching their learning. One student wrote: "*Method helps focus on what you have achieved and what is still to do"*; another student said: *"I think the PDP will help students to adopt a more structured and systematic way of talking about their studies; it shows you how to be methodical so that you set out a study plan and regularly review your own progress as you learn*".

4. Implementing OneNote for the European Language Portfolio (ELP)

I have designed a similar OneNote ePortfolio for the European Languages Portfolio. Although this ePortfolio does not have the same functions as the PDP one (Identify/Plan/ Action/ Record / Review), the pedagogical self-regulatory cycle is also the basis of the structure. The tabs have been made relevant for the specifics of languages learning and follows the traditional structure of the European Languages Portfolio. Table 2 shows the comparison between the two types of ePortfolio tabs.

Table 2: Comparison Languages and Self-regulatory ePortfolio tabs

Languages ePortfolio	Self-regulatory ePortfolio
Understanding (Listening – reading) Speaking (production – interaction) Writing	Identifying (Self-assessment of the CEFR can-do descriptors)
Learning objectives	Plan
Dossier	Record
Learning journal	Review

This OneNote ELP is currently being piloted in workshops and HE institutions in different European countries where data will be collected to enable an evaluation of OneNote for ELP.

5. Conclusions

The pilots carried out with language and education students at the OU in the UK have provided valuable insights into the usefulness for students of engaging with an ePortfolio to work with PDP during their studies and the challenges of embedding an ePortfolio within a module or programme. The pilots also revealed what students valued about their work in relation to a Self-regulatory ePortfolio: In the context of their PDP what it brought to their studies included the possibility of developing new capabilities and a new self-awareness; the possibility of becoming a more autonomous learner and feeling more motivated. Therefore, this ePortfolio is much more than a tool to allow or catalyse a learning process, it is directly guiding students through the learning process and training them in self-regulative learning.

The self-regulatory model of ePortfolio presented in this paper, guided students through the different steps of their learning and their work with PDP using the tabs in their EPOS or OneNote ePortfolio. Each step was clearly explained in relation to the PDP principles, in relation to the module they were studying and their broader life context, and with guidance about how to reflect on or record the activity using their EPOS or OneNote ePortfolio.

The first pilot (EPOS) demonstrated that a complicated delivery platform unfamiliar to students and relatively complicated to use can distract students from the process of PDP itself. One of the advantages of using OneNote was that it is really user friendly and very easy to customize by the users. Under the tabs and in their personal space, students were able to enter their thoughts as text, in paragraphs, in tables, in lists or to upload audio and video. They could make use of check boxes to help prioritise and to keep track of progress. Finally, as a tool potentially used outside of the academic sphere – in daily life and in the workplace – OneNote supports the very essence of PDP in promoting the transfer of skills, knowledge and experience from one aspect of life to another, for this reason we are currently using OneNote in other contexts, such as the European Languages Portfolio.

The data we have gathered regarding the Self-regulatory ePortfolio and the use of OneNote are very promising. The integration of pedagogical principles in the structure of the ePortfolio clearly fostered the metacognitive skills and confidence of students. It also empowered them to take control of their own learning. Regarding the use of OneNote there is a need to carry out more studies in different contexts and with different types of learners. A further question that needs to be explored is whether the proposed ePortfolio can adequately address the demands of the two main aspects of an ePortfolio: the product and the process. In particular the product (output) side of the ePortfolio

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Feasible Ways to Personal Meaning Mapping in Out-Of-School Contexts?

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Abstract: Though most teachers find formal learning activities an important part of a class visit to a science center, research shows that formal learning is seldom the outcome. Instead, school visits tend to become "soda visits" without preparation and learning goals, and are rarely with explicit connection to the subjects taught back in school. To accommodate these challenges at the science center Experimentarium, a partnership with University College Copenhagen was initiated in 2017. In collaboration, ten Flipped Learning based teaching materials were developed to assist visiting teachers in supporting students' learning - before, during, and after the visit. To evaluate this intervention, a tool was developed to assess students' learning outcomes using Personal Meaning Mapping (Falk, Moussouri and Coulson, 1998). This paper investigates and discusses this tool as an effective means for measuring 'actual learning' (Bundsgaard and Hansen, 2011) in contexts involving interventions aimed to integrate out-of-school visits with in-school activities. Specifically, a pre- and post-test setup was conducted in order to measure development in students conceptual understanding. Data from students' Personal Meaning Maps were analysed quantitatively using four defined dimensions for coding: extent, breadth, depth, and mastery. The empirical data were collected from 26 students in the same class, of which 12 provided full data sets. Two central results are presented 1) the data shows development in students learning when engaging in the learning material 2) extent and breadth seem to be able to predict depth and mastery, opening up for adjustments to research method. While Personal Meaning Mapping is rather resource-intensive, and although some of these learning outcomes will remain hidden using this method, we still find it a useful and powerful tool for gaining nuanced insights into the development of students' conceptual understanding. In conclusion, we offer some suggested modifications to the method to make it more feasible to integrate in out-of-school contexts focussing on formal learning.

Keywords: personal meaning mapping, flipped learning, museum, out-of-school, blended learning

1. Introduction

In 1916, Dewey suggested that school should embrace society around the school: "For when the schools depart from the educational conditions effective in the out-of-school environment, they necessarily substitute a bookish, a pseudo-intellectual spirit for a social spirit" (p. 46). This opening movement is still valid today. In 2014, the Danish Ministry of Education reformed the school system, emphasising the schools focus on out-of-school learning activities. According to the Danish minister of education, the teacher is responsible for connecting the school visit to the overall purpose of school (Riisager, 2017, p. 103).

An investigation from 2004 show how most teachers visiting the Copenhagen science center Experimentarium also find a connection between the visit and the school curriculum important, but the actual visits tend to be "soda visits" with no related school activities before or after the visit to bridge the experience of out-of-school contexts with that of the school (Sørensen & Kofod, 2004, p. 529). This find is echoed internationally (cf. Griffin and Symington, 1997; Falk and Storksdieck, 2002; Storksdieck, 2002, cited in Sørensen & Kofod, 2004, s. 529). To accommodate this disconnect at the Copenhagen science center Experimentarium, a partnership with the teacher education at University College Copenhagen was started in 2017. In a joint effort, ten flipped learning lesson plans were developed to assist the visiting teachers in framing the teaching before, during, and after the visit (see Lie, 2018). This study makes use of data collected as part of this collaboration to evaluate and discuss the practical feasibility of methods to assess students' learning outcomes in science based out-of-school context (Philipps, 2018).

1.1 Research question

Evaluating students' learning outcomes from any teaching-learning activity makes great demands of both researcher, teacher and students involved in the activity. One method that has gained some traction in this regard makes use of methodologies to map out students' personal meaning making (Dolin 2002; Falk and Storksdieck, 2005). However, when comparing results from different studies of this kind, a pattern seems to emerge:

	Philipps, 2018				A	B	Cn	Ct
	Pre-test mean	Post-test mean	△ mean	△ percent	△ percent	△ percent	△ percent	△ percent
Δ Extent	3.25	6.92	-3.667	112.8%	70.70%	80.00%	8.3%	17.5%
Δ Breadth	2.33	3.42	-1.083	46.4%	32.70%	50.00%	4.7%	3.8%
Δ Depth	2.00	2.92	-0.917	45.8%	5.20%	44.00%	3.0%	7.4%
Δ Mastery	1.83	2.58	-0.750	40.9%	11.60%	37.50%	2.2%	8.2%
Sample size:	12				217	30	175 (350 total)	175 (350 total)

A: Falk and Storksdieck, (2005), B: Bowker and Jasper (2007), C1 and C: Bueddefeld and Van Winkle (2018); Cn = no treatment group, Ct = treatment group.

Figure 1: PMM study mean comparison

In figure 1 above, four studies that compare results of students' personal meaning mapping pre- and post learning activities, reveal that large gains are observed on the first dimension (extent), while smaller gains are consistently, albeit differently, recorded on three other dimensions (breath, depth and mastery). Considering the time and effort it takes to record gains across each variable, it seems prudent to ask if one or two of these variables might predict outcomes on other variables. This is what this study aims to investigate.

Main question: How can Personal Meaning Mapping (PMM) methodologies support evaluation of learning materials used in an out-of-school science context as a feasible, reliable and valid tool for measuring students' learning outcome.

Sub-questions:

- How interdependent are the four "semi-dependent" dimensions in the PMM-method?
- What adjustments could be made to the PMM-methodology and what implications would these adjustments entail?
- Could PMM methods combine researchers investigations and teachers pedagogical praxis to mutual benefit?

Feasibility refers to the effectiveness of the method in regard to the overall effort put into the application of the method, compared to its reliability and validity within the research scope. A feasible application of the tool needs to be both practical and precise in the given context.

2. Flipped learning in external learning environments

The studys most central theories of flipped learning, informal learning and concept mapping is presented her.

2.1 Formal learning in informal contexts

Ansbacher (2002) developed a non-definitive list of visitors learning outcome which falls into 8 categories: 1) No outcome, 2) add to experience bank, 3) develop physical knowledge, 4) change feelings or attitudes, 5) lead to active curiosity, interest, or awareness, 6) achieve understanding, 7) develop skills, and 8) acquire information or factual knowledge. All of these are valid, albeit not necessarily desirable outcomes for visiting guests. Even "no outcome", since regular guests might have a strictly social agenda or the like. However, for visiting schools it is another matter. These 8 categories includes tacit, explicit and effective change. Developing students' physical knowledge, adding to the experience bank or becoming more curious, can later on lead to motivation and more formal learning within school curriculum - if the learning processes are scaffolded and framed properly (Busch, 2004, p. 169).

Compared to the relatively controlled classroom environment, the museum context is not an easy place to frame and scaffold the learning processes given the many impressions from the exhibition, noise level, the novelty of the location for both students and teachers, lack of physical space for classes etc. (Bush, 2004, p. 169). Due to these challenges, the teacher often let the students follow their own individual interests (Sørensen and Kofod, 2004, p. 529). This will often lead to students “zapping” around in the exhibition instead of focussing their energy on a few select models (Bush, 2004, p. 169). The “zapping” students can be described more positively as “zapping explorers”. A more constructive mode would be for the teacher to help students act as "curious young science students", transforming the exhibition into a laboratory for systematic investigation (Andersen et al, 2018, p. 13). The flipped learning materials developed for Experimentarium is an attempt to facilitate this transformation in mode using flipped learning strategies (Lie, 2018), which was consequently evaluated using PMM (Philipps, 2018).

2.2 Flipped learning

Flipped learning is a didactical set of methods that blends ICT and teacher presence in order to facilitate students active learning (Eppard & Rochdi, 2017). The “flip” in flipped learning refers to a reverse of a traditional way of teaching, where the teacher prepare students in-class to carry out tasks as individual homework. Instead, teaching flipped, means using videos to instruct students before class, to thus allow the teacher to guide students with their tasks in-class (Bishoo & Verleger, 2013, p. 9). Most academic definitions and practitioners mention the video media as central for the concept (Eppard and Rochdi, 2017, p. 35), and Bishop & Verleger explicitly reject definitions of flipped learning which do not include video (Bishop and Verleger, 2013, p. 5). However, close-ended problems or quizzes are often used to supplement and ensure students’ understanding of the preparatory video materials (Bishop & Verleger, 2013, p. 5).

Videos are easily distributed and has a lot of possibilities as a media for conveying abstract or contextualized content. The purpose of the video is to scaffold the students’ active learning processes. The video is typically made or carefully selected by the teacher to introduce students to a given subject. Typically videos are instructional (Eppard and Rochdi, 2017, p. 35), but since the main purpose is to engage students in active learning (Bishoo & Verleger, 2013), other video types and components should be considered equally valid, e.g. videos that guide, inspire or motivate. Together with quizzes that help students evaluate their outcome or help them focus on the material as intended such practice is “... touted as a highly successful practice” (Bishop & Verleger, 2013, p. 10).

To guide scaffolding efforts, Puntambekar and Hübscher (2005) suggest helping students to structure the task, arguments, or scientific explanations or to structure and make the scientific process more transparent. Furthermore, the video itself constitutes an invaluable resource to students, when the teacher is with other students during the activity.

Ideally, the technological scaffolding tools fit most students’ needs as a hard scaffolding “blanket” facilitating most students active learning, and the teachers time is freed for soft scaffolding, e.g. to diagnose and adapt different scaffolding options to the various constellations of students in need (cf. Brush and Saye, 2002). Thus, “to orchestrate all the activities and integrate the tools, the teacher [still] plays the most important role.” (Puntambekar and Hübscher, 2005, p. 10).

2.2.1 The FLIP experimentarium model

The challenge in out-of-school contexts is to connect the visit to the school curriculum. To this extent, Experimentarium and University College Copenhagen developed and used a three phase model based on the flipped learning framework. The following model is an adaptation of a four phase model applicable for teachers who flip their teaching (See Levinsen et al, 2017):

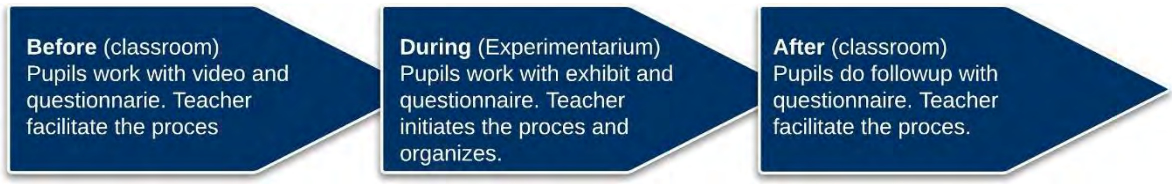

Figure 2: FLIP experimentarium - model for teaching exhibit. Adapted from Andersen et al., 2018, p. 8

If used as intended, the class prepares at home by engaging with video materials and materials for scaffolding the preparational learning processes, prepared by the external learning environment. In theory, this will prepare the students to engage in meaningfully scaffolded learning activities in the exhibit. After the visit, the students might bring home data or notes from a shared and investigative experience. Having the teacher positioned as a professional guide, this material can then be used to contextualise the curriculum.

Another central element for definitions of flipped learning are pedagogical approaches like "hands-on activities", "engaging students" and "solve students' problems" (Eppard and Rochdi, 2017, p. 35). Bishop and Verleger (2013, p. 7) sums these different approaches up to the term of active learning. This includes Cooperative Learning, Collaborative Learning, Peer Tutoring, Peer-Assisted Learning, and Problem Based Learning that are all considered student-centered pedagogical approaches to help students develop conceptual understanding and make personal meaning of learning activities (Bishop & Verleger, 2013, p. 7).

2.3 Concept maps represent a cognitive structure

A way to evaluate students' conceptual understanding and their construction of personal meaning of learning activities that is commonly used within natural sciences, is concept maps (Dolin, 2002). Concept maps are created by a learner to express the relation between concepts within a certain subject. Traditionally, these maps are constructed as part of learning activities to scaffold reflection and dialogue. In the later years, they have also been used in research to measure learners conceptual knowledge, assuming that the maps reflect an inner cognitive structure (Dolin, 2002, p. 261). "The ability to construct a concept map also illustrates two essential properties of understanding, the representation and the organization of ideas" (Kinchin, Hay and Adams, 2000, p. 44). Multiple learning theories within natural sciences focus on the development of students' conceptual understanding, which makes this method valid within science curricula (Dolin, 2002, p. 91). The PMM methodologies are based on the concept maps and are designed to measure students' conceptual understanding.

3. Study design

In the sections describing the methodology, we will frame how the study uses PMM in a pre- and post-test design, and how data is created and analyzed. The application of the PMM method is an effort to measure "actual learning", as a part of a more holistic research design which could also include a learning materials "the potential learning potential" or "the actualized learning potential" (Bundsgaard and Hansen, 2011, p. 33). Looking for "actual learning", we focus solely on what PMM can tell us about learning, well aware that this method will not measure all which is relevant for learning, e.g. tacit knowledge or affectional change.

Students and teachers engage in one of ten flipped learning-based learning material called "Dikes and gates". A video and questionnaire offer instruction and scaffolding to help the students engage in the learning activities before, during and after the visit.

3.1 Pre- and post-test setup

In order to measure the development in conceptual understanding, this study is based on a pre and post-test setup. The learning material "Dikes and gates" facilitates learning in the three phases: Before, during and after a visit at the science center Experimentarium in Copenhagen. The learning material scaffolds the students' work with measuring and calculating the potential energy of a water stream flowing over a watermill.

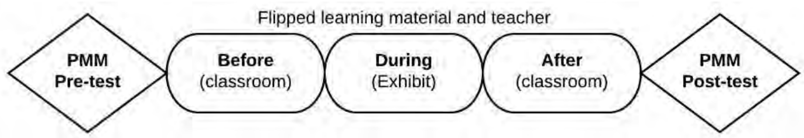

Figure 3: Study setup

3.2 Personal Meaning Mapping

PMM is a research method based on concept mapping. It was developed by John Falk in 2003 to measure regular visitors learning outcome in informal learning environments (Lellilot., 2007, p. 204). Few studies explorer PMM in a formal learning setting (Hartmeyer et al., 2017). Whereas concept mapping requires a specific technique, PMM can be used with a simple instruction (Lellilot., 2007, p. 204). The method starts with the learner prerequisites, and is therefore very flexible in relation to the respondents prior knowledge (Mortensen and Quistgaard, 2011, p. 65). Lellilot (2007, p. 217) claim that "It generates a lot of data, and is therefore time-consuming to transcribe and analyse, and requires knowledge of analysis procedures on the part of the researcher. Issues of validity and reliability are similar to other techniques which involve coding during analysis, and require careful attention to the selection of the initial words or phrases used as prompts, and to inter-rater agreement.".

3.2.1 Data generation process

The Pre-test is established before the students engage in the lesson plan which effect is under investigation. Normally an introduction is required to the students in order for them to understand how to engage in the meaning maps - e.g. with examples from other topics. Each student gets the template framing their concept map - e.g. with a subject, or with a model showing the core of the topic in hand. In this case, an illustration of a water power plant.

After the introduction to concept mapping, but prior to the students being introduced to the topic of the learning materials "Dikes and gates", the student go through the following data generation process:

- **A1:** Each individual student write down concepts relevant for water power and potential energy.
- **A2:** On turn, each student is interviewed based on their exact written concepts, letting them explain the different concepts inter connection. The interviewer follows a consistent interviewing technique, and add notes on each students concept map with a new distinct colour.

The Post-test follow the same procedure on a new blank template. A less detailed introduction is given.

- **B1:** Repeat A1
- **B2:** Repeat A2

The pre-test and the visit happened the same day, and after-phase and the post-test were conducted a week later. The below should cover an example of a single students' pre- and post-test. This particular student has a somewhat average development, except for breadth witch goes from 4 to 3.

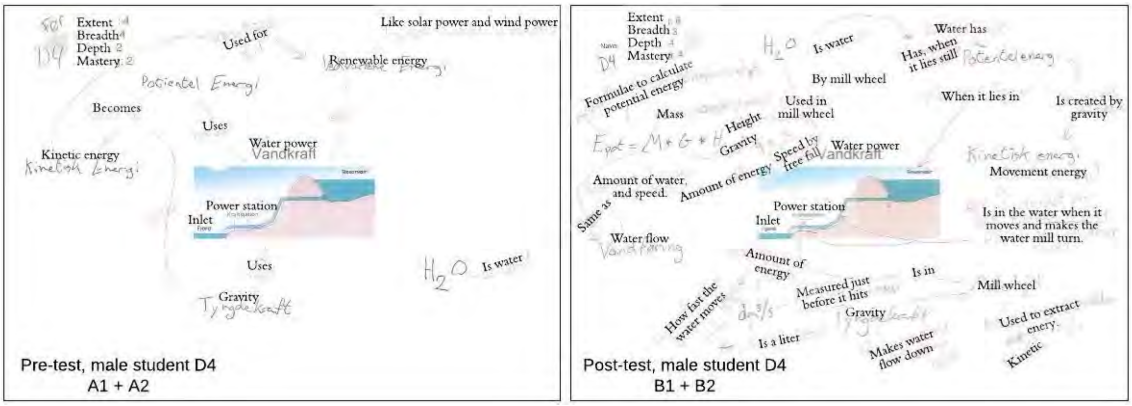

Figure 4: Example of a pre-post test, quantified and translated

3.2.2 Quantification process

The concept maps generated by the respondents are analysed and quantified within four dimensions: "The four constructs extent, breadth, depth, and mastery were designed to be independent and complementary measures of learning, capturing different aspects of cognitive gain in a free-choice learning environment." (Falk and Storksdieck, 2005, p. 753). Often a specific tool is developed in an iterative process between multiple raters, creating Inter rater reliability. According to Falk & Storksdieck (2004, p. 758), the PMM dimensions extent and breadth are statistically semi-dependent to PMM depth and mastery.

- **1. Extent:** Every relevant term where counted. Some terms overlap, and only count once (e.g. potential energy and stored energy). *Scale*, from 0 to an undefined cap of approx. 31 (top score 13).
- **2. Breadth:** Gives one point for every relevant category where a term has been mentioned (e.g. students mentioning "water current" or "movement energy" has proved that they considered the "Kinetic energy" category). *Scale* 0-5.
- **3. Depth:** Depth expresses the students' in depth understanding, and is interpreted on the basis of how scientifically accurate terms are used, and the connection of these in the concept map. *Scale* 0-5.

- **4. Mastery:** Is an overall assessment of the students understanding. "Mastery can thus be seen as a more traditional measure of learning, it is designed to be a holistic measure, taking into account all of things an individual said during the PMM process in order to gauge where an individual falls along a continuum between novice and expert relative to the specific concept or phenomenon represented by the prompt." (Falk and Storksdieck, 2005, p. 753). *Score* 0-5.

Some terms didn't give points, mostly because they were judged outside the scope of "water power" and "potential energy" or was already stated on the PMM handout, e.g. Water pipes, power station, water filtering, fresh water, salter water etc.

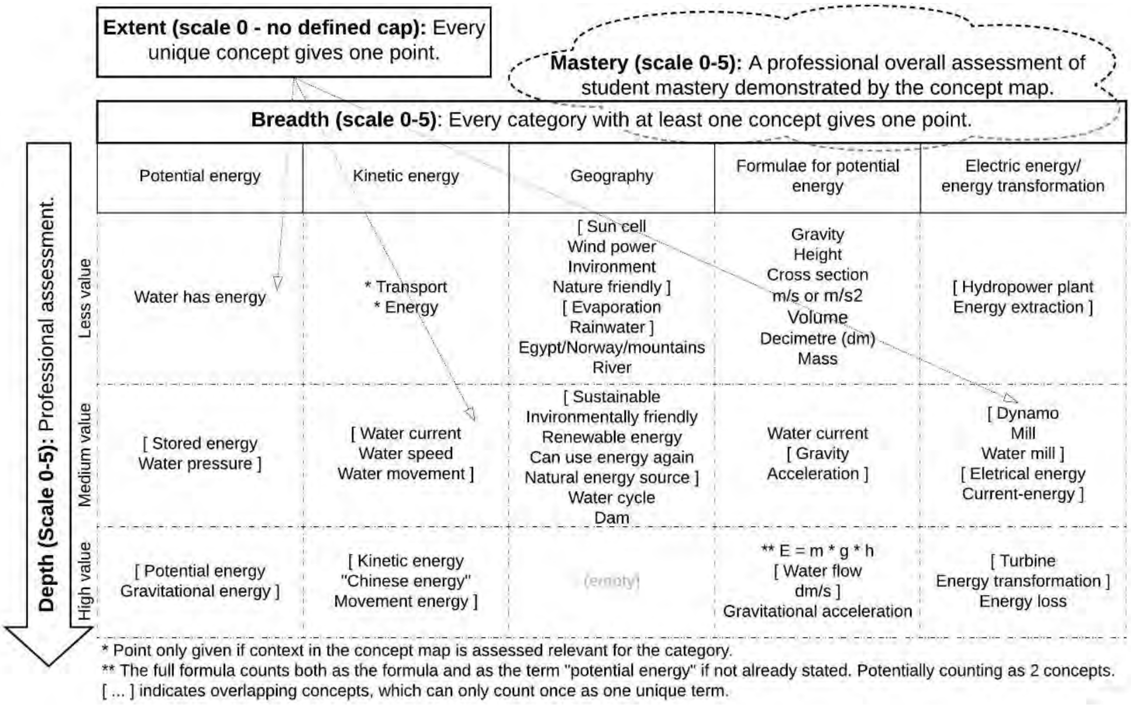

Figure 5: Scoring chart for PMM used to assess conceptual learning within "Dikes and gates")

In our case, we didn't use an intercoder procedure as recommended (Falk and Storksdieck, 2005, p. 753), but instead we developed a scoring chart for consistent interpretation. Every written term was compared to the chart. This tool gave a high consistency to the interpretation of Extent and breadth which are interpreted simply by counting. The depth and mastery interpretation was supported by the tool as well, but still required more interpretation, with a potential error margin which an inter coder procedure would have minimized.

4. Analysis of data and results

4.1 Data evaluation

The PMM-methodologies give insights to cognitive schemas of concepts and their relations, though only as far as the respondents are able to express them under the given circumstances. Thus not saying much about tacit knowledge, motivation, affections or other equally important factors of learning. The PMM process itself should be considered a learning activity and might it selv influence both cognitive structure and the students further engagement between the pre- and post-test. "Teaching to the test" or "looking for what the researchers want" might apply to this method as well. This could possibly result in respondents wildly guessing, wrongly censoring out terms or simply bee too nervous. All of this should be taken into consideration when interpreting the results of a PMM-based study. This study is based on a very limited sample from a homogeneous group, and the quantification process does not use intercoder reliability. The results should therefore be interpreted carefully.

4.2 Analyzing quantified data

The quantified data gave each student a pre-test and post-test score in each of the 4 dimensions. Out of the class of 26 students, 19 students managed to complete both pre- and post-test concept maps, and only 12 also completed the interview. Thus, 12 full datasets where collected, which comprise the data used for this study.

4.3 Scatter chart

The below four scatter charts each represent the full sample. Each plot represents a single students pre- and post-test score, indicating the learning development. Multiple points may stack. Data points on the red dotted "no learning" curve shows no development in conceptual understanding, dots above the line show learning progress. The blue line is a linear trend line inserted to emphasise the average difference between students' learning gains and the "no learning" curve. All four PMM dimensions show an overall learning progression that in some dimensions seems to vary depending on pre-test score. Extent's trend line lies parallel to the "no learning" curve, which could indicate that students learn to the same degree invariably of their prior knowledge. On breadth, depth and mastery it seems as if high pre-test scores means lower learning gains. This is likely an artificial pattern created by the instrument, a "ceiling effect", since 5 is the maximum possible score on both pre- and post test.

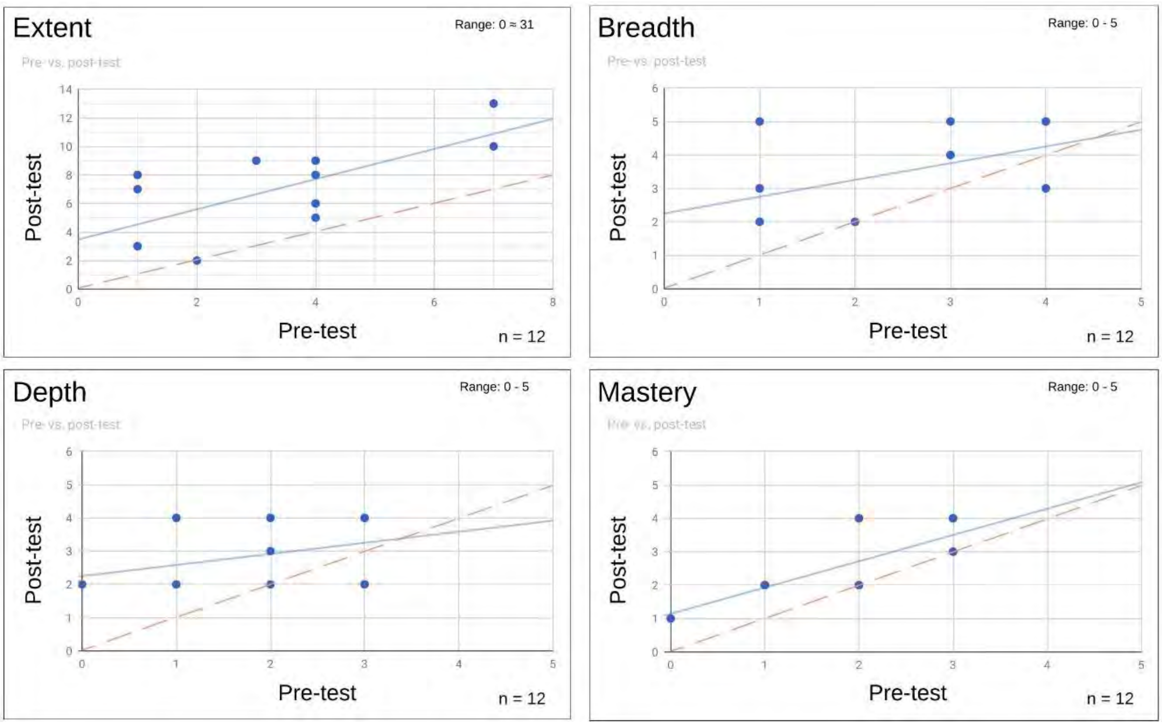

Figure 6: Plot diagram of pre- vs post in four dimensions: Extent, breadth, depth and mastery)

4.4 Statistical correlation across PMM dimensions

In order to investigate how well the semi-dependents dimensions correlate, a two tailed correlation analysis was carried out as is recommended in educational science (Pillemer, 1991). Results from the pre-test were compared, as were the post-test results. It shows a significant, moderate to strong correlation from the PMM pair extent and breadth to the PMM pair depth and mastery in both the pre- and post-test, with the exception of post-breadth to post-depth.

Pre-test		*Extent*	*Breadth*	*Depth*	*Mastery*
Extent	*Pearson*	1.00	**.83	*.64	**.79
	Sig.		.001	.025	.002
Breadth	*Pearson*	**.83	1.00	*.68	**.82
	Sig.	.001		.015	.001
Depth	*Pearson*	*.64	*.68	1.00	**.93
	Sig.	.025	.015		<.001
Mastery	*Pearson*	**.79	**.82	**.93	1.00
	Sig.	.002	.001	<.001	

Post-test		*Extent*	*Breadth*	*Depth*	*Mastery*
Extent	*Pearson*	1.00	**.86	**.75	**.72
	Sig.		<.001	.005	.009
Breadth	*Pearson*	**.86	1.00	.47	*.59
	Sig.	<.001		.121	.041
Depth	*Pearson*	**.75	.47	1.00	*.69
	Sig.	.005	.121		.012
Mastery	*Pearson*	**.72	*.59	*.69	1.00
	Sig.	.009	.041	.012	

∗ p < .05. ∗∗ p < .01. n = 12

Figure 7: Pearsons two tailed correlation analysis across the four PMM dimensions

5. Conclusion and discussion

This study investigates the application and feasibility of PMM as a means to measure learning in out-of-school contexts, as a difficult frame for teachers to facilitate and ensure student learning. Especially two dimensions (depth and mastery) are resource demanding task, as they rely on interviews and qualitative coding. Although this study is based on a small sample, we observe moderate to high correlation across the two pairs of PMM dimensions: PMM extent/breadth and PMM depth/mastery. Furthermore, since such correlations across dimensions correlate with of constructivist learning theories, there is good reason to suggest further studies into these apparent dependencies across contexts, to better understand the relation between the four "independent" or "semi-dependent" dimensions (as Falk and Storksdieck 2005 also describe them). If the correlation reported here can be echoed by future studies, it might help researchers adjust the methodology in different ways to accommodate their needs. Hopefully even help lessen heavy time and resource constraints in educational studies and the systematic development of teaching activities.

To this end, a list of possible adjustments to the PMM methodology are discussed. However, these should be applied with respect for reliability and validity, or studied further to develop the PMM methodologies.

5.1 PMM and feasibility

On the basis of this study, a variety of different PMM adjustments are discussed in relation to feasibility. These adjustments mainly consider out-of-school contexts. However, the discussed adjustments are not examined in relation to *reliability* and *validity* which need careful consideration. Due to reliability issues in research, the PMM design should ensure consistency in data collection and interpretation. This can especially be an issue if multiple researchers or non-researchers, or the lack of precise scoring charts.

Consider only measuring extent and breadth, while skipping depth and mastery. A very precise score chart can be made for coding extent and breadth, thus reducing the need for an intercoder procedure and making the coding process lighter. Skipping depth and mastery can make some of the other suggestions less intrusive to the original PMM methodologies, e.g. skipping the interview. Some details from depth and mastery will get lost, rendering such an adjustment a less detailed version, albeit the resource demands could be decreased substantially, and directed towards other means of evaluating. Though some evidence is presented here as extent and breadth being predictors of breadth and mastery, further research is needed to better understand the correlation, and thus what consequences the implication of such and amputation of the PMM method.

Consider concept mapping without interview, due to the high logistical and resource pressure. This will influence all four dimensions, since the interview can pull forward *almost* active concepts from the learners, but it will most likely influence the dimensions of depth and mastery, since they take concept connections into consideration.

Consider using videos and online templates for print to initiate the process, due to the uniform, scalable and accessible nature of the online media as a hard scaffold. This adjustment could be used in conjunction with a responsible adult acting as a soft scaffold - e.g. the teacher or research assistant.

Consider PMM as a part of the learning design, since it is considered a meaningful learning activity by itself. A combination of empirical data creation and pedagogical praxis could both accommodate difficult logistics in an out-of-school research setup and help render meaning in the PMM activity for both students and teachers.

Consider af combination of the suggestions above. This could highly reduce resource costs, especially if the teacher facilitates the concept map process. Though this is intriguing, a combination putting the teacher in charge is likely to highly affect the students responses and lower consistency of the data across contexts.

Also consider:

- a research based PMM design, improving in iterations
- adjusting the PMM measure points differently than a pre- and post-test setup
- a peer-learning PMM model allowing multiple learners to collaborate on the concept maps
- complementary research methods, for inspiration see Falk and Storksdieck (2005) or Philipps (2018)

- giving learners some degree of access to the measuring tool
- using follow-up strategies for respondents, see Falk and Storksdieck (2005)

5.2 PMM and quality

Though focus in this study has been on PMM adaptations that are practical and applicable, a focus on the qualities of the PMM methodologies seem a relevant path to explore as well. One aspect of quality could be *longitudinal* studies, investigating the long term development of conceptual knowledge when the learners are exposed to different learning- and exhibition designs. Another dimension of quality could be *latitudinal* studies, exploring development in conceptual understanding of a particular activity design, e.g. robustness, perceived relevance, interconnectedness etc. Longitudinal and latitudinal approaches to PMM based studies, could help build larger investigational frameworks. Such frameworks should carefully address the reliability and validity issues, as should researchers and practitioners deploying adjustments mentioned in this paper.

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Investigating the Voice of Customers for M-Learning Application Quality

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Abstract: E-learning has become a new option for learners to access the learning materials and enhance their learning experiences outside the classroom. The flexibility of the technology goes beyond the traditional way of learning and enable learners to use mobile devices as the mean to learn. The emerging of mobile learning (M-learning) provides tremendous advantages for both learners and teachers, while more and more mobile learning applications have been developed and introduced to the market. The current study aims to investigate the voice of customers who have downloaded and used the mobile application. The edX - Online Courses by Harvard, MIT, Microsoft mobile application in Android platform was used as a case study. The M-learning evaluation factors employed in this study are including functionality, security, performance, usability, support, communication, portability, and pedagogical. The main methodology of the study is qualitative approach using text mining to analyze users' reviews gathered from Google Play website in the past year. The total number of the reviews is 4,200 collected from January 2018 to April 2019. The reviews have been collected as the voice of customers by using web-crawler, and text mining were analyzed by using Nvivo 12 program. The attributes of the m-learning application were then compared with the findings from the reviews. The information that arose from the reviews were categorized into m-learning quality variables, users' satisfaction, preferences, constraints, and suggestions. The research findings confirm the prior factors essential for evaluating the m-learning application, while new notions have been discovered. The limitations of the study are the limited sample of the m-learning application, and only reviews in the English language were analyzed. The practical implication of the research will benefit the m-learning application developers and the recently discovered factors can be applied to the theoretical implication for future research. This exploratory study aims to investigate the m-learning application from the customers' point of view, while most of the previous study focused on application development. Moreover, the findings also revealed the constraints and potentially useful features that could benefit learners and application developers.

Keywords: mobile learning, application evaluation, online review, text mining

1. Introduction

Electronic learning (E-learning), online learning, and mobile learning are the hot topics in the academic sector during the last decade. Web 2.0 technology is one of the supporting technology that facilitates online communication, user generate content (UGC), as well as online learning or pedagogy 2.0 (McLoughlin and Lee, 2008). Since mobile computing technology has been developed, the advanced version of the pedagogical technology has been introduced as Mobile learning or M-learning. M-learning is a platform the allow leaners to access to the academic resources aside the webpage and becomes popular nowadays, especially among higher education students (Aresta, Pedro and Santos, 2015). Considering the mobile technology attributes, the unique advantage of this technology allows learners and instructors to engage, share, participate, and ubiquitously access the learning materials through different types of mobile devices (McLoughlin and Lee, 2008; Soad, Duarte Filho and Barbosa, 2016). Basically, mobile learning development relies on support infrastructure (internet and network connectivity), support technology, support lifelong learning policy, and mobile learning framework (Traxler, 2009). Several studies propose m-learning evaluation measurements (Cochrane, 2010; Romrell, Kidder and Wood, 2014; Soad, Duarte Filho and Barbosa, 2016) and m-learning experience (Parsons, Ryu and Cranshaw, 2007), which both technical and educational aspects are discussed in different levels.

The majority of previous studies on mobile learning topic are m-learning effect evaluation and designing the system for m-learning, while less attention is paid on the affective domain of m-learning experience and the influence of m-learners' characteristics in the learning process (Wu *et al.*, 2012). Besides, the problematic issues of m-learning applications in the market are seldom discussed. The comprehensive understanding of application user experience of massive open online courses on the mobile platform should be explored to understand the critical factors for user satisfaction and challenging issues that should be concerned. The current study aims to investigate the m-learners' experiences on application usage from online reviews, while the negative comments are the focus.

2. Literature review

2.1 Mobile learning and higher education

There are several confusing terminologies used in the educational context, for instances, distance-learning, e-learning, online-learning (Moore, Dickson-Deane, and Galyen, 2011) and mobile-learning. The distance learning can be described as the distance education that allows learners to access the learning resources from the geographical distant, while both printed and electronic materials are included (Moore, Dickson-Deane and Galyen, 2011). Clark (2002) defines e-learning as the instructional method that deliver content to learners via computer, including internet, DVD, multimedia, video clip, etc. On the other hand, online learning refers to the learning environment that uses the communication network technology to access the content and enhance the educational opportunities for learners (Benson, 2002), which allows learners to access the learning resources from everywhere with no time restriction (Motiwalla, 2007). The expectations and perceptions of learning environment between those terminologies are different (Moore, Dickson-Deane and Galyen, 2011). M-learning is the combination of mobile computing used by individual user and e-learning benefits (flexibilities of time and location), supporting the interactivities between the learners from the distance via the online network (Cochrane, 2010). Traditional education setting can be supported by using learning technology to enhance the learning experiences of learners through the communication network technology or internet. McLoughlin and Lee (2008) suggest that pedagogy 2.0 can also promote lifelong learning to learners in all age ranges. Lifelong learning refers to the educational opportunity available for all types of learners from different levels, while the largest group of learners is in higher education (Nordin, Embi and Yunus, 2010).

Despite the traditional online-learning, Massive Open Online Courses (MOOCs) is widely introduced to the academic sector with the benefits of unlimited enrollment, global scale, a fewer requirements on tuition fee or prerequisite courses (Deale, 2015). On MOOCs platform, online courses provided by many universities and experts around the world are gathered and provide social network features for educators and learners (Mcauley *et al.*, 2010). The popular MOOCs systems on mobile platforms are available in the market. edX is one of the MOOC systems which was found in May 2012. Recently, it claims that more than 20 million learners are on the platform, while 2,437 courses are offered by over 140 institutes around the world. The edX mobile application has been downloaded by more than a million devices on the Android platform and rated 4.6 for the overall performance. The majority of courses are computer science (26.67%), business and management (21.01%), engineering (15.59%), social science (14.28%), humanities (11.33%), data analysis and statistics (9.93%), etc. Most of them are offered in the English language (88.88%), Spanish (9.93%), Chinese -Mandarin (2.79%), respectively. Similar m-learning applications are Udemy - Online Courses and Coursera: Online courses, found in 2009 (rated 4.5, more than 2,000 courses in over 50 languages, five million downloads with 146,100 reviews) and Coursera: Online Course, found in April 2012 (rated 4.4, more than 2,000 courses, five million downloads with 94,800 reviews). This research intends to select edX m-learning application since it has the smallest number in terms of users, while it has the highest rating score. The online reviews should reveal the potential issues that edX is facing and can be improved to enhance the learners' using experiences and increase the downloads.

2.2 Evaluating a mobile learning application

Nordin, Embi, and Yunus (2010) recommend that the requirements of m-learning technology should include portability, subjectivity, unobtrusive technology, availability, adaptability, persistence, usefulness, and user-friendliness. During the m-learning application designing process, those factors should be concentrated. Parsons and Ryu (2008) propose that there are three metrics essential for evaluative the quality of m-learning application, including internal metrics (software quality), external metrics (quality of external factors), and quality in use metric (perceived quality). Therefore, the quality of the system may be varied depending on external a quality in use dimension, which can be subjective. Romrell, Kidder, and Wood (2014) proposed SAMR model for design and evaluate m-learning activities, which includes substitution, augmentation, modification, and redefinition. The framework defines *substitution* as the function of multimedia in m-learning that is used in place of traditional classroom lecturing. *Augmentation* refers to mobile features that support onsite learning, where students can connect and reach the information anywhere at any time. The transformation of the learning experience is the explanation of *modification*, which allows learners to personalize their learning engagement, according to m-learning functions. The last topic is redefinition, which denotes the use of technology via mobile phone to enhance the learning experience and the effectiveness of the subject, for instances, using the augmented-reality technology, GPS technology, etc. (Romrell, Kidder and Wood, 2014).

According to Sharples *et al.* (2008), the m-learning experience offers mobility in space, technology, mobility in the conceptual topic, mobility in a social setting, and learning dispersion. The previous research recommends that mobile learning design framework should include the theory of learning, generic mobile environment, m-learning context, and learning experience and objective (Nordin, Embi and Yunus, 2010). *The theory of learning* (behaviorism, cognitivism, and constructivism) help guiding the lesson and material designs used in the courses, while *generic mobile environment* (mobility, user interface, support services, etc.) concerns the user or learner dimensions, where the design should base in the users' preferences. *M-learning context* (identity, activity, spatial-temporal, facility, etc.) involves the mobile technologies that assist users to acquire knowledge, while improving *learning experience* (challenge, interaction, story, etc.) *and objective* (improve skills and new skills) by considering the enjoyment or the attractiveness of the application from the users' point of views.

Table 1: M-learning quality and attribute items

M-learning Quality	Item	Author
Communication	Collaborate, feedback, group, individual activity	Parsons, Ryu and Cranshaw (2007); Alrasheedi and Capretz (2015); Soad, Duarte Filho and Barbosa (2016)
Functionality	Adaptation, capacity, concise message, data, effective, execution, facility, input, multimedia, multi-screen, network, output, physical, precision, process, screen, task	Parsons, Ryu and Cranshaw (2007); Alrasheedi and Capretz (2015); Soad, Duarte Filho and Barbosa (2016)
Pedagogical	Acquisition, activity, audio-visual, cognitive, complexity, content, deficiency, didactic, education, environment, instruction, integration, knowledge, learning process, management, profile, reuse, source, target	Parsons, Ryu and Cranshaw (2007); Deale (2015); Soad, Duarte Filho and Barbosa (2016)
Performance	Battery, cleaning, data transfer, load, memory, response, scale, Size	Parsons, Ryu and Cranshaw (2007); Soad, Duarte Filho and Barbosa (2016)
Portability	Device, installation, mobility	Parsons, Ryu and Cranshaw (2007); Soad, Duarte Filho and Barbosa (2016)
Security	Access, authenticity, backup, encrypt, recovery, reliability, security, detect	Soad, Duarte Filho and Barbosa (2016)
Support	Configuration, error, help, upgrade	Soad, Duarte Filho and Barbosa (2016)
Synchronization	Real time, smooth, time lag	Deale (2015); Soad, Duarte Filho and Barbosa (2016)
Usability	Attract, component, continuity, diverse, layout, motivate, navigation, presentation	Parsons, Ryu and Cranshaw (2007); Alrasheedi and Capretz (2015); Soad, Duarte Filho and Barbosa (2016)

Soad, Duarte Filho and Barbosa (2016) follow the of ISO/IEC standards and propose evaluation measurement with the comprehensive nine characteristics of mobile learning application, including *communication* (collaborate, feedback, notification, etc.), *functionality* (multimedia, multi-screen, network, etc.), *pedagogical* (activity, audio-visual, cognitive, complexity, content, course, etc.), *performance* (Battery, cleaning, data transfer, load, etc.), portability (Device, installation, mobility, etc.), *security* (encrypt, recovery, reliability, security, etc.), *support* (Configuration, error, help, upgrade, etc.), *synchronization* (smooth, time lag, real-time, etc.), and *usability* (component, continuity, diverse, layout, navigation, etc.). Deale (2015) also addresses that synchronous learning experience variable, which involves the real-time or time lag between the instruction occurring and student response, is also essential from the instructors' perspectives. This study follows m-learning quality variables and attributes from previous studies, mainly from Soad, Duarte Filho and Barbosa (2016), which are comprehensive and appropriate for the current technology (see Table 1). The fundamental concept of m-learning quality variables based is considered as the internal metrics or the quality of the software. To develop the measurement for user experience, external metrics and the quality in use should also be included as suggested by Parsons and Ryu (2008). As the exploratory research, this study explores the online reviews in order to reaffirm the measurement from previous studies, as well as seeking for occurring themes from the data.

2.3 E-Word-of-Mouth and voice of customer

Electronic word-of-mouth (eWOM) is a buzz term used widely in marketing. Several scholars state that consumers nowadays tend to trust, eWOM and the online user-generated content (UGC) than advertisement created by the organizations(Bronner and de Hoog, 2011; Hennig-Thurau *et al.*, 2010; Marchiori and Cantoni, 2015; Sotiriadis, 2017). In general, websites that provide UGC feature allow users by post, discuss, rate, share experience and pictures, etc. and engage with the websites and companies. EWOM becomes a vital tool for reputation management and marketing communication management, not only in the consumer product industry, but also in the service industry (Schuckert, Liu and Law, 2015).

The corporate forum is considered as a social network, which encourages consumers to share their experience relating to the corporate's products or services (Chua and Banerjee, 2013). As the information sharing session, online reviews or eWOM greatly benefit the corporate and the marketers to observe customers' expressions, opinions, judgments, inquiries, etc. According to the creditability of eWOM that can influence consumers' decision making, scholars affirm that eWOM can be used in place of interviews since online reviews can present the narrative experiences of the reviewers (Zhou *et al.*, 2014; Tontini *et al.*, 2017). Moreover, the corporates should regularly inspect their service quality and attain user satisfaction through the Voice of Customer (VOC) in order to maintain the standard of products and services (Aguwa, Monplaisir and Turgut, 2012). The companies can collect VOC data from direct or indirect investigations, for instances, analysis of product or service reviews, selection of purchases, sales, etc. (Zhang, Narayanan and Choudhary, 2010). The process of listening to VOC involves analyzing information, opinions, or recommendations from customers to identify their needs, perception, preferences, and evaluating their satisfaction (Aguwa, Monplaisir and Turgut, 2012). Hence, this research investigates VOC from online reviews on Google Play to examine the m-learning application context.

According to the research gaps mentioned earlier, less attention has been paid on the application usage experiences among m-learners. The online VOC should provide essential factors of m-learning application that can enhance user satisfaction as well as the potentially problematic issues the application designers should concern. As the exploratory research, this study aims to identify the m-learning application variable using VOC from online reviews as the sample data.

2.4 Research objective

- 1) Identify the main themes that consumers frequently mentioned the M-learning application in online platforms.
- 2) Identify the sentiment of reviews regularly appeared in the M-learning application reviews.
- 3) Identify the potentially problematic issues that the application developer needs to be aware of and improve the service.

3. Methodology

Currently, a qualitative approach with netnography method is utilized to investigate eWOM. As the exploratory study, the explanatory sequential mixed method, suggested by Ivankova, Creswell, and Stick (2006), is the guideline. Firstly, the online data were collected using web scraping tool, followed by analyzing data by a quantitative text-mining method in order to acquire the keywords and themes occurring in eWOM. Therefore, the contents were analyzed by using a qualitative approach to identify and define the fundamental codes and gain inclusive knowledge and understanding of the crucial variables of m-learning application.

3.1 Data collection

This study investigates one sample of m-learning application, edX, while only reviews from Google Play Store were collected since it has the highest number of downloads and reviews for the chosen application. The total reviews available online was nearly 45,100 reviews. edX application is also available for iOS devices, however, only 2,000 reviews exist with the less downloads comparing to Google Play Store. The different performance could be found between those two operating system. Hence, in order to avoid confusing results from the reviews, this study solely chose reviews from edX application on Google Play Store. The current version, 2.19.1, was recently updated in May 2019. For the consistency of the recurring issues and mislead problems from older versions in the collected data, reviews from April 2018 to May 2019 were used. In general, users reviewed the application in English language, however, a few different languages were found and removed. The total usable review for edX Online Courses application by Harvard, MIT, Microsoft, is 4,200 reviews. The review information presented on the website was limited. Therefore, only the date of the review and the reviews were collected using a web scraper tool.

3.2 Text mining

This study mainly used Nvivo 12 to prepare and analyze textual data collected from online reviews, following a previous study (Barreda and Bilgihan, 2013). The qualitative approach is believed to help identify the codes and theme, while the fundamental variables or themes can be borrowed from prior studies, concepts, and theories (Hsieh and Shannon, 2005). During the text-mining process, stopwords list was employed to detect and filter out the useless word (Zanibellato, Rosin and Casarin, 2017); predefined codes and themes were followed (see Table 1); and recurring data that cannot be categorized into the predefined themes were collected and named as the new themes as appropriate.

3.3 Content analysis

The textual data collected from online reviews were analyzed by following fundamental codes, according to previous theories and concepts. Two coders worked independently to annotate and define codes, while the different opinions were discussed until achieving the consensus (Barreda and Bilgihan, 2013; Iacob, Veerappa and Harrison, 2013); Zanibellato, Rosin and Casarin, 2017). The m-learning application variables occurred in the reviews were added and merged the original predefined themes. As a result, 38 more measurement items were added to the initial 77 items in nine themes as presented in Table 1, totally are 115 items. Next, the sentimental analysis performed by Nvivo program was executed on all 4,200 reviews. The frequency of occurring codes and themes in all reviews and each sentiment-group were analyzed. Table 2 displays the descriptive statistics results of the sentimental analysis from sample reviews.

4. Results

The sample m-learning application, edX, has got 4.6 out of 5 ratings. Therefore, the majority of the 4,200 reviews tend to show positive feedback 94.43%, only 3.12% were negative feedback, and 2.45% were neutral (see Table 2). The negative comments were focal for further analysis.

Table 2: Descriptive statistics from sentimental analysis

Sentiment	Number of Reviews	Percentage
Positive	3,966	94.43%
Neutral	103	2.45%
Negative	131	3.12%
Total	4,200	100.00%

Source: Data collection

Table 3: M-learning quality mentioned by application users in online reviews

M-learning Quality	Positive (n=3,966)	Percentage	Neutral (n=103)	Percentage	Negative (n=131)	Percentage
Pedagogical	1,568	37.33%	72	1.71%	3	0.05%
Performance	294	7.00%	44	1.05%	29	0.69%
Support	259	6.17%	17	0.40%	23	0.55%
Functionality	249	5.93%	25	0.60%	41	0.98%
Usability	77	1.83%	14	0.33%	24	0.57%
Security	70	1.67%	6	0.14%	13	0.31%
Portability	38	0.90%	4	0.10%	4	0.10%
Synchronization	14	0.33%	4	0.10%	1	0.02%
Communication	11	0.26%	2	0.05%	3	0.07%
Occurance number	2,580		188		141	

*n=4,200

Table 3 illustrates the occurred themes of m-learning quality mentioned in the reviews. Nine themes borrowed from previous studies are including pedagogical, performance, functionality, usability, security, portability, synchronization, and communication. The most common themes positively mentioned in the reviews (n = 4,200) are including pedagogical (37.33%), performance (7%), support (6.17%), respectively. Some positive reviews cannot be categorized into the given themes, which led to the smaller number of occurrences of all themes (2,580). The neutral reviews also mentioned pedagogy attributes most often (1.71%), followed by performance (1.05%), functionality (0.60%), and support (0.40%). Functionality (0.98%) recurred most frequent in negative reviews, followed by performance (0.69%), usability (0.57%), and support (0.55%). The frequency of the mentioned themes was counted as one if the codes appeared in each review, not by word frequency, in order to avoid possible bias.

To explore in more detail, each sentiment node was investigated. Figure 1 illustrates the frequency of the m-learning application evaluation themes occurred in positive reviews (n=3,966). Almost half of the positive reviews were compliment phrase. For instances, *"Good app!", "Outstanding!", "Best of all. Thank you edX.", "Great app! Couldn't ask for more!", "I have no words to appreciate the good stuff in this app.",* etc. Comparing within the positive group, pedagogical (39.54%) was mention regularly. The common attributes mentioned were *"Great course", "quality course", "learning opportunity", "increase skill", "interactive course", "free education", "nice content", "best professor",* etc. Performance (7.41%) was also mentioned several times, involving "*video work properly", "download feature", "fast and reliable", "clear sound and text"*, etc. In support theme (6.53%), items found in the group were "*feature", "upgraded version", "support platform/browser",* etc. Functionality (6.28%) mentioned in positive review related to *"output", "platform", "effective"*, *"technology"*, etc.

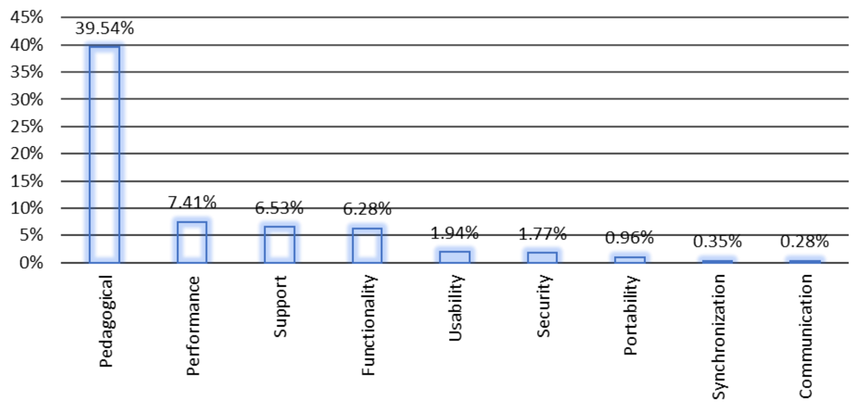

Figure 1: Distribution of positive review issues (n=3,966)

Figure 2 exhibits the distribution of neutral review issues from neutral reviews (n=103). In this group pedagogical (69.90%), performance (42.72%), functionality (24.27%), support (16.50%) were mentioned frequently. The neutral reviews usually consist of unbiased information and the referring of the available features and, sometimes, mixed emotions.

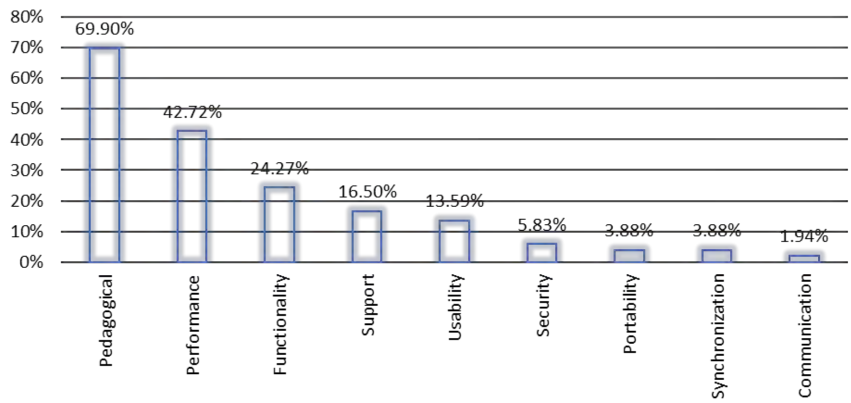

Figure 2: Distribution of neutral review issues (n=103)

The negative reviews are the focus of this study, which the distribution of the group (n=131) is illustrated in Figure 3. The potential issues repeatedly mentioned were including functionality (31.30%), performance

(22.14%), usability (18.32%), support (17.56%), and security (9.92%). The issues raised by users in functionality were generally related to *"playback feature", "broken link", "enrollment process", "payment process", "back up memory", "connection error", "internet connection", "slow connection",* while the performance also concerning the poor connection, such as *"data transfer", "download time", "video quality", "sound quality",* etc. Usability issues involved "user interface" and "screen mode". The support problems were several types of "error", "error message", "customer service", etc., while the security issue related to "sign-in error" and "poor back up feature". Some reviews revealed that pedagogy could be an issue, for example, "bad course", "only English-speaking course", etc.

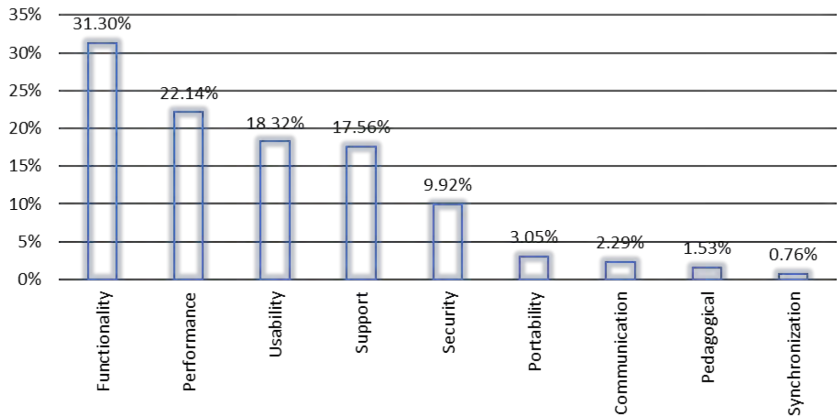

Figure 3: Distribution of negative review issues (n=131)

Table 4 presents the nine categories of complaint samples found among the reviewers. As mentioned earlier, each review could contain more than one issue. For instances, the negative review of portable issue reveals not only portable issue caused by the device, but also the log-in problem, which is considered as security issue. The functionality issue occurred most often and the main problems are the poor multimedia quality and internet connection.

Table 4: Examples of complaints from the reviews

Issue	Example
Functionality	Some courses won't even open. Swipe gesture is completely useless. I swept from a homework assignment accidentally a gazillion times, losing all answers in the process. (Reviewed on March 25, 2019)
Performance	For accessing of account, it's too much consume units of Internet connection, slow movement and buffering of video, and breakable audio comes at our point. How can I resolved, can you guide me? Also, it consumes more mobile battery power. It might be the background app that try to handle my database. If possible, please fix the issues. (Reviewed on January 1, 2019)
Usability	This is poorly designed and implemented. For example, why even have a calendar tab if you're only show a small portion of the course calendar and leave out the most important dates? (Reviewed on April 23, 2019)
Support	It doesn't have any service at all. Completely useless. (Review on November 4, 2018)
Security	Unable to login with Microsoft account from mobile app. Very frustrating (Review on March 4, 2019)
Portability	It won't let me log in, I am registered and can log in through Chrome, but in the application. It insists I don't exist. It also insists on starting in portrait mode - I'm using a 10-inch tablet and that's really stupid in portrait mode... (Review on April 28, 2018)
Communication	Tried to verify, but it didn't accept my Mastercard. Must it be the dollar currency Mastercard? I need quick feedback on this, but it took too long. (Review on February 5, 2019)
Pedagogical	Bad courses. (Reviewed on July 15, 2018)
Synchronization	Its nice idea, but the implementation is quite poor. Course contentment appears with delay of few days compared to web version. Had to uninstall as it jumps out of lesson and prevent using web browser by jumping into app. (Reviewed on May 30, 2018)

5. Conclusion

According to the results, this study affirms the fundamental variables of m-learning application quality from previous studies (Parsons, Ryu and Cranshaw, 2007; Alrasheedi and Capretz, 2015; Soad, Duarte Filho and Barbosa, 2016). However, some suggestion could be added. As can be advised from the findings, some problematic issues were caused by external quality, namely internet connection, internal/external memory, etc. The external metrics should also be included in the evaluation criterion, as suggested by Parsons and Ryu (2008). Though, in order to evaluate the m-learning application quality, the quality of the system itself and the external quality should be separated. The external quality can be treated as the moderator, which can affect the m-learning application users' experience. Moreover, the internal/external memory, which seemed to be a problem for those who download the video to the devices, can also be accounted as the external quality since each device has different memory capacity. This study contributes to the theoretical implication of the m-learning application quality evaluation development for future research. There are some items in the functionality variables that should be detached and categorized as a new theme of external quality, including connection, device, memory, etc. The external quality should be considered as the moderator or the external factor instead of the measurement items of the mobile application quality. Therefore, the actual quality of the application system can be evaluated. In conclusion, aside of nine fundamental M-learning quality variables suggested in previous studies, external quality would be a new variable that could be used to evaluate the application. However, further research should be conducted to find the reliability and validity of the proposed variable.

The practical implications for m-learning application developers and MOOCs managers were discovered from the reviews. Aside from the connection issue, the potential problematic matters of the m-learning application should be noted. For instances, video playback feature, payment process, enrollment process, support browsers and platform, etc. Moreover, MOOCs should be introduced to more teachers or instructors globally and encourage them to involve in this technology to offer courses in new subjects or in more languages. Furthermore, customer service and support are important, especially for the information technology product or service. Aguwa, Monplaisir, and Turgut (2012) also suggest that it is crucial that the customer service team need to respond to the user's inquiries or needs to improve operations and improve users' experiences. In this case, edX overlooked the importance of the customer service tasks, as can be detected from the reviews, while both Coursera and Udemy always provided response and answers for online reviewers. The communication between the corporate and consumers can improve the relationship and maintain existing customers, hence, increasing numbers of new customers.

The limitations of the current study are the sample of the m-learning application. Future research can recruit more application to compare the results and make the research more reliable. Besides, only reviews in English language were analyzed, while opinions in other languages were neglected. As the exploratory research, this study only focuses on finding initial measurements for the m-learning application quality. The future research expands from the current one would involve a quantitative approach to explore the relationship between the suggested m-learning application quality, the external quality, toward the user's experience, satisfaction, and behavior.

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Learning Gains of Process Oriented Guided Inquiry Learning in an Online Course Setting

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Abstract: There is substantial evidence that student-centred learning activities foster the evolution of higher-order skills, such as critical thinking and problem-solving. Process Oriented Guided Inquiry Learning (POGIL) approach is one such student-centred instructional approach that is mainly focused on improving student's content mastery and learning skills such as information communication, critical thinking, problem-solving and metacognition. Currently, POGIL has been mostly implemented in traditional classroom settings, where all participants are physically present. However, advances in online learning technologies have increased the popularity of online courses. Our study aims to implement and evaluate the effectiveness of POGIL in improving the overall student performance in an online course setting. We also present a meta-analysis on POGIL implementation and its effectiveness in different course settings. We implemented a POGIL approach in two completely online courses from the Health Information Management (HIM) program, M200 (Database Design for HIM) and M220 (Health informatics for Decision Support). We integrated POGIL practices into the course redesign of these HIM courses considering the core philosophy of POGIL - students learn through the process of performing activities that aid in developing critical thinking skills - the teacher, in this method, does not instruct, but rather facilitates guided inquiry. The lecture slides and videos were updated with POGIL activities and updates to the educational content, by removing the introduction of new concepts, and replacing them by background information that was required to do the POGIL activities. The modified content was implemented in Summer and Fall semesters of 2018. To evaluate the effectiveness of the POGIL, we compared the student academic performance (grades in the course assessments) of HIM M-200 course before (all semesters of 2017 and spring of 2018) and after POGIL implementation (Summer and Fall semesters of 2018). We used the Wilcoxon rank sum test to compare the performance of the student's pre and post-implementation. The results of the analysis showed that there is a statistically significant difference (p-value = 0.03) in the academic performance of the students before and after implementation. These different implementation under two contexts have been discussed and evaluated under the results.

Keywords: process oriented guided inquiry learning, POGIL, online courses, student-centred, instructional approach

1. Introduction

Online college courses are a rapidly growing feature of higher education. The number of students taking at least one online course in USA is now over 6.7 million in 2017. One out of three students now take at least one course online during their college career, and that share has increased threefold over the past decade (Allen and Seaman 2013). According to Allen and Seaman (2017) study, of all students taking at least one online class, almost half (48%) are taking only online classes. Online education tools are changing the way not only students learn but also their expectations towards how they could be taught efficiently. "Flexible delivery" is a common term used by the majority of the tertiary institutions to introduce off-campus teaching. Online technologies have benefits in terms of flexibility to deliver the courses and learning materials, facilitates collaboration within students, and subject administration. Amidst a multitude of versatile technologies, education practitioners pose the question of how to employ the technologies to enable a rich, engaging learning experience for the students. From the literature reviewed, as the solution, we found out that the acquisition of critical thinking and problem-solving skills can be improved through the implementation of collaborative inquiry-based learning (Duran & Dökme, 2016; Espinosa, Monterola, & Punzalan, 2013; Kowalczyk & Leggett, 2005; Miri, David, & Uri, 2007; Styron, 2014; Wartono, Hudha, & Batlolona, 2018), in which the learning process is emphasized on developing metacognitive skills, such as building some solution, testing the solution, and evaluating the results (Schraw, Crippen, & Hartley, 2006). Through the activity that involves the students in scientific investigation, they are expected to construct their knowledge independently by connecting the new knowledge with the prior knowledge (Fay, Grove, Towns, & Bretz, 2007).

Problem-solving and critical analysis are educational milestones that can be achieved by student engagement and the development of process skills (Kruger & Soltis et al., 2015). Learning methods have revolutionized from lecturer-concentrated to student-focused in the contemporary era, where "Active learning" has the ring of the slogan; and "Passive learning" is an oxymoron (Marchese 1998). Process Oriented Guided Inquiry Learning (POGIL) is one such strategy of active (dynamic) learning where the instructor portrays the role of a facilitator, and students are accountable for their comprehension as well as learning. In this class, the instructor doesn't lecture rather students work in groups or teams, typically of four students, on specially planned activities accompanying a learning cycle paradigm including worksheets completion containing background material, critical thinking questions to develop fundamentals and application exercises that utilize the concepts derived in the critical analysis phase (Elliot P. Douglas,2012). Initially, widely adapted and practiced only in the chemistry curriculum but today POGIL has application in nearly all major disciplines viz. Engineering, Organic Chemistry, Marketing, Nursing, Computer Science, Online Information Technology, Anatomy & Physiology, Pharmacology, Physiological Psychology, Pharmaceutical Sciences & Information Literacy. Existing POGIL techniques were tested for teaching chemistry in a traditional context (Farrell, Moog, & Spencer, 1999; Moog & Spencer, 2008). However, most of the studies still address a situation where the teacher and the student are physically present. Therefore, implementing the results of such studies in an environment where interaction happens majorly online was not successful. (i.e., no face-to-face interaction between the tutor, students, and students themselves).

Encouraging results were generated by Myer et al. (2012) when he adapted POGIL methodology in Information Technology (IT) classes. Myers's et al. (2012) study spanned two years, which consisted of two subjects (networking and databases). The study noted a significant improvement in students' problem-solving abilities, interpersonal skills, and learning outcomes. POGIL was found beneficial by over 85% of the surveyed students for their studies. The outcomes focused not only on developing content mastery or emphasis on core concepts through student construction of their reason, but also enhancing essential process skills such as data processing, oral and written communication, problem-solving, critical thinking, meta-cognition and assessment fostering improved outcomes exclusively when deep learning is to be accomplished (Erl C. Villagonzalo, 2014). Being an instructional strategy to recognize the learning outcomes, the notable aspect of POGIL implementation is its ability to be independent of a specific course outcome. It reinforces accountability among groups generating peer-driven outcomes in comparison to instructor-driven (Myers & Trevathen et al., 2013). Several studies have mentioned that students working together found peer-peer interactions to be more beneficial for active learning than teacher-student interactions alone.

Additionally, the majority of students recognized that being actively engaged in class and interacting with others is an essential part of gaining understanding and retention of knowledge. However, one research study cited that it was unclear that learning outcomes were possibly due to several other factors like cooperative learning, active learning, student mental constructivism & indirect factors like regular study due to POGIL. A clear demarcation for one factor being responsible was not justifiable (Vanags & Pammer et al.). However, despite the proposed advantages of POGIL in these diversified disciplines, there is a paucity of research in the overall effects of POGIL on student performance. Hence our paper entails a meta-analysis on the adoption, implementation and efficiency of POGIL in improving student's performance in different educational disciplines and also details about an actual implementation and learning gains of POGIL in an online course environment. Furthermore, results indicates that implementation of POGIL in a single subject do not yield as much results as when we implemented in a different context with alternate subjects.

2. Methodology

2.1 Meta-Analysis

2.1.1 Data sources and search strategy

Journal articles published during the period 2008-2017 were searched electronically through the primary databases such as PubMed, Ovid, and Science Direct. Keywords such as 'POGIL Assessment' and 'POGIL Methodology' were searched. After collating all the material of the related literature, another round of search was conducted using the reference list found in the literature yielded by the electronic search.

2.1.2 Search results

Initial Screening:

The initial screening yielded 536 abstracts published between 2000 and 2017 that were related to POGIL. The abstracts were read and judged about the POGIL implementation, the methodology used, assessment and their outcomes achieved outcomes, which further resulted in the selection of 60 abstracts out of which 30 abstracts were excluded.

Screening based on methodology and assessment of the outcomes:

In the second stage, the studies were screened according to the methodology. Experimental studies including the pre-test, post-test, review studies, post-test case studies only were included. After this stage, only 14 articles met the inclusion criteria

2.1.3 Application of Inclusion and Exclusion criteria

Inclusion criteria

- Studies were eligible for inclusion in the meta-analysis if they conformed with the following criteria
- If the studies had a properly defined methodology for conducting the POGIL Assessments. (peer reviewed)
- All original articles, reviews were included.
- Articles having POGIL implemented in multi-disciplinary domains were considered.

Exclusion Criteria

- Articles involving active learning methodologies apart from POGIL were excluded.

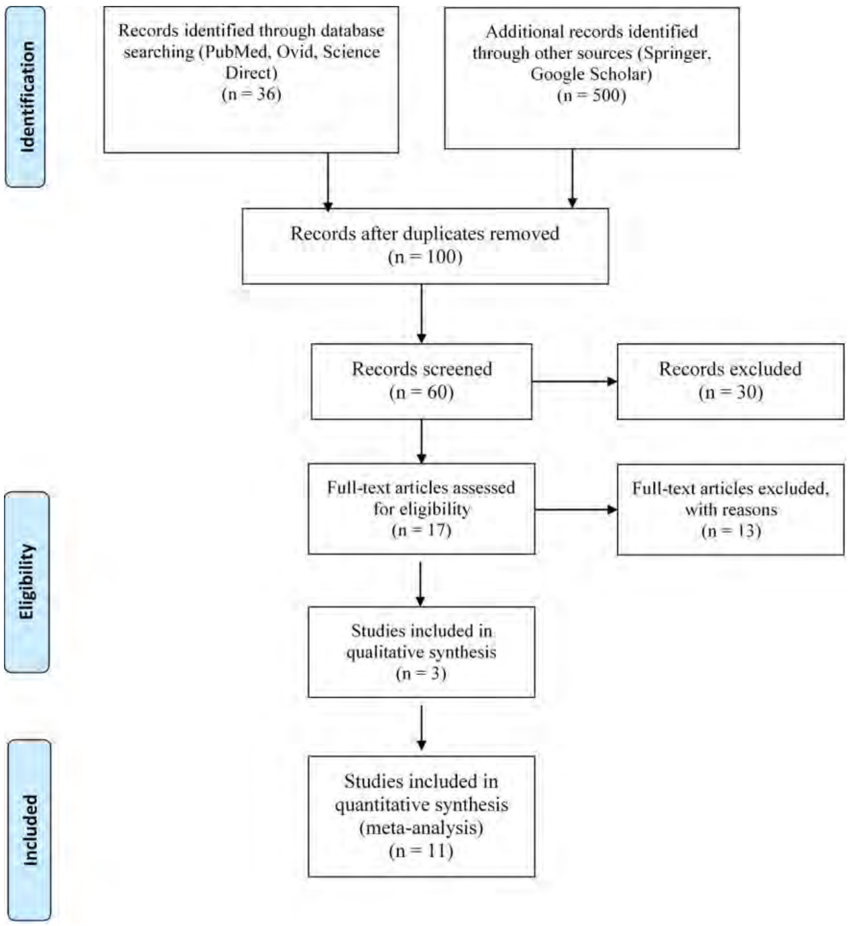

Figure 1: Prisma diagram

1.2.Our POGIL implementation context and methodology

At IUPUI's HIM program, we have taken multiple approaches such as active learning, problem-based learning, experiential learning, and inquiry learning, to involve the undergraduate students in the learning process. These methods are mainly aimed at engaging students in their learning process and are executed under the POGIL implementation. Two courses from the HIM program - M200 - Database design for HIM and M220 - Health Informatics for Decision Support were selected and the core philosophy of POGIL - that students learn through the process of performing activities - that is, by doing, rather than by instruction from a teacher. The teacher, in this case, only facilitates guided learning. The two courses selected for the study contain around 40 students, and already encompass active learning strategies like group discussion and virtual labs in their curriculum. Considering the core philosophy of POGIL, we integrated POGIL practices into the course redesign of these HIM courses - students learn through the process of performing activities that aid in developing critical thinking skills - the teacher, in this method, not only instruct but rather facilitates guided inquiry. The lecture slides and videos were updated with POGIL activities and updates to the educational content, by removing the introduction of new concepts, and replacing them by background information that was required to do the POGIL activities. The modified content was implemented in Summer and Fall semesters of 2018.

The two HIM courses provide didactic content on the Canvas learning management system (LMS) in the form of lecture slides and video recordings. This content gives background information required to synthesize the new concept that the students are expected to develop and understand using the POGIL pedagogy. POGIL implementation began by dividing the class into groups of 3-4, with each member playing the roles of iTrainee and rTrainee. The iTrainee is asked to create a set of tasks on the Canvas LMS, based on the concept that will be discussed based on materials, information from the lecture, and the instructor. The iTrainee, after finishing the task he created, requests the rest of the group - the rTrainees - to complete the task. After completion, the rTrainees and iTrainee will be able to compare their work with each other. The iTrainee will also similarly have to play the role of a rTrainee when other members of his/her group make inquiries and propose new tasks to the group. This method facilitates an intragroup system of learning by doing tasks, as per the POGIL system.

For a sample POGIL activity, an assignment from the HIM M220 course is chosen and modified into a group work. It requires students to identify data/information and knowledge from the EHR data on a patient's dashboard and use it to help in creating clinical decision support rules. Here, an iTrainee is instructed to search for a patient in the EHR system and tag the data as information or knowledge. He posts the same on the Canvas LMS with specific instructions for the rTrainees to complete this task. The students would then compete and collaborate with each other to discover new approaches to finishing this task and of using the EHR system, which would have been difficult in a traditional didactic setting.

Sample POGIL task: Here is the process that an iTrainee follows to reach a patient record and tag data, information, or knowledge. In this POGIL activity, the iTrainee has to gain a process skill that has *three planned concepts* relevant for the basics of clinical decision support systems.

- The process skills of finding a patient record helps articulate the concept of identifiers to search and identify a patient. Doing this activity by themselves would help the students to understand the various parameters in the search function, and the most efficient way to articulate these parameters to complete the task, unlike in a didactic setting which would only entail a lecture about the UI of the EHR.
- The skills of opening the vitals section of a patient record helps articulate the concept of forms in the OpenMRS EHR. Data can be captured through multiple forms, and the vitals form is the most important in the EHR workflow. The students need to be able to distinguish between demographics, formulate questions and learn the concept of forms in their knowledge construction to be able to finish this task.
- This step develops the skill of looking through the vitals data and by processing the data extract information, which when drawn inferences from, creates knowledge from it - for instance, height and weight are used to calculate BMI and when BMI is higher than 25, condition of the patient is overweight.

The iTrainee might sometimes not have understood these concepts and create an incomplete question on the Canvas LMS for the remaining group members to perform a task. The rTrainees would approach this task in their own way and compare it with others, enabling a discussion around the most efficient way to perform the task, which might differ from the iTrainee's initial intention. Improvements in understanding and formulating tasks and questions was seen within 2 weeks in both the trainees.

Student engagement was measured by using learning analytics and survey instrument from the Canvas LMS. The survey is based on the National Survey of Student Engagement (Kuh, 2003) and the Student Engagement Instrument (Appleton, 2012). It contained 22 questions under four engagement components and an interview about the student's experience with POGIL. The results of the analysis of the survey and interviews have been reported elsewhere.

3.Assessment

2.2 Meta-Analysis

Out of 14 articles selected for review and analysis, a majority, i.e., 11 articles performed a quantitative analysis while two articles used a qualitative methodology and 1 study used a mixed methodology approach for analysis. POGIL was implemented in various domains viz Bachelor of Pharmacy, Biochemistry, Online IT, Information Literacy, Computer Science, Pharmaceutical Sciences, Nursing, Marketing, Introductory Anatomy & Physiology, Engineering, Organic Chemistry, Chemistry, Introductory Psychology. POGIL activities were conducted in class in 13 studies, whereas one research study implemented POGIL in an online Information Technology class (Myers & Trevathan). Ezeala 2013, Soltis et al., 2015, Vanags (2012) & Gale (2015) conducted a pre-& posttest analysis, Soltis et al. evaluated GPA, Gale assessed summative scores and applied Non-directional & paired t-test, One-way ANOVA, Kruskall Wallis Test, Tukey's HSD test.

Murray conducted an assessment based on post activity skill, exams, and surveys and further calculating Mean and S.D whereas Roller (2015) considered the final grades by conducting quizzes, examinations, analyzing results by computing Mean, percentage and application of Mann Whitney test. Similarly, Mullen and Hale (2009) & Brown 2010 too assessed mean final grades and conducted quizzes (formative), thereby calculating average scores in percentage & using two-tailed T-test respectively.

Douglas et al. conducted the research using mixed methodology (Interview and final course grades) analyzing probability. Villagonzalo had a very different approach and utilized a tool ParNoMA2 for assessment and calculated ANCOVA, frequency, and Levene's test for Homogeneity. Only a single study was conducted online and was survey based providing analysis using percentages.

Qualitative analysis was conducted by Mitchell & Hiatt assessed effectiveness of POGIL based on questionnaires.

Table 1: Review of meta-analysis

Author	No. of subjects involved	Courses	Assessment	Interpretation of results	Conclusion
Ezeala	42	Second year Bachelor of Pharmacy	Pre-& Post-Test analysis	Mean Pre-& Post-test scores, paired sample t-test at $p < 0.01$, average normalized gain > 0.30 based on Hake's Criteria was considered significant.	POGIL, by computer simulations, produced significant learning gains in student's understanding of pharmacology.
Murray	26 (Fall 2009), 13 (spring 2010)	Biochemistry	Post activity skill Exercise, Exams, Survey	Average score & SD	Student satisfaction observed when dealing with the primary literature.
Myers & Trevathan	122	Third-year online Information Technology	Survey	Percentage (Majority found blogging & social media use interesting)	Students were receptive to the online teaching environment. Online technologies were conducive to

Author	No. of subjects involved	Courses	Assessment	Interpretation of results	Conclusion
					promote engagement and build a student-centred community.
Mitchell & Hiatt	9	Information Literacy	Qualitative analysis	Questionaries' to learn database search, discuss the experience as a group, problem diagramming, learn to design research questions.	Student satisfaction towards POGIL was documented. The active teaching methodology was preferable for technical aspects of the course but not discussion or issue centred topics.
Kussmaul	-	Computer Science	Average grades, Interviews, Activity reports	-	Students initially were uncertain but later satisfied by process skills acquired & concept mastery
Soltis et. *al*	112 (2011 class), 111 (2012 class), 111(2013 class)	Pharmaceutical Sciences	GPA Evaluation (Mean and S. D, Range) Pre-& Post test	One - way ANOVA, Tukey's HSD post hoc test, Kruskall Wallis test.	Positive shift in grade and improved performance distribution and students. Overall students supported POGIL methodology for learning.
Roller	Experimental – 25 Control – 25	Nursing	Final grades – 2 exams, two quizzes, final exam, concept map & ATi grades	Mean, the maximum & minimum percentage of the final grade and ATi nursing national exam grades using Mann Whitney. The test was not statistically significant.	Mean final grade of POGIL group was higher.
Mullen & Hale	Section A – 22 students (Lecture) Section B- 22 students (POGIL)	Marketing	Quiz Final grades	Average percentage	POGIL class had less absenteeism and better performance, but final grades had no significant difference.

Author	No. of subjects involved	Courses	Assessment	Interpretation of results	Conclusion
Brown	Lecture based – 25 (spring 2008), POGIL – 18(fall 2008), 31 (spring 2009), 17 (fall 2009)	Introductory Anatomy & Physiology	Mean Final course grades evaluated by four formative quizzes	Two-tailed t-test at $p < 0.05$	Grade distribution was striking where D/F rate fell, and A/B rate rose. Student satisfaction and perception were recorded.
Douglas & Chiu	Control – 217 students Treatment – 98 & 96 students (2 groups)	Engineering	Interview questions, final course grades (mixed methods)	$P < 0.05$	Goal to reverse the pedagogical roles of the instructor and the student achieved, but student satisfaction was lacking.
Gale	22	Organic chemistry	Pre and Post-test questionnaires, summative scores	Non-directional t-test was used to compare the means.	Students showed a varied academic performance at the end of organic chemistry with a general overall class decrease in the mean score.
Villagonzalo	41	Chemistry	20 multiple choice items to assess students conceptual understanding using ParNoMA2	Analysis of Covariance, percentage, and frequency, Levene's test for homogeneity	POGIL method is better in enhancing students' level of performance & academic performance with higher mean scores as compared to the control.
Vanags	354 undergraduate students	Introductory psychology	Pretest, posttest, and follow-up quizzes.	ANOVA	POGIL approaches to teaching can produce improved long-term learning outcomes for students even when less experienced teaching assistants do the teaching
Rege & Sheikh	50, Third-year level students	Organic Chemistry	Post-test analysis with 11 positively skewed questions based on Likert scale, summative academic test	Pie charts, summary statistics	POGIL offered remarkable potential to improve academic performance and confidence of the candidates facilitating deeper learning

4.Results

2.3 Meta-Analysis

Upon collection of the data from each article Standard Deviation, Standard Error, and mean for both the Control and Experimental studies were calculated. Power analysis for each study population was performed in order to understand the statistical significance of each study. The Alpha value for this analysis was selected as 0.05, which indicates the error rate that we are willing to accept. The calculated effect size for this study was found to be 0.5. In general practice, 0.5 is used as it indicates moderate to a significant difference in the calculation of power.

From the four different types of power analysis, our study falls under Post-hoc power analysis where we are trying to compute the power based on the given Alpha, N (sample size) and ES (Effect Size) values. The sample size of each study greatly influenced the power analysis value. With N = 13 (given .05 alpha), the study has the power of 0.562 whereas, with N = 112, the study has the power of 0.999. After calculating the power analysis for each study sample, the values were found to be in the range of 0.562 – 0.999.

Apart from the above calculation, there is a discrepancy in the evaluation method of each study which restricts its application to other studies. For example, in Hale & Mullen (2009) paper, no assessment of understanding was conducted for the control group, whereas the POGIL treatment group was assessed. The assessment of the traditional lecture group would have proved more basis for comparison. Moreover, the study size of the treatment group was found to be smaller than the control group. All the results show treatment group to have gained less percentage when compared to the POGIL group, which can be attributed to the unequal size of the study population.

In the paper by Roller (2015), the most significant limitation was that the participants were not randomly assigned between the two groups. Undertaking the discrepancy in sample distributing the significance of this study cannot be considered beneficial. The accurate assessment of the study can only be considered when the knowledge and skills of the same student are tested. Though the power analysis gave good value, the results from the study are not very significant.

There are some papers which were mainly focusing on the particular implementation of POGIL method. For example, Fiji (2013) paper talks about the integration of POGIL with computer simulation software in a pharmacy setting. This method cannot be generalized to other areas or subject as it is not necessarily essential to have computer simulation software in every subject. Hence this method of implementation can only be restricted to the courses which have simulation exercises. As Soltis et al., the paper also focuses on the implementation of the POGIL implementation in pharmaceutical studies, it was mainly focusing on Pharmacokinetic and Pharmacodynamic studies. Whereas the pharmaceutical studies also include other areas of focus such as Chemistry, Biostatistics, Anatomy & Physiology. Though the title of the paper says pharmaceutical sciences, it was mainly focusing on just two areas out of all. Hence this method of evaluation may not provide significant results when implemented in other areas of Pharmacy. Apart from this, Rege's paper focuses on understanding its implementation for effective learning of Organic Chemistry. Though this paper presents results on the improvement of student's confidence and Academic performance, it did not necessarily talk about gaining in-depth Organic Chemistry concepts. Although it talks about how helpful it was in understanding the basic concepts but does not provide evidence of improvement, this provides less evidence for its actual significance in improving Organic Chemistry learning. In one paper by Sen (2016), the study was more specific to understanding how POGIL methodology can improve the student's misconception. Though this study was conducted only in Electrochemistry focus, the literature review provides evidence to conduct this type of research with alternative students as well as other subjects.

Though the power calculations gave us the range of values showing the effect of each study was purely due to the differences in the effect size of each study population. Based on the above review, we can conclude that the results of the implementation of POGIL in different settings were dissimilar. As there is not enough evidence of its implementation in the general setting to be successful, we can infer that POGIL implementation was not very impactful.

2.4 Our POGIL implementation

To study the effectiveness of the POGIL implementation in our online courses, we compared the student academic performance (grades in the course assessments) of HIM M-200 course before (all semesters of 2017 and spring of 2018) and after POGIL implementation (Summer and Fall semesters of 2018). The sample size(N) of the pre and post implementation phase was 42 and 37, respectively. The effect size was 0.355, and the power of the study was 47.4%. We used the Wilcoxon rank sum test to compare the performance of the student's pre and post-implementation. The results of the analysis showed that there is a statistically significant difference (p-value of 0.03) with a mean difference of ±4% in the academic performance of the students before and after implementation.

3. Conclusion

POGIL implementation in various courses reveals the methodology employed, and assessment was done using different parameters. POGIL implementation among the students facilitates them in deep learning. The implementation and assessment methodology of POGIL in various settings is different and differed with the type of study population taken into consideration. In some studies, there was an improvement in conceptual knowledge, whereas others presented the advancement in interpersonal skills. Overall, no two studies have either taken the same type of methodology or assessment so we cannot talk about its overall impact on a general setting. However, in our online course setting, there is an improvement in overall academic performance of students after POGIL implementation. Students show diverse academic performance at the end of work taught using POGIL. The success rate of POGIL differs from the methodology used and other factors like a response from students. Initially, POGIL is new and needs basic awareness programs for students and faculty for effective implementation.

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E-Learning and Learner Knowledge Sharing Quality: Ahlia University as a Case Study

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Abstract: E-learning is an emerging approach in universities where self- directed students and motivated learning increases the utilization and integration of knowledge sharing in e-learning. The learning virtual community is a domain where inquiries, interest or needs, are shared. Such circumstances lead to interactions that allows virtual participants to learn from each other. This study examines the impact of e-learning on learner knowledge sharing quality. To fulfill the requirement, a quantitative approach was used to measure the e-learning approach developed at Ahlia University in Bahrain, and whether it directs the students to the required knowledge sharing quality. A constructed questionnaire has been developed and a sample of 376 Ahlia University respondents generalizable over the College of Business and Finance. The study concluded that there's an impact of e-learning on learner knowledge sharing quality and this is due to the e-learning environments at Ahlia University that are composed of those technologies that aid in teaching and learning; such as Moodle, where students log-on to attain blended e-learning experiences. This study and its conclusion overcome the gap exists in which students expressed an influential role of self-directed and motivation for learning and knowledge sharing in e-learning environments.

Keywords: e-learning; knowledge management; knowledge sharing

1. Introduction and review

E-learning or (online education) has become a quotidian practice in many educational institutes as a way to deliver knowledge and information to students (Allen and Seaman,2013) which in turn increased the learners' autonomy and independence in the learning process. Moreover, , e-learning provides flexible learning materials and consistent information, with ease of use which in turn motivates universities to invest their resources in developing online practices (Wenchieh, Lan-Yin, 2010). As e-learning refers to the use of electronic devices for learning, including the delivery of content through electronic media such as internet, audio, or video (ASTD, 2001), universities are placing increased emphasis on improving the quality of their educational services (Kuo and Ye, 2009). Since decade, with the advent of information and communication technologies (ICT), learning environments (e.g., web 2.0 e-learning tools: Moodle, email, instant messaging, wiki blogs, social networks, video conferencing) and changing practices, there is an increasing tendency for student-centered and virtual community-based learning (Yilmaz, 2016; Kunthi, Wahyuni, Al-Hafidz, & Sensuse, 2018). In this scenario, the learning virtual community is a domain where inquiries, interest or needs, are shared. Such circumstances lead to interactions that allow virtual participants to learn from each other. A learning community environment is responsible for fostering its learning and managing knowledge to develop competencies. Here, such communities, allow the transfer of knowledge between learners; enabling participating learners in such communities to learn from each another, as well as, foster new knowledge creation within the social capital of resources of such a learning community. Here interactions help to learn, problem-solving, new knowledge creation and motivation for learning during the moderation of ICT, when one thinks of virtual learning communities. In such situations, knowledge societies are part of knowledge dependent operations-based knowledge economies that transition into strategies and policies-matured learning environments. Every society holds a diverse group of people's skills and experiences, where knowledge is a commodity in the form of the social capital of the society's resources, that when subsidized empowers the knowledge economy of a society. Unfortunately, no strategies or policies are assisting society to become knowledge-intensive economies. Knowledge increases as a society globalize. Knowledge assets become goods, which increase with time, and get utilized, unlike tangible goods`. A knowledge society is constructed upon four pillars being infrastructure, governance, human capital and culture (Karolak & Razzaque, 2013; (Moylan & Razzaque, NYIT Education Survey, 2014) (Moylan & Razzaque, 2014)). There has been a reported growth in virtual classrooms for academic teaching and learning, and workplace training. While 70% of the teaching and learning is classroom-based, such teaching and learning is a blend between e-learning using online learning platforms and traditional in-class teaching and learning, with an increase adaption of cell phones for M-learning. When learners enroll in an online course, interactions occur via text, audio and video messages across time and space. Hence, e-learning is a blend of asynchronous and synchronous communications where synchronous live teaching and learning in chat rooms with the continuous conversation but asynchronous learning is across breaks in interaction within virtual discussions (Baehr, 2012). With tools like instant messaging, e-mails, forums, blogs, social platforms and virtual conferencing; virtual learning has become an alternative channel to support learning in and outside classrooms. Hence, social media is especially applied as virtual learning environments to engage learning through interactions in a social environment as learners participate. Through the construction of new knowledge in the minds of these learners, learn can also occur through observations of discussions on a discussed issue, which his being shared within a community of learners. This indicates that using the virtual environment, even social platforms like Facebook, could prove useful in ensuring knowledge exchange and diffusion within no time, as well as an environment that harvests cooperation and interaction between learners. In such learning environments, knowledge is shared as the main motion, which encourages community participants to share more knowledge, increasing motivation to learn and participate through their behavior of knowledge sharing, as well as, frequently share knowledge. Knowledge sharing is also the main challenge encountered in the learning process in online learning environments (Yilmaz, 2016). Knowledge enrichens and becomes deeper during knowledge sharing while e-learning in groupware, chat-room, and forums. Knowledge sharing in e-learning is vital for enriching the social capital of knowledge, or else e-learning will discontinue. Social media platforms like Facebook, WhatsApp or Line are vital and popular tools for virtual learning interactions, far better than plan e-learning environments like Moodle. The application of social media as virtual communities reinforces the ease in the use and acceptance of is virtual learning platform to interact and, therefore, learn (Kunthi, Wahyuni, Al-Hafidz, & Sensuse, 2018). E-learning is also a buzz word within the commercial sector of the globe. “Learning organization” is a term that arouses conceptualization reflecting a structure where, knowledge is utilized through knowledge sharing, acquisition, and diffusion, a participating behavior to improve competition. Such a process to build a learning organization is fundament as an underpinning infrastructure to formulate an organizational memory. With the development of the ICT that promotes virtual conditions to increase organizational memory; the E-learning tool forms the stepping stone for a fundamental environment for systems interoperations and knowledge communications. The adoption of the E-learning as a knowledge communication tool is so to allow organizations to access others’ experiences from which they could develop unique knowledge. Such available knowledge allows organizations to learn in competitive environments thus, to pursue sustainability from learning and innovation (Sousa & Pinto, 2013). Blended e-learning is mixing online and traditional teachings and learning modes; a combination of both, or by the use of variances in media types, technologies, and communication modes. Hence, developing effective virtual teaching and learning environments requires a complex understanding of how technology is integrated with users such that learner participants can interact to share knowledge to learn. Such challenges are further complex for the instructors who have limited experience in teaching methods, in addition to virtual teaching and learning experiences. Such an e-learning environment requires higher digital literacy from the instructor and learning point of view. E-learning environments that are mediated by ICT help learners create a social learning environment where knowledge gets shared for cooperative learning, and online the sharing of knowledge formulates an appropriate learning culture, whether in a traditional classroom or an e-learning mode of teaching and learning; where learners should take a more active role in knowledge exchange, particularly in online training (Baehr, 2012; Caspersen, Frølich, & Muller, 2017; Honey & Mumford, 1992).

2. Method and sample

This study initiated with a critique of a literature review to understand gaps in research focused on e-learning. After this phase was the pinpointing of the research question and research objectives followed by the formulation of a conceptual framework, and the relative hypothesis. To test the hypothesis; data were collected from 376 Ahlia University respondents generalizable over the College of Business and Finance’s 700 students (i.e. close to approximate) population. Collected data were analyzed using descriptive and advanced descriptive analysis followed by correlation analysis and explained in the data analysis section. This a deductive research approach seeks confirmation on its hypothesis and its cross-sectional data collection on 376 responses were based on filled online survey forms. The survey instrument was adapted from two sources: learning readiness and learner knowledge sharing quality. The needs for assessing this study’s hypothesis is literature driven; s past scholars have not assessed this role in the higher education sector; hence a novel assessment of this study.

Table 1: Demographic distribution.

Sample Characteristics		Frequency	Percent
Gender	Male	212	56%
	Female	164	44%
	Total	**376**	**100%**
Age	12 - 17 years old	16	4%
	18 - 24 years old	312	83%
	25 - 34 years old	48	13%
	Total	**376**	**100%**
Student Status	GCC student	250	66%
	Non-GCC student	126	34%
	Total	**376**	**100%**

Table (1) indicates that in terms of gender, the respondents who participated in the survey were mostly Males with 56%, while the females represent 44%. In terms of age, most of the respondents (83%) were between the ages of 18 & 24, 13% of the respondents were between the ages of 25 & 34, while 4% of the respondents were between the ages of 12 & 17. Regarding the status, it can be seen that in terms of nationality, the majority of the respondents (250) were those the GCC students representing 66%, while Non-GCC students (126) represent 34%.

3. Findings

Table (2) shows the mean of all respondents' opinions about learner knowledge sharing quality. The highest mean of learner knowledge sharing quality was 3.915 related to "The knowledge shared between instructor and students in Moodle is easy to understand" with general percent 78%, followed by" The knowledge shared between instructor and students in Moodle is relevant" with mean equals to (3.883). On the other hand, the analysis also determined that "The knowledge shared between instructor and students in Moodle is timely" had the lowest mean which was 3.617 with a general percent 72%.

Table 2: Learner knowledge sharing quality

Learner Knowledge sharing quality	The Answers%							
	Strongly disagree	Disagree	Neither	Agree	Strongly agree	Mean	SD	General Percent
The knowledge shared between instructor and students in Moodle is easy to understand.	9.574	1.064	4.255	58.511	26.596	3.915	1.099	78%
The knowledge shared between instructor and students in Moodle is relevant.	5.319	6.383	6.383	58.511	23.404	3.883	1.010	78%
The knowledge shared between instructor and students in Moodle is easy to understand.	7.447	3.191	11.702	54.255	23.404	3.830	1.060	77%
The knowledge shared between instructor and students in Moodle is accurate.	7.447	3.191	17.021	50.000	22.340	3.766	1.068	75%
The knowledge shared between instructor and students in Moodle is complete.	6.383	4.255	17.021	46.809	25.532	3.809	1.066	76%
The knowledge shared between instructor and students in Moodle is reliable.	6.383	6.383	7.447	54.255	25.532	3.862	1.069	77%
The knowledge shared between instructor and students in Moodle is timely.	9.574	5.319	15.957	52.128	17.021	3.617	1.123	72%

Table (3) shows the mean of all respondents' opinions about Self-Directed Learning, the highest mean of Self-Directed Learning was 3.85 related to "I have higher expectations for my learning performance" with general percent 77%, followed by" I carry out my study plan" with mean equals to 3.75. On the other hand, the analysis also determined that "I manage time well" had the lowest mean which was 3.54 with a general percent 71%.

Table 3. Self-Directed learning

Self-Directed Learning	The Answers%							
	Strongly disagree	Disagree	Neither	Agree	Strongly agree	Mean	SD	General Percent
I carry out my own study plan.	8.3	7.5	17.4	34.4	32.4	3.75	1.22	75%
I seek assistance when facing learning problems.	7.5	14.2	14.2	40.3	23.7	3.58	1.207	72%
I manage time well.	10.7	9.1	20.2	35.6	24.5	3.54	1.252	71%
I set up my learning goals	7.9	7.1	17.8	42.3	24.9	3.69	1.155	74%
I have higher expectations for my learning performance.	5.5	7.5	15.8	39.1	32	3.85	1.122	77%

Table (4) shows the mean of all respondents' opinions about Motivated Learning, the highest mean of Motivate Learning was 3.78 related to "Have the motivation to learn" & "improve from my mistakes" with general percent 76%, followed by "I am open to new ideas" with mean equals to 3.77. On the other hand, the analysis also determined that "I like to share my ideas with others" had the lowest mean which was 3.68 with a general percent 74%.

Table 4. Motivate learning

Motivate Learning	The Answers%							
	Strongly disagree	Disagree	Neither	Agree	Strongly agree	Mean	SD	General Percent
I am open to new ideas.	6.7	8.7	17.8	34.8	32	3.77	1.184	75%
Have motivation to learn.	6.3	8.7	15.8	39.1	30	3.78	1.154	76%
improve from my mistakes.	6.3	9.5	11.9	44.7	27.7	3.78	1.14	76%
I like to share my ideas with others.	7.1	9.9	16.2	41.1	25.7	3.68	1.166	74%

4. Conclusion

This study aimed to assess the role of learner's self-directed and motivated learning on the quality of their shared knowledge behavior, while they conduct teaching and learning with their instructors, and particularly their peers during e-learning. Considering that this study occurs with the target population of Ahlia University students, from the College of Business and Finance's 700 enrolled undergrad students; the empirical findings are not surprising to the authors of this study. It is important to take note here that e-learning environments at Ahlia University are composed of those technologies that aid in the teaching and learning; such as Moodle, where students log-on to attain blended e-learning experiences, smartboard technologies, used during face-to-face traditional classroom teachings; but not limited to only such ICTs. This is since students also indulge in in-class participation while using their cell-phones to participate in instructors' teaching inquiries; for instance, when an instructor may ask students to check the definition of a term since the best learning is from self-inquiring. Students at Ahlia University prefer using Google to do such searches, to participate to learn. However, other forms of ICTs are also used for e-learning but those technologies are more in association with social media (such as WhatsApp for out-of-class student-instructor communications, etc.) and m-commerce, or m-learning (Moodle thru cell-phones, etc.). It is no wonder why students expressed an influential role of self-directed and motivation for learning and knowledge sharing in e-learning environments, since such students are tech-savvy, as this is an observed phenomenon by the authors of this student, not only for the students of Ahlia University, or the citizens of Bahrain but in general for those who reside in the Gulf Corporation Council (GCC) region. The empirical evidence in this study shed new knowledge on how further research is inevitably evident to further understand the key issues that pertain to e-learning in this part of the developing world. However, it does without saying that this study has a few limitations. First, an online survey was hosted on Google Forms and it was cross-sectional data collection; whereas future research could assess this study's model with further details when assessing this instrument longitudinally. Second, the timeline given to conduct this research project was only one semester, while other issues remain under the pending list, e.g., using such a phenomenon using social media or through m-learning means, should, and will be, assessed in future research. Also, considering that internet action is a trendy, but more importantly a serious research subject of concern, should also be assessed from the prism of e-learning, considering that students constantly are online, with lack of empirical evidence actually informing parents, to what extent such platforms are used for sharing knowledge versus wasting time establishing friendship ties. Furthermore, this study has implications for theory and practice. From theory, the model is viable for improving curriculum design, such that students' learning readiness and knowledge sharing should spearhead a stronger drive for Ahlia University to use e-learning more comprehensively, though still with caution. Practically speaking, findings of this study set a benchmark for assuring quality in teaching and learning; with the emphasis on future research to also an example to what extent students are motivated to share knowledge so that such knowledge drives their imagination, creativity, hence innovation.

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Examining the Compatibility of Students in Distributed Pair Programming

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Abstract: Pair Programming (PP) has a long history both in the software industry and education. More recently, specially designed environments have made the application of Distributed Pair Programming (DPP) possible, which enables two programmers to work remotely. Through these collaborative activities, students produce better programs, improve their performance and programming skills, and increase their self-confidence. Student attitudes towards Distributed Pair Programming and the factors that affect them, remain largely unexplored, while some of the existing studies have yielded mixed results. One important aspect is to understand the underlying factors that contribute to a successful pairing formation, i.e., factors that make pairs very compatible. This paper focuses on the examination of possible factors which we felt had the potential to affect the compatibility of student pairs who worked remotely. The present study was conducted in the context of a 3rd semester undergraduate “Object-Oriented Programming” course. The OOP concepts were approached through hands-on exercises completed in the lab sessions. Students carried out projects in pairs using the educational DPP system SCEPPSys. The analyzed data were collected from a pre and post questionnaire distributed to students before and after the end of the course, respectively. Pair Compatibility was examined in relation to pair perceived skill level, pair actual skill level, and pair programming self-esteem. Besides this, we examined if students' perceptions on the factors they believe hinder collaboration differ on the basis of their compatibility. The findings indicated that the compatibility rating differed significantly based on the partner’s perceived technical competence. Also, students that rated their partners as very compatible had more similar actual skill level with their partners than those students who rated their partners as not-compatible or satisfactorily compatible. We did not find any relationship between compatibility and pair programming self-esteem. Lastly, very compatible pairs rated the following three factors as hindering collaboration less negatively than not-compatible or satisfactorily compatible pairs: a) coordination problems (collaboration time), b) unreliable partner, and c) lack of partner knowledge.

Keywords: distributed pair programming, pair compatibility, OOP course, programming skills

1. Introduction

The growth of the internet has facilitated communication and collaboration among distributed teams and as a result various technologies have been developed that support multiple users and real time collaborative activities. Nowadays, it is common to use applications that allow concurrent document editing, file sharing, project management, or even software development. One such form of remote software development is Distributed Pair Programming (DPP). It is performed using a system that allows team members to communicate, to coordinate actions, and to write code using a shared file repository and a shared editor (Schümmer and Lukosch, 2009). DPP is practiced by both professional and student programmers; the latter being the focus of our study.

DPP is based on the principles of Pair Programming (PP), an agile software development technique and one of the key practices of Extreme Programming (XP). PP consists of a pair of programmers working together at one computer (Beck and Gamma, 2000). One programmer writes the program code and the other one reviews the inserted code. The two co-workers switch roles regularly. The aim of this practice is to improve software quality and share coding skills. A survey conducted in 2017 by the website StackOverflow, revealed that PP is quite popular in the software industry, since 42.8% of reviewed developers stated that they use PP methodology in software development. In education, PP appeared in computer science classes almost two decades ago. The first experiments of PP in the classroom reported positive outcomes. Since then, extensive studies have been conducted, mainly in higher education.

Research suggests that the use of PP in introductory programming courses has a positive impact on student performance and satisfaction (McDowell et al, 2006; Mendes et al, 2006; Smith et al, 2017). It improves software quality and student confidence in programming ability (McDowell et al, 2006; Braught et al, 2011; Celepkolu and Boyer, 2018). Moreover, students share problem-solving skills and responsibilities, and they may work on large-scale projects as professional teams (Schümmer and Lukosch, 2009; Stapel et al, 2010). Despite the benefits, the success of PP depends on pair dynamics and each developer's skills and attitudes (Katira et al, 2004; Chaparro et al, 2005). DPP is as effective as PP (Hanks, 2006) and but has a major advantage over PP: it is more flexible and allows programmers to collaborate remotely.

The focus of this paper is to investigate compatibility between pair programmers and factors that might affect collaboration at a distance. Pair Compatibility was examined in relation to pair perceived skill level, pair actual skill level, and pair programming self-esteem. Besides this, we examined whether students' perceptions on the factors they believe hinder collaboration differ on the basis of their compatibility.

The paper is organized as follows: In the next section (Section 2) a presentation of related work in the field is given. Then, the methodology of the study and the research objectives are presented (Section 3). Section 4 contains the results of the statistical analysis. A discussion and conclusions follow in the last section (Section 5).

2. Related work

Pair formation and pair compatibility are well-studied factors in the literature of PP. Researchers have experimented with various team formation strategies in order to study their impact on students' participation and motivation. Although random pairing has been applied, other factors include students' personality type, and programming skills. In fact, student skill level was shown by a meta-analysis to be the most commonly investigated parameter (Salleh et al, 2011), defined as either actual or perceived. The former is based on students' prior programming experience and academic performance, while the latter is based on students' subjective assessment of their own and their partner's skill levels. Perhaps not surprisingly, most studies came to the conclusion that the best results are achieved by pairing students with similar skill levels.

Williams et al (2006) conducted a number of studies in order to understand the factors that contribute to the compatibility of pair programmers. The pair programming-based courses in which they performed their research were: freshmen Introduction to Programming – Java (CS1), undergraduate (junior/senior) Software Engineering (SE), and graduate Object-Oriented Languages and Systems (OO). They suggest pairing students with similar grades, since students reported that they worked compatibly better with partners of a similar skill level. In the same study, they investigated whether pairs are more compatible when students with similar programming self-esteem are put together. The results showed that students' confidence in their problem-solving skills may be an indicator of pair compatibility. In a study by Van Toll et al (2007), where students formed pairs based on programming skills it was found that PP is more effective when programmers are of a slightly different skill level. Chaparro et al (2005), observed that a difference in skill level between partners negatively affects their collaboration thus reaching the conclusion that matching pairs by skill level is a key factor in the success of PP.

Students' self-esteem in programming has been examined in many studies as a principal factor concerning the effectiveness of PP and DPP. Thomas et al (2003) report that students with less self-confidence seem to enjoy pair programming the most. In contrast, Hanks (2008) states that in his study the most confident students liked pair programming the most, while the least confident students liked it the least. Muller and Padberg (2004) define the feel-good factor of a pair as how comfortably the developers feel in a pair session. It should be mentioned that researchers use the terms 'self-esteem' and 'self-confidence' interchangeably.

In our study, pair compatibility was examined in relation to perceived skill level, actual skill level, and programming self-esteem. The main difference between the aforementioned studies and our study is the programming technique used. Instead of co-located PP, the participants in our study collaborated remotely using a DPP system. Research in the field of DPP is less developed and more empirical studies are needed (da Silva and Prikladnicki, 2015). Canfora et al (2006) performed an experiment to investigate the impact of DPP, and despite the similar programming experience of the participating students, they found that each pair member tended to work alone. They suggest that different levels of programming experience may lead to a more successful collaboration. Another study involving DPP where prior programming experience is correlated with a pair's performance, reports that pairs are more compatible when both students have a similar perceived skill level (Tsompanoudi et al, 2018).

3. Methodology of the study

3.1 Research objectives

As already mentioned in the related work section, pair formation and pair compatibility are well-studied factors in the literature of PP and less studied in DPP. Thus, this study focuses on the examination of possible factors which we felt had the potential to affect the compatibility of student pairs who worked remotely. Pair Compatibility was examined in relation to perceived skill level, actual skill level and programming self-esteem.

The following five hypotheses were investigated:

H1: Pairs are more compatible if students with similar perceived skill level are grouped together.

H2: Pairs are more compatible if students with similar actual skill level are grouped together.

H3: Pairs are more compatible if students with similar programming self-esteem are grouped together.

H4: Students' perceptions on the factors that hinder their collaboration differ according to their compatibility.

H5: Students' perceptions on the frequency of use of the system's features differ according to their compatibility.

Hypotheses H1-H3 were adopted from the work by Williams et al (2006: p. 412), where they studied pair compatibility when students worked co-located. We adopt these three hypotheses because we wanted to investigate if the same results hold for DPP as for PP. Besides this, we further investigate hypotheses H4 and H5 which are related to DPP, compatibility and the system used by the students to collaborate remotely.

3.2 Course outline - participants

For the investigation of the above stated hypotheses, a study was carried out in the context of a 3rd semester undergraduate "Object-Oriented Programming" course at an Informatics Department. Data were collected throughout the spring semester of the academic year 2016-17. The course was taught in the lab and hands-on exercises were used for presenting and familiarizing students with OOP concepts. A summarized course outline is presented in Table 1.

Table 1: Course outline

Course	Object-Oriented Programming
Semester	3rd
Duration	13 weeks, 3 hours per week (lab sessions)
Programming language	Java
Programming environment	Eclipse
Syllabus	Objects and classes (necessity of using classes) Class definition (fields, constructors, methods) Constructing objects and calling methods (main) Class associations Object collections (array, ArrayList) Inheritance, polymorphism and overriding Abstract classes and interfaces Graphical User Interface (constructing a simple GUI, event handling, interaction with domain classes) Collection framework of Java Manipulation of text and binary files

Within the course context, students carried out five DPP assignments in pairs using the educational DPP system SCEPPSys. Details on the DPP assignments is presented in summary form in Table 2.

SCEPPSys (Tsompanoudi et al, 2015) is an educational DPP system that comprises an Eclipse plugin installed by students and a web-based authoring tool used by instructors for scripting DPP. In order to start a DPP session, both students must log in to the system, while assignments are solved synchronously. SCEPPSys includes the following categories of features:

- Typical features of DPP systems: a shared editor; synchronization of editors after connection problems; support for the roles of the driver and navigator and role switching either by the system or freely; a text-based chat tool for communication; remote code highlighting (a basic gesturing feature) that enables the navigator to point out code parts in order to indicate potential problems to the driver; synchronized program execution (the driver executes the project and both the driver and the navigator watch execution results).
- “Awareness indicator” features, whose aim is to provide pair programmers with information about the user’s status and performed actions within the workspace, such as editing, saving etc., as well as their participation rates.

Unique *didactic features* that serve specific needs: assignments comprise of small and manageable tasks or steps associated with specific didactic goals or else OOP concepts; hints can be retrieved for each task that support students to complete each task.

Table 2: DPP assignments

Participants (DPP assignments)	88 (44 pairs)
Prior Programming knowledge	1st semester “Procedural programming course based on C”
Prior experience on DPP	None
DPP system	SCEPPSys
Pair formation	Free selection of partner
Assignments	1. Class definition, main 2. Class associations 3. Object collections – ArrayList 4. Inheritance & polymorphism, GUI, event handling 5. Binary files (& inheritance, ArrayList, Comparator)

3.3 Measurement instrument and data analysis

The meanings and measures of the factors in our study are given below. As in the research

Actual Skill Level is measured as the absolute difference between the partners’ grades, where the grade is made up of the mean from the 3 courses (Algorithms, Procedural Programming, and OOP-Java). “Procedural Programming (C programming language)” and “Algorithms in C” are introductory first year courses and their syllabi and assignments are quite typical of Universities around the world. In the literature, actual skill level is based on students’ prior programming experience and academic performance. In the present study, actual skill level was measured in the same way as in the research by Williams et al (2006).

Programming self-esteem is measured as the absolute difference between the partners’ self-esteem about Programming. Self-esteem in programming is measured by the students themselves on a scale from 1 to 9 prior to the beginning of the OOP course. Students were asked to answer question (Q)1 on the pre-questionnaire.

Question (Q)1. Place yourself on a 1 to 9 scale with the following endpoints:
1 = I don’t like programming, and I think I am not good at it. I can write simple programs, but have trouble writing new programs for solving new problems.
9 = I have no problems at all completing programming tasks to date, in fact they weren’t challenging enough. I love to program and anticipate no difficulty with this course.

In their studies on Pair Programming, Thomas et al. (2003: p. 364) and Williams et al. (2006: p. 417) posed Q1 in order to measure students’ self-esteem on their ability to program. Consequently, although one might argue that Q1 asks how challenging the assignments were, and how much students like programming, it should be noted that given the specific context, the question deals mainly with students’ confidence in their ability to program.

Perceived Skill Level (partner): Students were asked to provide their perception of their partner's technical competence with regard to their own competence [Better, About the same, Weaker] as a response to question (Q)2 on the post-questionnaire.

Question (Q)2. Assess the technical competency of your partner in relation to yourself [Better, About the same, Weaker].

In the literature, perceived skill level is based on students' subjective assessment of their own and their partner's skill level. Question (Q)2 was adapted from similar researches conducted in the context of PP. Muller and Padberg (2004), used Q2 to measure how comfortable students felt during the pair programming session, and the same question was used by Williams et al (2006), to ask students to evaluate their partner's technical competence.

Compatibility was based on the student's perceived compatibility. Each student evaluated, on a scale from 1 (not-compatible) to 3 (very compatible), how compatible they felt with their partner regarding the latter's programming ability (question (Q)3 on the post-questionnaire).

Question (Q)3. Assess how compatible you felt you and your partner were [Very Compatible, satisfactorily compatible, Not Compatible].

Williams et al (2006), asked students question (Q)3 in order to evaluate their perception on their joint compatibility.

In the present study, Pair Compatibility was based on students' responses to Q3: when both students chose *Not Compatible* to characterize their partner, we classed them as *Not compatible* pair; when both students chose the *Very Compatible* option, they were classed as such; and all other pairs were classed as *Satisfactorily compatible*.

The analyzed data were gathered from:

- The grades achieved in the three courses: the first year introductory courses "Procedural Programming (C programming language)" and "Algorithms in C", and the "OOP".
- Students were asked to answer Q1 prior to the OOP course (pre-questionnaire).
- In order to investigate students' attitudes on DPP, they were given a questionnaire as a Google form on completion of the DPP assignments at the end of the semester. The students were asked to evaluate: their perception of their partner's skill level (Perceived Skill Level) (Q2); their joint compatibility (Compatibility) (Q3); factors hindering collaboration (Q4); and lastly, they were asked to rate the frequency of use of the system's features which aimed to facilitate DPP (Q5).

The following questions (Q)4 and (Q)5 were included on the post-questionnaire:

Q4. What factors hindered collaboration?
(1=very much, 2=much, 3=averagely, 4=a little, 5=not at all)
Coordination problems (collaboration time)
Unreliable partner
Lack of partner knowledge
Dominating role of partner
Technical problems
Difficulty in using the plugin

Q5. Rate the frequency of use of the system's features which aimed to facilitate DPP over Eclipse.
(1=not at all, 2=a little, 3=averagely, 4=much, 5=very much)
Role switches
Synchronization in the execution of a program
Retrieve help (hint) of the solution for every programming task
Remote code highlighting
Display participation rates

Synchronization of editors

Out of the 88 students, the statistical analysis was compiled on 78, as these students answered both questionnaires.

We should point out that the few students who rated their partner as not compatible (1%), we combined with those students who rated themselves as satisfactorily compatible. Combining these two groups of students has a reasonable basis and allows for a more reliable application of statistical tests.

Statistical analysis was performed by using IBM SPSS Statistics. The Chi-square Test of Independence was applied for H1, while the Mann-Whitney test was used for the rest Hypotheses.

4. Results

A Chi-Square test was performed on H1. The Chi-Square test indicated that the compatibility rating differed significantly (X^2=8.422, df=2, p=0.015) according to the partner's perceived technical competence (partner's assessment). The students, who considered their partners as weaker than themselves in technical competence, tended (90.9%) to rate their partners as satisfactorily compatible or not compatible rather than very compatible (9.1%) (Table 3).

Table 3: Students' distribution with respect to compatibility and perceived technical competence

Perceived Skill Level	Not compatible/ Satisfactorily compatible	Very compatible	Total
partner was weaker	10 (90.9%)	1 (9.1%)	11 (100%)
partner was equal	26 (46.4%)	30 (53.6%)	56 (100%)
partner was better	4 (36.4%)	7 (63.6%)	11 (100%)
Total	40 (51.3%)	38 (48.7%)	78 (100%)

A Mann-Whitney test was performed on H2. Students who rated their pairs as very compatible have more similar actual skill level with their partners (Z=-2.922, p=0.003) than those who rated their pairs as satisfactorily compatible or not compatible.

The absolute difference between the partners' grades who rated their pairs as very compatible (M=1.3, SD=1.2) was lower than that between the partners' grades who rated their pairs as satisfactorily compatible or not compatible (M=2.1, SD=1.3).

A Mann-Whitney test was performed on H3. There was no significant absolute difference (Z=-1.385, p=0.166) between students' programming self-esteem and compatibility rates (satisfactorily compatible or not compatible than very compatible).

A Mann-Whitney test was performed on H4. Students' responses to Q4 are presented in Table 4. As might well be expected, very compatible students evaluated the following three factors less negatively than the others: collaboration problems, unreliable partner, and lack of partner knowledge.

Table 4: Evaluation of the factors that hinder pair collaboration and compatibility.

Factors that hinder pair collaboration and compatibility	Subgroups	Mean	S.D.	Z	P
Coordination problems (collaboration time)	Satisfactorily & not compatible	3.15	1.25	-3.876	<0.001
	Very compatible	4.21	0.99		
Unreliable partner	Satisfactorily & not compatible	4.18	1.38	-2.207	0.027
	Very compatible	4.68	0.96		
Lack of partner knowledge	Satisfactorily & not compatible	3.75	1.28	-2.404	0.016
	Very compatible	4.37	1.00		
Dominating role of partner	Satisfactorily & not compatible	4.15	1.31	-1.784	0.074

Factors that hinder pair collaboration and compatibility	Subgroups	Mean	S.D.	Z	P
	Very compatible	4.55	1.06		
Technical problems	Satisfactorily & not compatible	3.00	1.26	-0.921	0.357
	Very compatible	3.26	1.25		
Difficulty in using the plugin	Satisfactorily & not compatible	3.53	1.13	-1.362	0.173
	Very compatible	3.82	1.25		

A Mann-Whitney test was performed on H5. Table 5 summarizes the results of students' answers on frequency of use of the system's features. The results did not reveal any significant statistical difference between the two groups and how they rated the frequency of use of the system's features (collaboration features). The only significant difference was found in the "re-mote code highlight" feature which was used more by very compatible pairs than the other subgroup of pairs (not-compatible and satisfactorily compatible pairs) (p=0.024).

Table 5: Evaluation of the frequency of use of the system's features and compatibility

System's features	Subgroups	Mean	S.D.	Z	p
Roles switch request	Satisfactorily & not compatible	4.28	0.78	-1.201	0.230
	Very compatible	4.03	0.92		
Synchronized program execution	Satisfactorily & not compatible	3.60	1.01	-0.016	0.988
	Very compatible	3.58	1.15		
Retrieve help (hint) for the solution of every programming task	Satisfactorily & not compatible	4.08	1.19	-1.205	0.228
	Very compatible	3.92	0.94		
Remote code highlighting	Satisfactorily & not compatible	2.73	1.20	-2.258	0.024
	Very compatible	3.37	1.13		
Display participation rates	Satisfactorily & not compatible	3.35	1.21	-0.197	0.844
	Very compatible	3.32	1.19		
Synchronization of editors	Satisfactorily & not compatible	2.83	1.13	-0.764	0.445
	Very compatible	2.97	1.15		

5. Discussion – conclusions

This study examined possible factors that we felt had the potential to affect the compatibility between students who worked in pairs in an OOP course using a DPP environment. Based on our findings, some conclusions were drawn, which contribute to the enhancement of knowledge in the literature.

Since the study findings suggest that students with a similar perceived skill level, form more compatible pairs, they support H1, which agrees with the study on PP by Williams et al (2006) whose results showed that a significantly positive relationship exists between compatibility and the partner's perceived skill level.

As regards compatibility and partner's actual skill level, which provides more objective information than perceived skill level our findings indicate that students with a similar actual skill level rated their partners as very compatible, which supports H2. Although, Williams et al (2006) measured actual skill level differently to us (measuring actual skill level as the absolute differences in the partners' midterm grades, SAT, GRE, and overall), they did not yield the same results as they were not generally able to support the hypothesis about compatibility and actual skill level, stating that it is not feasible for an instructor to proactively match students based on available measures of skill (midterm, SAT, GRE, GPA), except for the use of midterm and SAT in the Software Engineering (SE) class.

In the present study, we also examined whether students with similar programming self-esteem form more compatible pairs (H3); which, however, was not supported by the findings. Williams et al (2006), on the other hand, found that this hypothesis was partially supported and that students' confidence in their problem-solving abilities may be an indicator of pair compatibility.

Besides the three main hypotheses motivated by similar studies on PP, students were asked to evaluate factors mentioned in the literature that hinder collaboration, which in the present study were examined in relation to the degree of student compatibility The interesting finding was that very compatible students rated the three factors (coordination problems (finding common time for collaboration), unreliable partner, and lack of partner knowledge) significantly less negatively than the subgroup of satisfactorily and not compatible pairs. Two other factors that all pairs rated as existing to a moderate degree were difficulties related to plugin and technical problems.

Finally, irrespective of their compatibility level, students used the features of the DPP system with almost the same frequency. Only very compatible pairs used the “remote highlight” feature more frequently than the other pairs, which shows that the navigator was active during the process of code developing and this is an indicator that high compatibility supports collaboration.

It appears that our findings concerning student compatibility are in accordance with most of the findings on similar studies on PP, which is encouraging as DPP is more demanding than PP. In this study, SCEPPSys the educational system developed for a typical undergraduate OOP course, promotes student collaboration and balanced participation in DPP. Clearly, the present study results that used SCEPPSys and a specific set of assignments cannot be generalized for all DPP educational settings. Despite the limitations, this study adds to the body of literature on DPP, since compatibility and pair formation are issues that need further research in order to formulate reliable conclusions.

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Towards Integration of Deep Gamification Into Formal Educational Settings

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Abstract: Gamification can be defined as application of game design elements on real-world processes. The term deep gamification is used when real-world processes are changed by gamification, i.e. users have options to tailor processes in parts due to their preferences. Compared to gamification, deep gamification is considered to have a higher impact on user motivation and engagement. So far, however, there is no systematic framework for integrating deep gamification into real-world processes. This article explores potential bases of such a framework for the application of deep gamification in formal educational settings. Two case studies, each with characteristics of deep gamification, form the starting point. Furthermore, two theory models are identified to provide a framework for the integration of deep gamification into formal educational settings. The Self-Determination Theory provides a theory model from a psychological point of view, while the game categories of Caillois incorporate the motivational effects of proven game design elements. Based on the theory models, corresponding gamification design elements in the case studies are identified. The theory models and characteristics of the case studies could be aligned. The theory models therefore could provide a theoretical foundation of a systematic framework for the integration of deep gamification design elements into formal educational settings.

Keywords: gamification, deep gamification, SDT, Caillois, formal education, motivational design

1. Introduction

Gamification can be defined as application of game design elements on real-world processes (Deterding, Dixon, Khaled, & Nacke, 2011). One goal of gamification is to increase the engagement of users in the real-world processes, i.e. to increase the dedication with which users pursue the activities assigned to them in the real-world-processes, due to motivational effects. A term associated with games - and also with gamification - is intrinsic motivation. Games are played because of the activity of playing. Thus, the activity of playing is intrinsically motivated. Extrinsic motivation, on the other hand, exists when an activity pursues a goal beyond the activity. In the field of education, there have been many approaches to gamification in recent years, especially as the increasing use of educational technology promotes the automatized implementation of gamification. So, Majuri, Koivisto, & Hamari (2018) have compiled a current review of empiric gamification studies in education. The categorization of gamification design elements revealed that the majority of gamification design elements focusses on achievement and progress, such as points, badges and leaderboards. Only a few studies found social gamification design elements, such as cooperation and peer-ratings. Almost 30 % of the studies found reported non-positive results of gamification. At the same time, Subhash & Cudney, (2018) report an increasing facilitation of gamification in higher education. Correspondingly, gamification research continues to develop (Nacke & Deterding, 2017). Nevertheless, some relevant implications of gamification are still unclear. For example, the effects of extrinsic and intrinsic motivation caused by gamification design elements is still to be refined. Mekler, Brühlmann, Tuch, & Opwis (2017) state that gamification design elements have an effect on performance, but do not change the perception of competence and intrinsic motivation. Thus, the investigated gamification design elements of points, badges and leaderboards have to be considered as extrinsic motivational factors. In other studies, extrinsically effective gamification design elements, such as points, badges and leaderboards are considered to reduce the intrinsic motivation in the gamified activity (Dicheva, Irwin, & Dichev, 2018; Hamari, Koivisto, & Sarsa, 2014; Hanus & Fox, 2015). The reduction of intrinsic motivation by gamification design elements leads to partly vehement criticism among other authors (e.g., Bogost (2014)). Nicholson (2015) points out that reward-based gamification is not appropriate to foster long-term motivation. Own experiences suggest that the effects of gamification are diminished by the effort-optimizing goal orientation of students (Authors 2018; Authors 2016).

There are different approaches to address the described weaknesses of gamification. One of these approaches is adaptive gamification, i.e. selecting gamification design elements based on individual preferences (Böckle, Novak, & Bick, 2017) or so-called gamification user types (Orji, Tondello, & Nacke, 2018). Another recent approach is deep gamification, in contrast to shallow (or thin) gamification. Although deep gamification is not per se more effective on motivation than shallow gamification, the simple addition of shallow gamification levels typically consisting of points, badges and leaderboards is often observed not to be as effective as the context-specific integration of deep gamification. Lieberoth, Møller, & Marin (2015) introduce a deep-shallow continuum of gamification: *"Shallow gamification is characterized by relying on surface features and a few game elements. Deep gamification is characterized by integration of intrinsically interesting properties of the target behavior in the gameplay."* While in shallow gamification the gamification design elements often form an additional layer, in deep gamification the gamification design elements and the desired activities are aligned meaningful. Gurjanow, Oliveira, Zender, Santos, & Ludwig (2018) point out that for the use of shallow gamification mainly programming knowledge and graphic design skills are required. However, game design skills are essential for the integration of deep gamification into learning contexts.

Another, pragmatic definition of deep gamification in education delivers Santos (Santos, 2015): The essential criterion of deep gamification is the change of real-world processes. In the following, this definition of deep gamification is used. Deep gamification allows students to control their formal learning processes, e.g., to choose between various learning activities, as it can be observed in the well-known example of *Quest to Learn*, a school where the curriculum has been developed based on game design elements (Salen Tekinbas, Torres, Wolozin, Rufo-Tepper, & Shapiro, 2010).

2. Research goal and method

Using the example of two self-conducted case studies, we were able to experience and to document the enormous potential of deep gamification. The educational settings were each developed with the aim of motivational design, the application of gamification is to be seen here rather as a by-product of motivational design. However, to implement deep gamification design elements purposefully in further educational settings, a theoretical framework is considered essential. To our knowledge, such a theoretical framework does not yet exist. In this article, we therefore examine two theoretical models regarding the extent the models can be used to substantiate the observed effects. This, the aim of this paper is to contribute to the definition of a theoretical framework.

As the underlying theoretical foundation, we have chosen Self-Determination Theory (SDT) (Ryan & Deci, 2000, 2017), because it is one of the most widely used theoretical foundations of gamification (e.g., Kapp (2012) and Lamprinou & Paraskeva (2015)). SDT is a general psychological theory. Gamification, however, is the specific application of game design elements contributing to game-like experiences. Therefore, we want to look at deep gamification from a game-specific perspective to broaden the set of gamification design elements for educational settings with possibly motivational effects rooted in game design. For this perspective the game categories of Caillois (2001) are used, as his theory is one of the most widely used game theories.

This article is structured as follows. In the next section we describe two case studies of deep gamification we have executed. Section 4 discusses in short SDT as theoretical foundation of gamification. Section 5 aligns an SDT-based deep gamification framework with the case studies described in section 3. Section 6 does the same for Caillois' game categories. Section 7 discusses the limitation, and finally, section 8 draws the conclusions.

3. Two case studies of deep gamification

3.1 Case Study 1 (CS1): A quiz app as facultative learning tool

The course *Urban Wastewater Management* in the bachelor programme *Civil Engineering* requires students to memorize factual knowledge as a base for acquiring procedural knowledge. Memorization of factual knowledge is supported by a sequence of admission tests which have to be passed during the semester. Each of the admission tests, provided in the learning management system Moodle, consists of five multiple choice questions, focusses on a specific lecture and has to be passed within 14 days after the lecture. Admission tests can be prepared with a QuizClash (FEO Media AB, 2013)-like quiz app offering questions similar to the questions asked in the admission tests. The 10 % top ranked students regarding correctly answered questions do not have to take the admission test - they get a so-called "free ticket". Further, depending on the number of played matches of all participants of the course, additional mock final exams are provided to the entire course as a group incentive. The study in the winter term 2018 revealed an extreme high engagement: more than 2000 questions have been answered by each student in average (Author, 2018). This engagement exceeds the engagement reached in previous quiz app studies in the same course by far (Authors 2018). Previous studies observed most of the students using the quiz app only to capture questions and answers and thereafter to document them. However, the current study has been repeated in the winter term 2019 with a change of one rule of the educational setting: Each student, which answers more than 120 questions of a specific lecture topic does not have to take the admission test. Preliminary results show an even higher engagement.

3.2 Case Study 2 (CS2): Intra-course incentive design

In the course *Infrastructure Management* of the bachelor study programme *Civil Engineering* students have the task of creating a commented self-taken photo of technical infrastructure. All photos are presented to the course and the public in an exhibition. During the opening of the exhibition, to which all students, especially those of the course *Infrastructure Management*, are invited, there will be the opportunity to study the photos. Studying the photos should be stimulated by offering a best-photo competition. All participants of the exhibition opening have to vote for the best photo. This is also regarded as a learning activity for the students, therefore it is part of the educational setting. Unfortunately, the participation of students in the exhibition opening has been very low. The penultimate exhibition opening was attended by 5 out of 60 students (participation rate: 8 %).

The question therefore arose as to how the participation of students in the exhibition opening could be increased without declaring the participation a compulsory activity. As a remedy, a link to the final exam was introduced. The final exam in the course is an oral examination in one of a total of four sub-disciplines covered in the course. Shortly before the examination, the students are drawn by lottery tickets for one of these sub-disciplines. In the end, each student who took part in the opening of the exhibition was assured a second chance to draw a lottery ticket. In other words, if the student is given a sub-discipline for the examination that she does not particularly like, she can put back the lottery ticket and draw another lottery ticket again, in the hope that she will then be examined in a discipline that suits her more. As a result, the participation rate increased from 8 % to 89 % (81 of 91 students) in the next semester. That was a much unexpected increase.

4. Self-determination theory as framework for deep gamification

A commonly used theoretical foundation from the perspective of psychology for the effects of gamification is the Self-Determination Theory (SDT) (Loughrey & O´ Broin, 2018). SDT identifies three basic (psychological) needs of human beings, as there are (I) autonomy, (II) competence and (III) relatedness as drivers of intrinsic motivation, i.e. the motivation resulting from doing an activity itself. Autonomy can be defined in short as acting according to own decisions but should not confused with independency from other persons. Competence is understood as the ability to achieve desired outcomes and the feeling of mastery. Relatedness can be seen as the will to interact with others and be part of a group (Ryan & Deci, 2017).

Loughrey & O´ Broin (2018) give an detailed overview of the state of scientific research on SDT as theoretical foundation of gamification. They conclude that SDT can be seen as a valid theoretical foundation of gamification: *"Facilitation of autonomy, competence, and relatedness leads to greater internalisation of extrinsically motivated activities, up to the point of integration."* Further, they conclude that the meaningfulness of rewards contributes to the motivation: *"The effect of an extrinsic motivator on intrinsic motivation depends on the functional significance of said motivator. The functional significance is influenced by one's causality orientation."* This statement can also be used as a rationale for the effectiveness of deep gamification: Rewards with high functional significance act as extrinsic motivators and increase intrinsic motivation. However, Loughrey & O´ Broin recommend applying extrinsic motivators cautiously, because the extensive use of extrinsic motivators can place great pressure on users and reduce the users' well-being in the long term.

5. Linking the case studies to SDT

As SDT may be used as a theoretical foundation for deep gamification, SDT should also be constructively incorporated through guidelines into the design of educational settings. For example, this constructive approach of design, based on the theoretical foundation of SDT, has already been described for the design of a learning management system (Dicheva et al., 2018). The goal of this section is the identification of characteristics of the case studies' educational settings, which contribute to deep gamification based on SDT. One of the most well-developed frameworks of SDT-related design is the framework of Shi & Cristea (2016). It has to be kept in mind that the framework of Shi & Cristea is focused on e-learning scenarios, while the case studies CS1 and CS2 are part of classroom teaching. In the following, the case studies are aligned with the directives, so-called gamification strategies, of the framework of Shi & Cristea. For each gamification strategy, according characteristics of the case studies are identified.

5.1 Autonomy

- **A1. A set of learning goals with clear descriptions and multiple paths to achieve each.** In CS1, there are various paths to achieve the admission to the final exam. For each lecture topic, the student can either take the admission test, or can answer a minimum number of questions in the quiz app. Further, the admission test can be "passed" by being within the top 10 % of participants regarding the number of answered topic-specific questions. All alternatives require a good knowledge about the factual knowledge captured in the questions.
- **A2. Various interaction tools to complete a task.** CS1 employs the quiz app and the Moodle-based admission tests, which are alternative tools to reach the admission to the final exam.
- **A3. Clear, immediate and positive feedback for learning activities.** In CS1, both the quiz app and the Moodle-based admission tests provide immediate feedback. However, the feedback is only positive if the questions have been answered correctly or the test has been passed. Here are still encouraging comments missing.
- **A4. Meaningful options with consequences.** In CS2, the options to exclude an examination topic are so important that they cause the majority of students to come to the exhibition opening.
- **A5. Customizable learning context that can be adjusted by students themselves.** In CS1, students can exclude a few admission tests by collecting free tickets. CS2 allows the exclusion of one sub-discipline.

5.2 Competence

- **C1. Reasonable small chunks of learning goals with increasing difficulty.** CS1 provides by multiple choice questions learning in small chunks. The lecture topic-specific question categories help with learning. An increasing level of difficulty still has to be ensured.
- **C2. Tasks with pleasantly surprising positive feedback.** Answering the questions is linked to short-term - mostly positive - feedback. At the same time, quiz app matches against fellow students usually provide positive feedback.
- **C3. Multiple choices for advancing or retracing through the learning paths.** Because of the quiz app's asynchronous matches, students have in CS1 more freedom to choose the time of their activities. The time of the admission tests can also be freely chosen during the two-week test opening period.
- **C4. Frequent decision-making, to keep the learning process moving forward.** In CS1, every question of the quiz app as well as the preparation of admission tests is linked to decisions. This is a huge enhancement compared to the original scenario with the graded final exam being the only feedback.
- **C5. Enjoyable and fun learning activities.** Especially the quiz app provides a lot of fun through the matches against fellow students. The gaming enjoyment is based on social interactions and at the same time increases the perception of competence. In CS2, drawing lots can create positive emotions - although this activity is not a learning activity but an administrative one. Drawing of lots is widespread in various variants in entertainment contexts. Examples include the lottery booth at the fair or, in a more general form, numerous dice games, where the outcome also is a matter of chance.

5.3 Relatedness

- **R1. Opportunities to discover and join learning communities.** In the ranking lists of the quiz app, all students of the course are visible throughout the course. The option of playing matches against random partners in the quiz app provides additional contact opportunities for establishing learning communities (CS1). Visiting the exhibition opening together with the task of evaluating some of the exhibited pictures also creates opportunities to get in touch with other course members (CS2).
- **R2. Connections of interest and goals between students and communities.** The group incentive of further mock exams depending on a certain number of matches played by all members of the course ensures a common goal of the course (CS1).

- **R3. Various tools for interaction, collaboration, discussion and mutual assistance.** The chat functionality of the quiz app and Moodle contributes to interaction and possibly subsequent collaboration (CS1).
- **R4. Visualizations of social status, reputation and contribution.** Ranking lists in the quiz app visualize the contribution and social status (CS1). The increased number of participants at the opening of the exhibition and the corresponding peer review ensure increased visibility of the contributions of fellow students within the course (CS2).
- **R5. Supporting the display of appreciation to/of others (such as "like").** Public votes for the best photo in the competition should be seen as appreciation (CS2).

6. Caillois' categories of games

A categorization of games into four categories has been described by Caillois (2001). Each of these categories highlights a set of specific game design elements. Although the game categories exist in their pure form, they commonly occur in a combined form. Therefore, the game categories can also be seen as a game element design set, which could support the integration of (deep) gamification into didactic scenarios. Each of these game categories addresses psychological needs of players and subsequently causes motivational effects. In Table 1, the categories are described. Further, in Table 2 the gamification design elements used are linked to category and case study – if applicable.

Table 1: Game categories according to Caillois (Caillois, 2001)

Category	Description
Agon (or competition)	Players measure themselves in specific skills and demonstrate their mastery (e.g., throwing darts).
Alea (or chance)	Players abandon themselves to a higher power that determines their success in the game (e.g., lottery).
Mimicry (or mimesis)	The players want to assume a role that they are not in real life (e.g., business games).
Ilinx (or vertigo)	Players alter their perception by experiencing emotions (e.g., roller coasters).

Table 2: Game categories, case studies (CS) and gamification design elements

Cat.	CS	Gamification Design Elements
Agon	CS1	Ranking lists (on individual level and team level), the competition for the free tickets, matches itself.
	CS2	Best photo competition
Alea	CS1	Assignment of match opponents and topics
	CS2	Sub-discipline lottery: The students cannot be sure whether a rather less well mastered sub-discipline will be excluded by the draw. Therefore, it is still unadvisable not to prepare for a specific sub-discipline at all. However, there is a chance that a less well mastered subject area can be avoided: a well-known application of chance in game design.
Mimicry	CS1	Avatar and nickname
	CS2	Photo as self-expression
Ilinx	CS1	Time pressure, unlimited number of matches
	CS2	Unlimited numbers of photos to evaluate

7. Discussion

In the previous two sections we have analyzed the characteristics of two case studies using two theory models. The goal was to investigate whether the theory models are applicable as the basis for a constructive framework to apply deep gamification in formal educational settings. The constructive framework still has to be created in a further step. Although the theory models could basically be aligned with the case studies, to create a functional framework for the integration of deep gamification in formal educational settings, further outcomes, discussed in the following, need to be obtained.

The selection of the theory models used was done in this work more (Caillois) or less (SDT) subjectively. It has to be evaluated to what extent other frameworks can supplement or replace the used frameworks. Another remaining task is to systematically integrate the existing taxonomies of gamification design elements (e.g., in Majuri et al. (2018)) into the frameworks used. Further, existing guidelines of gamifying course-settings (e.g., Brunvand & Hill (2018)) should be carefully reviewed for extraction of deep gamification design elements.

Further, there are concepts very similar to deep gamification. Meaningful gamification is one of them and defined as *"Using game design elements to help build intrinsic motivation and, therefore, meaning in non-game* *settings"* (Nicholson, 2015). Nicholson connects the RECIPE framework for designing meaningful gamification to SDT. The framework is built on the six concepts of *Reflection*, *Exposition*, *Choice*, *Information*, *Play*, and *Engagement*. These concepts are developed individually and do not find their theoretical foundation in a single framework. It has to be examined to what extent they can supplement the design of deep gamification didactic scenarios. Hallifax, Serna, Marty, & Lavoué (2018) suggest a design space for the visual and operational design of meaningful gamification, which is, however, not in the scope of this paper.

The presented case studies also contain extrinsic motivators, which should not be overused as already mentioned. It will have to be examined to what extent the use of extrinsic motivators can trigger activities that can be intrinsically motivating after having been started. For CS1, it could be shown that the use of the quiz app was widely perceived as a game. The visit to the exhibition, stimulated by the extrinsic motivator "Second chance", can certainly be regarded as a purely behavioral approach. On the other hand, visiting the exhibition remains the free choice of each student: the additional chance to win a lottery ticket is comparable to any other lottery setting in which one gets the chance of an expected advantage for a certain effort. Nevertheless, it should be excluded that the extrinsic motivators simply increase the pressure on the students (and consequently reduce the well-being of the students).

8. Conclusion

Based on the great effectiveness of two gamified educational settings, deep gamification was recognized as the underlying design principle. Deep gamification describes the configuring intervention of gamification design elements on processes of the real world (here: educational setting). Depending on the decisions of the users, they find individual ways through the processes. As theoretical basis the Self-Determination Theory (SDT) and the game categories according to Caillois were used. According to the SDT, important features of deep gamification are the provision of decision option for the users, short-term action cycles with immediate feedback and the promotion of social contexts for the users. From the point of view of Caillois' game categories, the effectiveness of competition and chance is particularly obvious. By demonstrating the applicability of the theory models of SDT and Caillois' game categories to integration of deep gamification design elements into educational settings, this article contributes to the development of a comprehensive framework.

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Policies to Implement Smart Learning in Higher Education

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Abstract: This article aims to analyze the smart technologies and contexts that can potentiate digital learning in Higher Education. First of all, the research will focus on the definition of the concepts of digital learning, smart learning technologies, and smart learning contexts. Digital learning is all learning activity that uses, in a significant way, information, and communication technologies. It is interactive learning in which the learning content is available online. To operationalize this research, it was applied a Delphi methodology, in order to discuss with a set of experts the environments where smart learning and which technologies could potentiate the learning process in Higher Education (HEI) Contexts. The lines of analysis of this investigation were oriented according to the following research questions: What types of digital learning can be used to potentiate the learning process of students of higher education? What are the leading smart technologies used in the digital learning process? Which are the smart contexts that can potentiate the learning process? The main findings of the learning process will be the identification of smart learning types, technologies, and contexts. The articles will intent to define some lines of orientation for the definition of public policies to promote the learning process in Higher Education.

Keywords: smart learning, technologies, digital, contexts of learning, Delphi methodology, HEI

1. Introduction

The technological evolution related to innovation in HEI leaning programs, has been a strategic choice for many Universities, and this study intents to analyze the smart technologies and contexts that can potentiate digital learning in Higher Education and the interactions among the learning participants are: a) student - technology; b) student - content; c) student - tutor; d) student - student.

Moreover, informal digital learning takes the form of communities of practice, knowledge management systems, work-flow-learning, FAQs, forums, among others. All of these types of learning and contexts are being used in a smooth way in Higher Education and Policymakers are interested in defining measures to exponentiate the learning based on digital and on smart technologies.

This research intends to create significant knowledge about the formal and informal types of smart learning and how can this be fully applied to Higher Education Contexts, presenting a brief literature review about digital leaning as smart learning, leading smart technologies for digital learning, and learning contexts. This is followed by an application of a Delphi methodology to 15 experts in the theme and finally the results and the conclusions are presented.

2. Literature review

2.1 Digital learning as smart learning

Digital learning is all learning activity that uses, in a significant way, information, and communication technologies. It is interactive learning in which learning content is available online. Digital learning takes the form of communities of practice, knowledge management systems, work-flow-learning, FAQs, forums, among others.

The interactions involved in this learning are: a) student - technology; b) student - content; c) student - tutor; d) student - student.

The concept of Smart Learning is framed in digital learning, emerging as a convergence concept of social learning and u-learning (Adu & Poo, 2014; Zhu et al., 2016). Is the efficient utilization of smart devices on the learning process, and an effective, intelligent tailored-learning based on advanced IT infrastructure (Kim et al. 2013), combining novel learning and teaching strategies with technologies.

Framed by this concepts of digital smart learning this research will try to answer the question, "What types of digital learning can be used to potentiate the smart learning process of the students of higher education?".

The main learning models are: a) individual self-learning: in which the learner relates directly to the content through materials and exercises that are provided automatically and whose answers are also evaluated automatically; b) assisted self-learning: in which the student takes the initiative to seek solutions to specific problems using; c) traditional learning: d) in which presenters mediate the transmission of information; e) collaborative learning: in which, based on reference documents, the concepts are developed by working in groups, with the support of tutors; f) participatory learning: in which individual learning happens not only through the relationship with content but also through interaction with peers (participatory learning) and tutors (who propose individual activities, moderates the discussions of the forums and work plans).

The strategic components of digital learning are: a) contexts and methodologies of learning, for courses oriented to self-learning and collaborative learning; b) the participants, open to different contexts of digital learning; c) the contents, prepared for self-learning; d) technology oriented to various types of contexts; (e) appropriate interaction between different types of participants and taking into account the contexts; f) communication, language appropriate to the participants and learning objectives; g) evaluation systems, rigorous and transparent in order to evaluate the various elements of the learning process.

The growing use of technology, social software applications, and personal learning environments (PLEs) has altered and questioned how we learn from the Internet (Schaffert, S. et al., 2008). Being, more and more, informal learning (i.e., storytelling (Nam, 2016; Yang, 2012; Robin, 2008)).

Informal learning in digital environments is propitious to be carried out in an autonomous and collaborative way (Siemens, 2008), according to the decisions of each one on the strategies used, on how to seek and access the information and the contents, on the sources and online environments used, according to personal goals and interests (Salmon et al., 2015).

Technologies are not a condition for learning, but they are tools (Camilleri et al., 2016) that facilitate informal learning, diversity of sources, ease of organization and temporal and local flexibility, cooperation and mutual aid, among other things.

2.2 Leading smart technologies for digital learning

The eLearning platforms have allowed the diffusion of one of the most used online learning methodologies that have advantages, which have facilitated the teaching and learning system, highlighting the following points (Lima & Capitão, 2003): a) to learn anytime, anywhere: since materials are available twenty-four hours and can be accessed from any location; b) time savings: there is no need to make trips to training, which cause so much inconvenience and become barriers to training/learning; c) the student learns at his own pace: the student becomes autonomous, responsible for his learning, has the possibility to choose the content and marks his rhythm; d) reuse of contents and experiences: the contents of the course can be reused in other courses partially or totally; e) always updated information.

E-Learning also presents a series of disadvantages, which refer to the following (Lima and Capitão, 2003): a) lower student / teacher interaction: student/teacher interaction becomes reduced, since communication is made via the Internet, originating as such a physical and/or temporal remoteness; b) motivation and rhythm: it implies a strong motivation and a proper rhythm on the part of the student, being denominated of solitary and little social learning; c) it requires more time in the elaboration of contents and in the formation: the teacher has to dedicate more time for the production of contents, being necessary the existence of specialists in several domains of knowledge; d) speed and costs of Internet access: this system requires the use of the Internet as a crucial tool for communication, resulting in costs. Another issue is related to the efficiency of content transmission.

In this context and following the literature review the second research question tries to identify the leading technologies used in the learning process: "What are the main smart technologies used in the digital learning process?".

According to Camilleri et al. (2016), digital learning environments have the potential to change the nature of learning and question the traditional role of learning.

Mobile Learning or mLearning is an extension of eLearning; learning is done through mobile devices such as mobile phones, tablets, among other mobile devices.

This new learning paradigm is contributing to a rethinking of pedagogical methodologies and learning tools since mobile technologies give individuals the possibility to choose when and where they want to learn.

Mobile Learning is student-centered and is based on social constructivism (network learning). Effective use of this technology is appropriate for students and the work context as it is easy to use and allows for interactivity.

These technologies are: a) portable: technology is available whenever the individual needs to learn; b) individual: the technology can be customized according to the competences of the individual, knowledge, and style of learning; c) discrete: the student can capture situations and use knowledge without the technology becoming overly visible; d) available: the individual can use technology anywhere to allow communication with other individuals. e) adaptable: technology can be adapted to the context of learning and student's evolution skills and knowledge; f) persistent: the individual can use technology to manage lifelong learning, resources and knowledge will be immediately accessible, despite changes in technology; g) useful: the technology is adequate to the daily needs of communication, work and learning; h) easy to use: the technology is easily understood and used by people with no prior experience.

Mobile Learning allows learning through the Internet with maximum portability, mobility, interactivity, and connectivity, since learning is done anytime, anywhere, making it portable. It can optimize downtimes with information that allows the user to become more productive.

Temporal and spatial limitations are reduced by the ubiquity that mobile devices provide, making it possible to improve the effectiveness and efficiency of teaching and learning.

Mobile-based learning has been seen as conducive to informal learning, readily resorting to Web-based content that is easily transferable to the small screen, such as images, audio, and video (Friend & Militello, 2014; Gonçalves et al., 2017).

In addition to its portability, mobility, flexibility, and autonomy, mobile learning devices allow on-demand functionality, that is, having what you want when you want and when you have the time.

Some of the main possible activities are presented in the following table (Table 1):

Table 1: Activities that enhance learning in mobile learning

Switch messages (SMS)
Browse Dictionary
Create and view glossaries
Exchange emails (Mobile Access)
Access graphics and images
Quizzes
Listen to audio lessons (Podcasts)
Make and view Videos
Access curriculum content
Record audio
Take a photo
Play

Mobile devices can be considered as repositories of learning content and as tools to read and write and to exploit multimedia (audio, video, and image) functionalities.

With the application of mobile technologies, new learning models are developed (Sousa et al. 2017b). A pedagogy appropriate to learning supported by mobile technologies must take into account three pillars of the construction of any learning environment: a) the student; b) the learning context; c) the technological device that allows to carry out the pedagogical activities.

Mobile learning offers greater control and autonomy over learning itself and enables learning in context, that is, in the place, time and conditions that the student judges most appropriate (i.e., through eLearning platforms or even educational games (Sousa & Rocha, 2017a)).

Klopfer, Squire & Jenkins (2002), Naismith et al. (2004, p.9) identify five specific characteristics of mobile devices for learning purposes: a) portability; b) social interaction; c) sensitivity to context; d) connectivity; e) individuality. The use of mobile learning practices integrated into teaching-learning, take into account the types of activity and corresponding application examples, as shown in the following table (Table 2):

Table 2: Activity types and application examples

Activity	Goal	Example of applications
Assimilation / Dissemination / Access	Manage and structure information	Google Docs, Social Bookmarking, Podcasting, ebooks
Adaptation / Reinterpretation	Simulations, roleplay	Second Life, Augmented Reality, Concept Maps, Games
Communication / Discussion / Reflection / Sharing	Dialogue	Blogs, wikis, OneNote Mobile, Twitter
Production / Demonstration / Elaboration	Design/production of resources	Youtube Mobile, Flickr Mobile
Experience / Discovery / Exploration		GMaps Mobile, mySKY

Mobile learning has the following advantages: a) it can happen anywhere and at any time; b) provides dynamic and motivational context learning; c) it increases the opportunities of professional development with the use of new technologies; d) guarantees the continual development of skills for professionals in all areas.

On the other hand, some disadvantages emerge a) information overload if it is not organized by priority of importance; b) difficulty in setting goals as efficiency.

Videoconferencing is a system that consists of delivering information (audio, video, and text) at the same time to several participants who are geographically dispersed. Because they are remote systems, they need to apply interactive pedagogical strategies that lead individuals to participate actively.

2.3 Smart contexts for digital learning

To clarify the notion of digital learning as comprehensive as possible, we focus on information theory oriented towards digital learning. The literature has shown that both material and immaterial sources play a role in digital learning. Some instances of these sources are communication, participation, and collaboration among students. Digital learning includes a broad spectrum of contexts and activities.

In this context and following the literature review, the third research question tries to identify the main contexts in digital learning: "Which are the smart contexts that can potentiate the learning process?"

The main contexts in digital learning prepare students to think critically and solve complex problems, work collaboratively, communicate effectively and have more autonomy independence in the learning process (Chen et al., 2015; Dooley et al., 2016).

Collaboration and cooperation, according to Sousa et al. (2017b) creates an environment that stimulates the learning process.

The importance of formal learning is high, but also informal learning is a compelling process enhancing digital learning. However, the synergy between formal and digital learning is too often underestimated, but in the future, the students will be more prepared if the HE institutions promote both types of digital learning.

3. Methods and techniques

3.1 Delphi technique

The Delphi survey methodology (Loo, 2002) was chosen in order to get information from experts and academicians about possible digital learning types, contexts, and technologies. The Delphi expert's panel was chosen in order to cover a maximum of differentiation of digital learning contexts in order to capture different views.

This technique allows structuring individuals' contributions to achieving consensus among a group of experts. It is characterized by the anonymity that reduces certain biases as it "eliminates committee activity among the experts altogether and replaces it with a carefully designed program of sequential individual interrogations (usually best conducted by questionnaires) interspersed with information and opinion feedback." (Helmer, 1967, p. 8). There were two rounds, and the experts were asked to rate the likelihood of types, contexts, and technologies for digital learning. After the final round, the data was then be analyzed, calculating mean and standard deviations scores.

3.2 Survey design

The survey design has a first section about the characterization of the experts: their professional as well as national backgrounds and their fields of interest; the second section is an overview on the themes and questions about types, contexts, and technologies for digital learning.

3.3 Expert panel design

The sample was composed of 15 experts. The sample was chosen by convenience, based on the knowledge of the experts and their participation in projects about e-Learning and online education. Table 1 gives a short overview of the distribution between practitioners and academicians.

Table 1: Distribution of expert participants according to their professional field

Position	Practitioners	Academicians
Experts	2	6
Researchers	2	5

Note: N=15

The decision about the experts was based on their positions in order to capture the plurality of opinions on the topics surrounding the digital learning field.

4. Findings

The types, technologies, and contexts for smart digital learning identified during the research process were (table 2):

Table 2: Types, technologies, and contexts of smart digital learning

Smart digital learning types	Project based-learning; Problem based-learning; Digital stories; Online learning environments; Digital Moments; Technology integrated teaching methods; Digital storytelling; Educational games; Authentic learning; Slowmation: Narrated stop-motion animation; eLearning; Mobile learning; Learning object repository; Blended learning.
Smart digital learning technologies	Web-based video; Computerised environments; Spatial science technology; Generic modeling language; Digital video; Augmented reality; Design-based research; Gamification; Learning manager; Simulation; Computer-based teaching; Library webinars; Blackboard; Moodle Learning Manager; Twitter; Videoconferencing; MOOC – massive open online courses.
Smart digital learning contexts	Collaborative Communities; Cooperative learning; Digital combinational system; Collaborative learning; Flipped classroom using digital media; Moving from fixing to online space; Experiential online development; Open educational practice; Network participation.

Smart digital learning types are new methods of teaching using technology with the purpose to improve the quality of education and involve students in the educational process. Our findings lead us to the following methodologies: Project based-learning; Problem based-learning; Digital stories; Online learning environments; Digital Moments; Technology integrated teaching methods; Digital storytelling; Educational games; Authentic learning; Slowmation: Narrated stop-motion animation; eLearning; Mobile learning; Learning object repository; Blended learning.

Smart digital learning technologies are considered learning tools that utilize technology in order to facilitate the learning process, such as computers, mobile phones, tablet PCs, projectors, or electronic books. Our findings lead us to the following tools: Web-based video; Computerised environments; Spatial science technology; Generic modelling language; Digital video; Augmented reality; Design-based research; Gamification; Learning manager; Simulation; Computer-based teaching; Library webinars; Blackboard; Moodle Learning Manager; Twitter; Videoconferencing; MOOC – massive open online courses.

Smart digital learning contexts are spaces, facts, or situations of learning, which supports innovative pedagogical models, and empower learners facilitating and promoting the learning process. In our research, we found: Collaborative Communities; Cooperative learning; Digital combinational system; Collaborative learning; Flipped classroom using digital media; Moving from fixing to online space; Experiential online development; Open educational practice; Network participation.

5. Policies to implement smart learning in higher education contexts

This section of the article includes some recommendations for policy which was inferred from the research process, in order to promote smart learning in higher education contexts:

Promote the use of Smart learning in HEI, focused on mobile devices, and which enables learning everywhere, it is easy to use, and has rich content, high efficiency, flexibility, security, reliability, interactivity, portability, and other features that can be used to compete with other teaching methods.

Define measures to implement in HEI adaptable learning strategies, tools, and resources to promote the use of Smart Learning.

Incentive the creation of a culture where the role of the teacher changes from a primary source of information into secondary source of information and a facilitator guiding the students' learning processes.

Promote technology innovation into classrooms, creating infrastructures to be possible the implementation of Smart Learning strategies; designing technology-integrated learning will continue playing a crucial role.

A consistent and structural change in the learning strategies on HEI will allow the students to acquire competencies as problem solving, collaboration and communication, and will provide means for all students in a global way.

6. Conclusions

At the beginning of this research, we are based on three critical questions of an exploratory study, for which we have been trying to find an answer in the course of the investigation. For this purpose, we carry out a Delphi study; the following the different answers obtained from the investigation.

The findings helped to create three categories: Smart digital learning types; Smart digital learning technologies; and, Smart digital learning contexts. And, in summary, the results of the present study show that there are a profuse set of types of smart digital learning, smart technologies that can enhance the engagement of the students, such as mobile technologies, tablet and smartphone's applications are becoming more and more popular among the higher education students.

Digital learning uses smart technology to strengthen the student's learning experience in a mix of contexts, including, among others, Collaborative Communities; Cooperative learning; Collaborative learning; Experiential online development; Open educational practice; and Learning Networks.

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A Teaching-Learning Blended-Course Model Support Tracking Student Bahaviour

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Abstract: This paper introduces an empirical study of applying the blended learning approach for teaching in the subject - Principles of Programming Languages, a course for high education students in Computer Science major. The course is designed by including online self-learning, face-to-face teaching, lab practising, online quiz, and traditional assessments where course contents, materials, and tools are available online. A teaching-learning model and support technology based on the blended learning approach are presented. Also, some requirements for tracking student behaviour are discussed, for example, to track their engagement, self-responsibility, learning progress, test assessment, and learning style. The measurement methods to measure the learning performance of the individual and class are discussed. Also, some opinions of the students towards the blended learning approach are investigated. With the proposed teaching-learning blended-course model, it is foreseeable that the blended learning approach is a suitable and flexible teaching method in the digital learning context where tracking supports monitoring students' learning progress and especially for teaching the subject related programming courses.

Keywords: blended-learning, blended-course, tracking, student behaviour

1. Introduction

Emerging technology enables changes in learning. The learners change their behaviour in learning and hence learning is not limited in the classroom but learning in the classroom is integrated with the use of technology especially in Computer Science major. In the traditional way of teaching, the students studying in the Computer Science major most relied on the textbooks and materials provided by their lecturer. Programming subject is managed by the course including lecture and laboratory. In this digital age, knowledge is available online and hence accessing to such knowledge becomes easy with many tutorials and examples support the learner to explore. There are many websites providing teaching online as well as the community discussing technology and programming, tools, tips, techniques. In addition, the online compiler programs are available for online learning.

The blended learning approach is a method to blend materials, knowledge, teaching, and learning using online as a means to increase the efficiency of the learner than using face-to-face learning only. Blended learning systems combine face-to-face instruction and human interaction with Information and Communication Technology (ICT) (Graham, 2006). The distinction between blended learning and online learning is the effective integration of face-to-face instruction and the usage of ICT to support the learners in their learning. Some benefits of blended learning are, for example, enhancing student learning outcomes, flexibility for both students and teachers, improving autonomy, reduced student withdrawal rate, and potential cost and resources saving (Poon, 2013).

Applying the blended-learning approach requires the digital-based learning context. There are many websites of the companies and software associations provide tutorials, codes, tools, and knowledge on the internet. Thus, learning in the Computer Science principles are accessible by all people. However, most of the related subjects require both practising and lecturing required the face-to-face suggestion by the instructor. In this paper, the blended-course is proposed as the teaching-learning model for the subject - Principles of Programming Languages. Section 2 is the background and motivation of this paper. The description of the course management – Principles of Programming Languages provided in the Department of Computer and Information Science, Faculty of Applied Science, King Mongkut's University of Technology North Bangkok, Thailand. Section 3 is the design of the teaching-learning model of the blended-course, questioning design for self-learning, and support technology in the blended-course. Section 4 presents the results of this empirical study. The opinion of the students towards the blended-learning approach is discussed. Section 5 introduced the analysed requirements for the development of the tracking system. Section 6 is related work and Section 7 is the conclusion of this paper.

2. Background and motivation

The subject - Principles of programming languages, was recommended by The Joint Task Force on Computing Curricula Association for Computing Machinery (ACM, 2013) as the major subject of Computer Science major. Most universities provided this subject for junior or senior levels and the prerequisite courses relate to some computer programming languages are required. This course examines the concepts and structures governing the design and implementation of programming languages. The concepts behind compilers and runtime representations of programming languages; features of programming languages supporting abstraction and polymorphism; and the procedural, functional, object-oriented, and concurrent programming paradigms. However, particular topics can be varied but under this suggestion. The format of teaching is also recommended as a lecture-based subject.

In this paper, the blended-course – Principles of Programming Languages provided in the author's department, were specified as the lecture-based and laboratory-based subject. Because the university has the mission to develop the student who may graduates with creativity and workability and thus the subjects in the curriculum were enriched by adding laboratory hours. The prerequisite in this subject is object-oriented programming and computer programming II (C programming). Thus, the students knew some concepts regarding the imperative programming paradigm and the object-oriented programming paradigm. The expected learning outcome of this subject aims to increase a better understanding of the concepts and principles in programming language and paradigm. This course is provided for the third-year student. The objective of this course is to describe principles of programming languages in various aspects, for example, variables, data types, scoping, controls (e.g. selection and iterative controls), expression, subprogram and parameter passing, abstraction, abstract data type, binding, grammar and parse tree, and programming paradigms and languages. The students are encouraged to understand the principles knowledge and the concepts implemented in various programming languages both learned languages and un-learned languages. They should be able to compare the principles and concepts and to understand the advantage and disadvantage of the implementation in the principles. The course has three credits of which 2 hours are lecturing hours, 2 hours are lab practising, and 5 hours is self-study. This course is provided for 15 weeks in the semester. This empirical study was taken in the second semester (January – May) of the year 2019 in which there are 120 students registered. The students are assigned to into three sections. The author is the lecturer who has experience in teaching in this related course for 8 semesters. In the previous semesters, the course is provided with the traditional teaching-learning method – giving lectures using some prepared MS Powerpoint slides, and lab assignment. With this teaching method, the author found that there are many problems as follows:

- The example of coding cannot be provided on a single page slide.
- Running the programs in the classroom was impossible in the lecture time.
- Some topics and examples were too abstract and these were difficult to explain to create a better understanding of the learner, however, learning by doing may enhance their understanding.
- A class has many students, for example, more than 30 people in each section, and so engagement is low in the lecture time.
- The students may not be honest to do the lab assignment by themselves, and so lab assignment cannot determine that they enhanced their skills,
- With the limited time of laboratory hours, the students who may have lower skills may not be able to finish their tasks.
- Many examples and many different languages were discussed in the lecture; the student should be supported by additional materials that they can search and study later by giving a clear supplementary material and sources.
- It was difficult to know that the students continue their practising outside the classroom.

The key to teaching programming languages is practising. However, the students usually complained that they disliked programming because it takes time on debugging the errors and the help or support materials are available in English which they are difficult to understand. Also, studying in the Computer Science programme, there are many subjects that require programming and so learning needs much time for each particular subject. Changing their attitudes is not easy for the learner particularly in the Computer Science major in which advanced knowledge and new technology are introduced daily. However, it is still in doubt that what the students do in their free time outside the classroom. Particularly when the course specified the self-study for five hours, but the assessment never took this into account and so student assessment eventually relied on exam scores as the basis. This is the objective of this paper hence is focused on self-regulation.

3. The design of the teaching-learning model of the blended-course

3.1 Teaching-learning process and assessment

Many guidelines for implementation of the blended-learning approach into the classrooms were suggested by McGee and Reis (2012) and Shand, Farrelly, and Costa (2016). This paper follows their suggestions and proposes the blended-course design by focusing on the flow of learning activity, technology support, and contents. Figure 1 depicts the teaching-learning model designed in this study. The instructor prepared the online contents to include the detail of teaching topics and self-learning study and published these into the online platform (i.e. Google site). The instructor gave a lecture in the detail of the course topic for 2 hours and gave the lab assignment to the students. The students who were eager may access the course website before the class and may do lab assignment and self-learning study before attending the classroom. Some students may do self-learning study after the class. The students were tested to collect the quiz scores and before testing the instructor announced the topics of the test. Teaching-learning in the classroom used online contents and websites. Two student sections studied in the lab in lecture time and therefore, they had their individual computer for learning. But one section studied in the lecture room; however, the students used their mobile phones or laptops to access the course online during the lecture hour. After the lecture period, the students did their lab assignment and submitted their assignments (e.g. MS words/PDF file with coding, output, and answer) to Google Classroom. Each lab assignment had due date and time. The students submitted their self-learning study and quiz to the Google form which their answers were recorded in Google sheet. Thus, their behavioural data are gathered according to their submission. With this course design and management, the problems mentioned in section II seemed were resolved. Doing a self-learning study, the lecturer sometimes demonstrated/explained the answer by using some online compiler and suggested more resources. So the students knew the available tools and support sources for their learning.

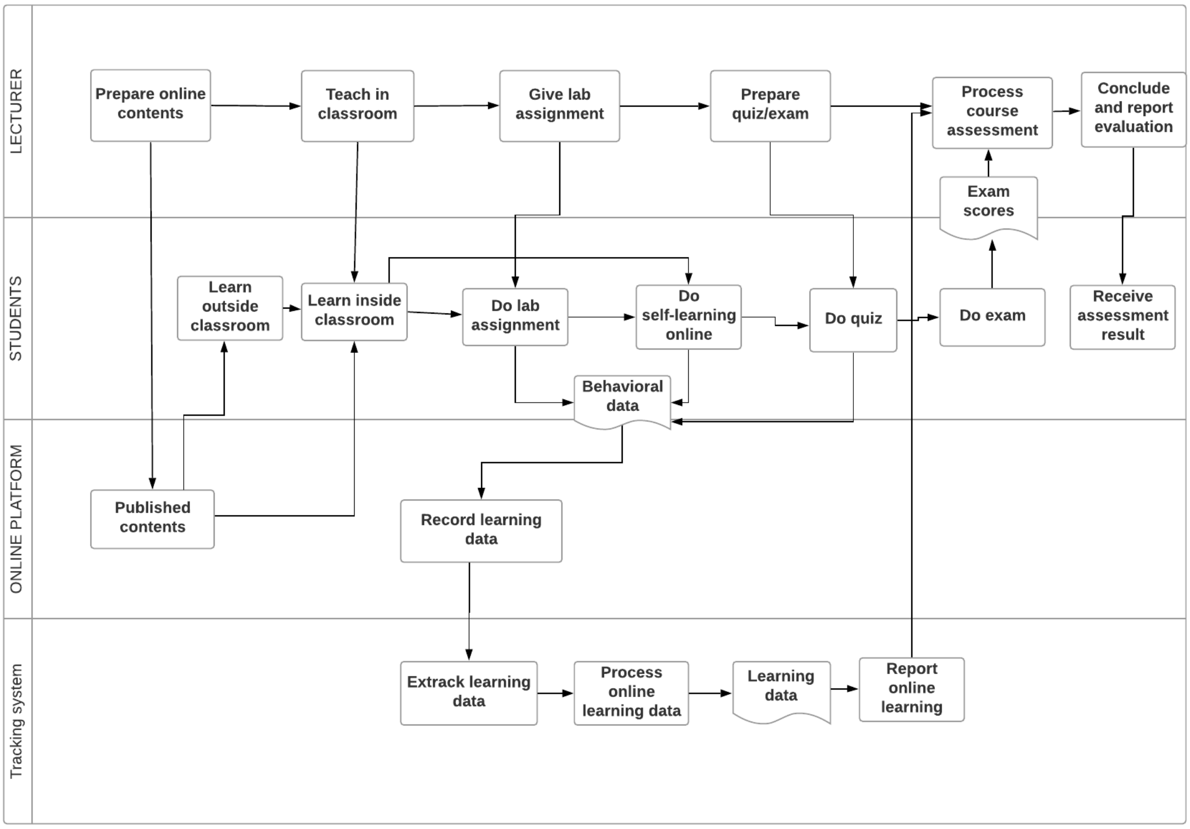

Figure 1: A Flow of activity in learning

The course, Principles of Programming Languages, were designed its course assessment consisting of the midterm exam (30%), final exam (30%), online quiz (15%), lab assignment (10%), and self-learning (15%) (see Table 1). Assessment comprises of the knowledge test (three former parts) and self-responsibility assessment. The author prepared 20 self-learning study for each part (midterm and final) and 10 lab assignments. Comparison of the course assessment of the previous traditional teaching method and the proposed blended-course is shown in Table 1. The author had the aim to motivate learning outside the classroom and self-regulation so the score for the class participant was removed. The quiz in the previous course was a programming quiz which was executed at the end of the course but in the proposed blended learning the quiz was given three times and these were specified according to the end of some modules of the course. One quiz was a programming quiz according to programming paradigms and two quizzes were online quizzes related to the concepts and principles of the subject. In this paper, some statistical data is processed according to some assumptions. For example, providing many options to collect the scores such as from self-learning study may increase engagement, and the convenience of accessing to the web contents and unlimited of self-learning submission may enabling a better understanding of their learning. The reported statistical data is discussed in Section 4.1.

Table 1: Course assessment in the previous course and the proposed blended-course.

Assessment	Previous course	Proposed blended-course
Midterm paper exam	35	30
Final paper exam	35	30
Laboratory assignment (in classroom)	10	10
Quiz (in classroom)	10	15
Attention/Class participation	10	-
Self-learning (outside classroom)	-	15

3.2 Support technology for course contents

The university, King Mongkut's University of Technology North Bangkok, provides Google cloud services for the lecturers and the students, for example, Google Sites, Google Form, Google Sheet, Google Drive, and Google Classroom. The others of Learning Management Systems (e.g., Moodle) are provided for each particular faculty. There is no mandatory policy of the university that requires the lecturers/instructors to use such these technologies. Organisation and policy can be one of the mechanisms to drive the new environment of learning (Garrison and Kanuka, 2004)(Porter et al 2014) that require more flexibility to support personalised learning context. However, lack of policy may be not able to achieve the real goal of the blended-learning approach. Here, the support technologies are chosen and provided by each individual course or each instructor. The author selected the Google Classroom for communication and for submission of the lab assignment. In addition, the author created a website for the course contents and used such websites for teaching in the classroom (see Figure 2 (a)). The two websites (for midterm and final teaching) were designed with some menus linking to each topic of the subjects. There were 5 – 7 modules for each website. Each page can be read within 10 minutes. The contents contained pictures, texts, and hyperlinks to particular sources. The structure of the website and course contents were introduced to the students at the beginning of the course. The page embedded self-learning study such as shown in Figure 2 (b). The self-learning study may contain 2 – 5 questions or open question (see Section 3.3). To find the answer, the students were required to investigate the contents of the page or do some coding in order to acquire the answer. For example, with the given PHP code in the self-learning number L.16, the student runs the code using PHP online interpreter. For example, the concept of type binding has two categories – static type binding, and dynamic type binding where the former means type of the variable cannot be changed during runtime and the second can change. Rather teach them to know which programming language has which type binding they had to explore coding to get the answer. By running the code, the students observed the changes of types of the PHP variables and thus they learned by doing and analysing.

Using Google Form, the feedback was delivered to the students after they submitted the answer directly. However, this is limited for the open questions. The answers were collected through the Google Form and stored in Google Sheet which can be exported for processing later. Before the students accessed the websites, they were required to login with their Google email account provided by the university and thus identifying the learner was possible. Data analytic regarding the access of the website can be implemented by Google Data analytics. However, in this empirical study, this function is not included for the observation because it has less significant to show that the number of access to the website presents real engagement in learning and also the cost. Thus, the author selected to observe the access of self-learning submission rather than to observe the access to read the content. However, the student may not pay attention to self-learning's correctness because the scores were not included in the evaluation.

(a) (b)

Figure 2: An example of the website and self-learning study

3.3 Questioning design for self-learning study

Self-learning study is proposed in the teaching-learning model of the blended-course and therefore, "what types of questions the student can learn by themselves in the blended-course exercise?" is the question leads to the content design. Here, summarisation of various types of questions provided in the blended-course is as follows:

- The question that the students can search for information from the websites. For example, the question that asks about the domain of particular languages. This type of question relates to remembering skill.
- The question that the students can code to find the answer by using interpreter online or offline. For example (see Figure 3), the learning content describes static and dynamic type binding by giving the definition of these as follows:
- *Static type binding is the variable's type that is defined before runtime and cannot be changed during runtime.*
- *Dynamic type binding is the variable's type that can be changed during runtime.*

The question is "what is the concept of type binding in PHP ?". To acquire the answer, the self-learning study is given by the code of PHP and the students run the given code using an offline or online interpreter. Later, they analysed the answer according to the definitions.

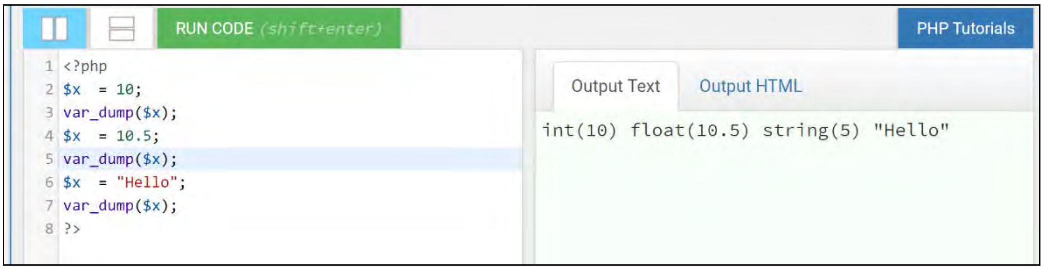

Figure 3: An example of the website and page with self-learning study

- The questions that require the student to compare similar principles and distinct principles of the programming languages. For example, the questions that ask about the characteristics of abstraction support in particular languages (see Figure 4). The learner needs to associate the concepts and programming languages together.
- The questions that require the student practice and submit the answer. Automated tool for checking the answer is required. However, in the proposed blended-course needs an additional automated tool such as grammar parser. Thus, this is limited in this paper. However, the submitted answer can be reviewed by the instructor to know the common of understanding of the students and this can be explained further in the classroom.

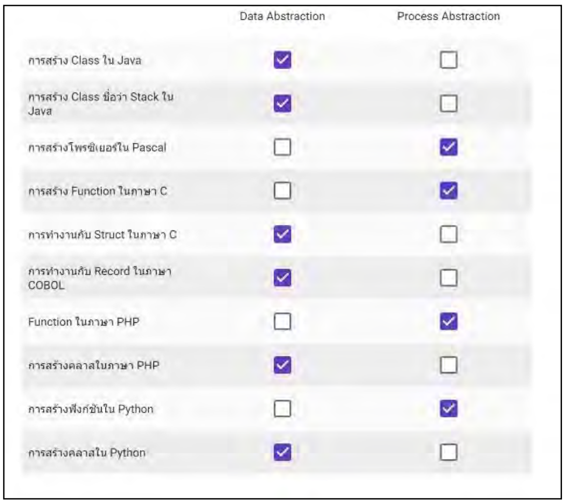

Figure 4: An example of the website and page with self-learning study

4. Learning assessment and results

4.1 Learning assessment

The proposed teaching-learning method has the assumption that the students who pay attention to self-learning study may increase better understanding. To diagnose this assumption, the learning assessment is computed by statistical measurements such as average, standard deviation, and correlation. Another measurement is measured by the frequency of submission of the self-learning study and this represents the learning engagement of the students. Table 2 is the results of the statistical data of the learning assessment of the 120 students. The correlation (Figure 5) of total assessment score (Section 3) and the number of self-learning submissions is 0.65 while the correlation of the exam score (i.e. final and midterm exams score) and the number of self-learning submissions is 0.34. This indicates that the self-learning score affects learning performance in overall higher than the exam score. However, the learning performance in overall still correlates to the exam score directly (0.92). Providing self-learning represents 24.36 percent as engagement result. This is computed from the ratio of the total number of submitted of self-learning study (non-repeated count for each study) and the total number of required submissions (i.e. 4,800 times calculated from 120 persons in which each should submit 40 times). This number is seemed small even though the self-learning is taken into account as part of the course assessment that is not difficult to achieve. With the low result of the engagement, the author inspected the student behaviour for each individual student. It was found that self-learning score presented the interests of the student obviously. For example, the students who may have low exam scores – one group tried to submit all self-learning study whereas another group ignored to do so, and the students who may have high exam score submitted all assignments.

Table 2: The learning assessment result

The number of students in this study (N)	**120**
Correlation (Total score, N.of self-learning)	0.65
Correlation (Exam score, N.of self-learning)	0.34
Correlation (Total score, Exam score)	0.92
Average of the total score (from 100)	50.85
Standard Deviation of the total score	10.39
Engagement of self-learning	24.36%

4.2 Opinion of the students to the proposed blended-course

To examine the opinion of the blended-course, the author created the questionnaire and sent to the students. The responses were from 113 students. Table 3 shows the results of the opinion of the students investigated from 113 students. The statistical data is computed by mean, standard deviation and median. The provided contents on the website are easy to access (4.09). The students committed to the rules and ratio of assessment (3.81). They agreed that self-learning enables self-review (3.89). An online interpreter is a good tool to support their study (3.82). This means the students do not install and configure the software compiler in offline which may take more time to study. However, they may have unconfident about the proposed teaching-learning method. For example, they still required others support materials (e.g. MS PowerPoint slide, and books) (3.12) and most of them requested the video clips. They had seen the importance of lab practising (3.69) while self-learning practising may have less significant (3.17). Learning this subject increased a better understanding of the learned languages (3.57). At the end of the questionnaire, students were encouraged to give positive and negative comments. They complained about the difficulty of the lab practising, they needed a tracking tool to track their progress on self-learning submissions, and they needed all solutions of the lab practising. The last need seemed unreasonable to the instructors because they can practise and learn by doing in acquiring the answer or may ask for more explanation during the lab class. However, the instructor provided and explained some solutions for some particular practises.

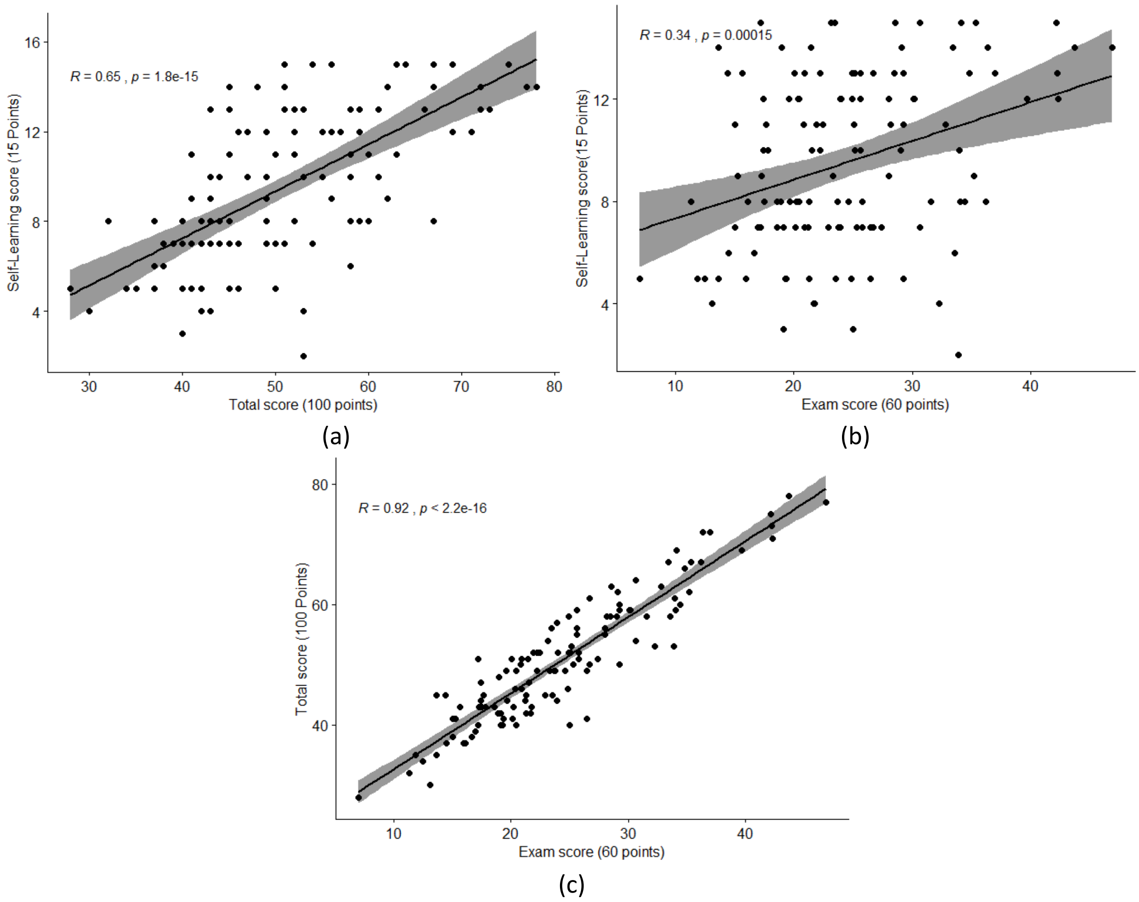

Figure 5: Correlation graph (a) relation between total score and self-learning score (b) relation between exam score and self-learning score (c) relation between exam score and total score

Table 3: Students' opinion on the blended-course

No.	Question	Mean	STD	Median
1	Convenience regarding the available contents in online.	4.09	0.90	4
2	The assessment ratio is suitable.	3.81	0.86	4
3	Self-learning enables self-review during study.	3.89	0.87	4
4	An online interpreter is suitable tools for the study.	3.82	0.92	4
5	Opinion towards other support materials such as slides and books.	3.12	1.17	3
6	Significance of self-learning to enhance a better understanding.	3.17	0.88	3
7	Providing laboratory supports learning the subject.	3.69	0.86	4
8	Learning this subject increases the learned programming languages.	3.57	0.85	4

5. The requirement of tracking system for the blended-course

A tracking system supports learning analytics which can be defined as the measurement, collections, analysis, and reporting of the data about the learners and their context. It is a mechanism to understand and optimise learning and the environments in which it occurs (Boyle et al 2003). The learning analytics can be measured by grade, retention, and completion. In contrast, the tracking purpose is focused on learner progression as basis however, self-regulated learning, knowledge construction, and creativity are observable by learning analytics.

Tracking the proposed blended-course can be considered in various perspective on the students, the instructors, and courses. With the proposed blended-course, some requirements that the tracking system can provide and analyse are as follows.

- The number of access (observed from assignment submission) and access time (e.g. 9.00 – 12.00 am.).
- Their learning styles that can be tracked according to the access time.
- Assessment of self-responsibility relating to lab assignment and self-learning assignment.
- Learning progression in the overall course time.
- Test performance from the online quiz, self-learning, and including the traditional exam.
- Engagement of the students that can be measured by self-learning study.

The mentioned requirements above can be measured on each individual, each section/class, and the entire course. Tracking tool reports the behavioural data in terms of particular measurement units which can be determined in terms of task unit or time unit, for example, one lab assignment is one task unit which requires 2 hours as the time unit. Thus, the progression of the learner can be calculated according to the task or the number of hours to accomplish a task and this may vary depending on particular assignment (e.g. lab assignment, self-learning assignment). In addition, the deadline for each submission should be able to be specified in order to encourage self-regulation.

Individual progression, class progression, and course progression should be computed particularly to represent the overall learning performance of the individual, class, and course. The important requirement is the information that gives the feedback to the learner and this should be provided in anytime during their learning. In this paper, the students' learning data (see Figure 1 tracking system) was gathered from Google sheets. Processing information was performed by extracting the data, storing, and querying the data from the database. The prototype of the tracking system is developed using HTML, and PHP as the server sides programs. JPGraph is used for virtualisation of the information. The Google platform provides API to access the sheet data for processing, enhancing the developed tracking system with the Google API will be investigated further.

6. Related work

McGee and Reis (2012) proposed a learning management system called AHyCo to support learning and testing in the course Teaching Methods in Information Science. Their teaching model was based on collaborative learning and project-oriented activities. The system provided the forum, file sharing, testing with the multiple-choice question, essay-type, and programming. They also provided automatically checked of the programming based on particular provided test cases. Learning performance was measured according to the testing. Boyle et al (2003) proposed blended learning for the course introductory programming. Their teaching-learning model provided an online submission for the assignment, online assessment, and course materials e.g., laboratory tasks, MS Powerpoint slides. More than 600 students registered in their course in which most were non-technical students. Their evaluation results revealed diverse preference to the blended learning approach. Surjono, Muhtadi and Wahyuningsih (2017) proposed experimentation to test between the controlled groups - the students learned using a blended-learning approach and face-to-face instruction. The experiment results showed that for the subject Multimedia Courses the former approach increases better student performance. Estacio and Raga (2017) proposed an analytic of students' learning behaviour on the blended-courses. Their analytic was on time-based and activity-based analysis using Moodle log data. Data mining algorithm – Vector Space Model, is used to determine the patterns of the activities. Atef and Medhat (2015) proposed the blended learning in Graphic Design Course in which pedagogy is based on project-based learning. Hadjerrouit (2008) experimented the blended-learning model for computer programming. His works paid attention to the well-designed contents and structures to solve the learning problem for novice students who learned Java programming. Wang et al (2007) proposed the teaching and learning using the blended-learning approach and their evaluation showed that it provided great flexibilities to both teaching and learning. El-zein, Langrish and Balaam (2009) provided the blended teaching and learning of computer programming and their results showed that the blended approach was flexible to the large classes. Bati, Gelderblom, and Van Biljon (2014) proposed the design of a blended learning solution for the large class of computer programming. This paper proposed the model of teaching-learning that materials and contents are provided online and practising was implemented in online and offline. The blended-course provided has the purpose to observe self-regulation and engagement but performance evaluation based on pre-test and post-test condition were not focused in this study.

7. Conclusion

This empirical study shows the fact that blended-course primarily focus on addressing issues of access and convenience. For example, the blended-course is intended to provide additional flexibility to the learners or attempt to provide the same opportunities or learning experience but through a different modality. It is obvious that teaching-learning in this method is suitable for teaching the subjects related to the computer technologies and computer programming languages although, engagement of the students still relies on each individual and particularly on the paper exam. However, it is a way to encourage self-regulation of the student, in particular, learning the subjects that require learning by doing approach. Another advantage of the blended-course is reducing the cost of providing software that may require a license fee. This empirical study used the supporting technology that was accessible through the university networks. It is possible to increase automated blended-course if the blended system can be managed automatically, for example, parsing the source code to check the correctness. However, the subject used many programming languages thus it may take time in developing such a tool. Identification of successful factor for applying the blended learning approach instead of the traditional approach may not sufficient to conclude that the former is suitable to encourage the learner to learn more because engagement result is quite low. However, flexibility and convenience for both learner and instructor are obviously seen particularly, for the learners who are technical-students in ICT. Project-based learning can be an alternative method for the blended teaching-learning model, and this may support performance evaluation on the subjects related to computer programming and principles.

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Automated Scaffolding and Feedback for Proof Construction: A Case Study

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Abstract: Beginners are often unaccustomed to the abstract and formal thinking required in tertiary computer science education. This can be alleviated through close support provided by an experienced person, like a teacher. Nowadays, such support is hardly possible because, in computer science, instructors face classes of a few ten to a few hundred students. This article shows how scaffolding and feedback needed by computer science beginners can be provided by software. The particularly difficult case of building logical proofs is considered so as to demonstrate the effectiveness of the approach. The approach to computer-provided scaffolding and feedback presented in this article is based on specifically designed proof editors that relieve learners from some choices and tasks – scaffolding – and provide immediate feedback on those tasks left to the learners. Building logical proofs is especially challenging – not only for beginners – because it includes various challenges: Understanding definitions, building a syntactically correct proof, and correctly applying complex proof building rules. This article introduces two specialized editors that support students in learning the proof methods Resolution and Natural Deduction. The editors make it possible for learners to focus on the correct order of rule application – the most challenging part of proof building –, by relieving them of the other aspects of proof building, and providing immediate feedback on the correctness of proof construction tasks performed by the learners. The contributions of this article are twofold: First, the conception and implementation of two original graphical proof editors, and second, a report on an evaluation of the editors and the feedback and scaffolding they provide pointing to the educational approach's effectiveness.

Keywords: scaffolding, interactive learning environment, problem-solving learning environments, STEM education

1. Introduction

Coming from secondary education, beginners are often unaccustomed to the abstract and formal thinking required in tertiary math education (Gueduet, 2008) which is a part of computer science education. This is traditionally best alleviated through close support provided by an experienced person, like a teacher, but is nowadays hardly possibly with teachers facing classes of a few ten to a few hundred students.

Computer-provided feedback and scaffolding both lessens the workload of instructors (allowing them to focus on students that require their personal help) and empowers learners to engage with the subject matter on their own terms independently from lecturers or fixed hours. One way to implement computer-provided feedback and scaffolding are specialized editors that support users while they learn a particular topic. Such editors relieve learners from some choices and tasks – scaffolding – and provide immediate feedback on those tasks left to the learners. Both scaffolding and immediate feedback can already be found in many computer-based tools, such as in linters for programming languages which provide users with error messages and propose solutions which can be seen as a form of scaffolding. A tool for building automatons, JFLAP (http://www.jflap.org/) does not allow syntactically incorrect automatons to be built at all. Another area are logical proofs, the building of which is especially challenging – not only for beginners – because of various challenges: Understanding definitions, building a syntactically correct proof, and correctly applying complex proof building rules.

This article introduces two specialized editors that support students in learning the proof methods *Resolution* and *Natural Deduction*. The editors make it possible for learners to focus on the correct order of rule application – the most challenging part of proof building –, by relieving them of the other aspects of proof building, and providing immediate feedback on the correctness of proof construction tasks performed by the learners, especially on the proof's correctness.

The contributions of this article are twofold: First, the conception and implementation of two original graphical proof editors; second, a report on an evaluation of the editors and the feedback and scaffolding they provide pointing to the educational approach's effectiveness.

This article is structured as follows: This section is the introduction. Section 2 introduces related work. In Section 3 both editors and the ways in which they provide feedback and scaffolding are described. Section 4 reports on the evaluation of the editors and Section 5 summarizes the article and gives perspectives for future work.

2. Related work

The editors described in this article relate to feedback, scaffolding, and the use of interactive editors in learning and teaching.

2.1 Feedback

Feedback has been subject of much research regarding its effectiveness in various situations especially in the context of education. Feedback can be defined as "actions taken by (an) external agent(s) to provide information regarding some aspect(s) of one's task performance" (Kluger and DeNisi, 1996, p. 255). Thus, feedback can be seen as a "consequence of performance" (Hattie and Timperley, 2007, p. 81). If students are completely unfamiliar with the subject they learn, feedback has no effect, but otherwise it can help students to recognize mistakes and enhance their learning behavior (Hattie and Timperley, 2007). In a study analyzing more than hundred factors influencing students' achievement, feedback ranked among the top ten factors (Hattie and Timperley, 2007).

Hattie discriminates between four levels of feedback (Hattie and Timperley, 2007, p. 90):

- *Task-level Feedback* gives information about the worked on task.
- *Process-level Feedback* gives information on how to solve tasks related to the worked on task.
- *Self-regulation Feedback* aims to improve the learner's abilities regarding self-monitoring, self-evaluation, and directing actions.
- *Self-level Feedback* is a task-unrelated evaluation of the student.

According to Hattie, the most effective levels of feedback are process and self-regulation, as the former improves understanding of the underlying task scheme rather than that of a single task, while the latter guides students towards independent learning. Feedback at task level is most effective when combined with feedback at process level. When feedback should be given depends on the level: Feedback at task level is more effective when errors are corrected immediately, as it can lead to faster acquisition rates, whereas feedback at process level is best given delayed, as "immediate error correction [...] can detract from the learning of automaticity" (Hattie and Timperley, 2007, p. 98). The effectiveness of self-regulated feedback is further backed by Orsmond and Merry (2013) who suggest that the ability of self-regulated learning corresponds to being a "high achieving" student (Orsmond and Merry, 2013). Furthermore, Orsmond and Merry (2013) suggest that self-regulation is essential to process feedback at all.

Nicol and Macfarlane-Dick (2006) propose principles that good feedback should adhere to as well as various ways to meet this requirements. According to them, feedback should "help clarify what good performance is" (Nicol and Macfarlane-Dick, 2006, p. 205). This can be met by the provision of exemplary solutions. Another principle is that feedback should "encourage motivation and self esteem" (Nicol and Macfarlane-Dick, 2006, p. 205) which can be met by many "easy-to-solve" tasks instead of a single difficult task, as well as providing feedback comments instead of scores or grades.

2.2 Scaffolding and fading

Scaffolding is a teaching method in which students are supported while working on tasks the solving of which would be otherwise beyond their abilities. Originally used in context of Vygotsky's Zone of Proximal Development to describe the potential development of a child under guidance of a more capable person, more recent research has transferred the theory to general education with scaffolding now being used for guiding and helping learners during their learning process (Gibbons, 2002). The support given throughout the learning process should be gradually removed ("faded") until it is no longer necessary (Jackson, 1996). While scaffolding, as provided by human tutors, has been well-established as an effective means of supportive learning (Jackson, 1996, p. 1), Azevedo and Hadwin (2005) conclude that scaffolding must not necessarily be provided by a human but can be provided by technology as well. In studies, computer-provided scaffolding has been shown to be effective in "moving students towards more sophisticated models" as well as increasing the students ability to self-regulate (Azevedo and Hadwin, 2005, p. 371). A study by Sao, Gobert and Baker (2014) examining the effects of computer-provided feedback observed that students who received automated scaffolding by software during various exercises performed significantly better afterwards than students who did not.

According to Van Merriënboer, Kirschner and Kester (2003), the aim of scaffolding is to reduce cognitive load during learning which allows learners to focus on fewer important concepts at a time. Scaffolding can either reduce *intrinsic* cognitive load, which can be done by gradually moving from simple to more complex tasks, or *extraneous* cognitive load, which could, e.g., be done by beginning with worked-out examples, to filling out gaps, and finally moving towards conventional tasks (Van Merriënboer, Kirschner and Kester, 2003). Providing whole tasks instead of parts of tasks supports students in gaining an overview of the structure and relations between the various parts of a task (Van Merriënboer, Kirschner and Kester, 2003). For optimal scaffolding, the correct information should be given at the correct time: *Supportive information*, such as cognitive strategies and mental models should be presented before the task is worked on, while *procedural information*, such as parts that stay the same across similar tasks should be explained while the task is worked on (Van Merriënboer, Kirschner and Kester, 2003). However, tasks can be also be simplified up the point that students do not have to mind certain aspects of the tasks at all: A concept closely related to scaffolding and fading is “Didactic Reduction”, a term coined by Grüner (1967), and describes breaking down a concept to its most basic parts, explaining those, and adding more advanced concepts step by step afterwards to the aim of reducing cognitive load on learners. Grüner differentiates between vertical and horizontal didactic reduction: While horizontal reduction aims to simplify tasks by helping students with examples or similar, vertical reduction simplifies the task by omitting some details of the task (Grüner, 1967). In the process of fading, these details can be reintroduced later during the learning process.

2.3 Interactive editors in STEM

In the past decades, various interactive editors for learning purposes were designed. Generally, these editors aim to assist students in performing exercises for a certain subject or in a certain task category. Research has shown that students usually perform better solving tasks with the help of such editors than without: A study examining the interactive geometry editor GeoGebra (https://www.geogebra.org) has shown that the usage of this editor has a significant positive influence on student learning (Zengin, Furkan and Kutluca, 2012). eChem, an interactive editor for visualizing chemical representations of molecular models has shown positive results on students' performance as well (Wu, Krajcik and Soloway, 2001). Regarding the field of logical reasoning, there already exist a variety of interactive tools and editors. P-Logic Tutor (Lukins, Levicki and Burg, 2002) supports students in understanding the concepts of propositional logic and theorem proving. While the effect on students' performance has not been measured for this editor, a study examining ITA (Yacef, 2005), a set of editors similar to P-Logic Tutor, has shown that using the editors has a strong impact on students' performance. ILTIS (Geck et al., 2018) is another recently developed system of logic editors including an editor for resolution in propositional logic, where authors concluded that the feedback provided by their system supports students in understanding the subject matter as well. However, although there are already various editors for logical reasoning, the authors are not aware of any editor for Resolution for first order logic. Furthermore, already existing editors for Natural Deduction, such as Alfa (Hallgren and Ranta, 2000), require a certain familiarity with the topic and can therefore considered less suitable to help beginners. The editors in this paper were designed for both propositional and first order logic with the specific aim to help beginners getting familiar in the field of logical proofs using Resolution and Natural Deduction.

3. Logic editors

This section introduces the editors for the proof techniques Resolution and Natural Deduction used for the evaluation described in Section 4. A more detailed explanation of the proof techniques and editors can be found in (Staudacher, 2018).

3.1 Resolution

Resolution is a proof technique developed by Robinson with which the unsatisfiability of formulas can be proven in both propositional and first order logic (Robinson, 1965). The editor can be seen in Figure 1: The left side shows the clauses of the formula of which the unsatisfiability is to be shown, and the right side shows the current proof tree. At each step (i.e., one line on the right side), the student chooses clauses from the right which contain complementary literals (M and ¬M in Figure 1), selects them in the tree, which are then eliminated in the subsequent step (line 2 on the right side of Figure 1). The steps of adding a clause from the left and eliminating complementary literals continue until the resulting clause is the empty set what proves unsatisfiability. For proofs in first order logic, the editor supports variable substitutions (in form of a most general unifier) and factorization rules.

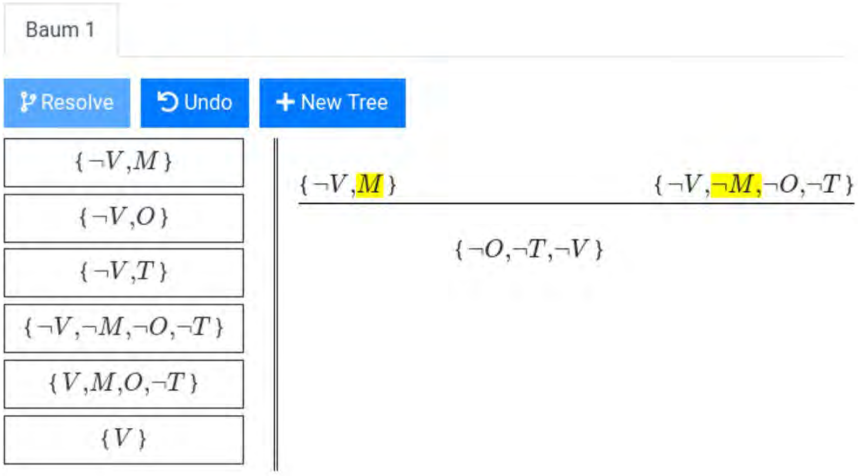

Figure 1: Editor for resolution by example of an exercise about propositional logic

The editor provides users with immediate feedback on the correctness of a step, as incorrect steps are met with an error message and are not performed on the proof tree. Error messages serve both as feedback at task level and at process level, as students not only learn why their current step was incorrect, but also about the general effect of a resolution step. While working on a proof, users can focus on the correct application of the rules and do not have to think about the creation of a syntactically correct proof tree, which eliminates one potential source of errors and acts as didactic reduction. As of scaffolding, the editor provides the aforementioned feedback during the creation of the proof and can as well be pre-filled with a partly constructed proof tree (c.f., Section 2.2).

3.2 Natural Deduction

Natural Deduction is a proof technique developed by Gentzen (1935) that allows to prove the satisfiability of a formula in both propositional and first order logic. The editor for Natural Deduction can be seen in Figure 2 and is split into three parts: The left side shows the rules of Natural Deduction, the right side shows assumptions (which are required for or created by the use of some rules), and the middle shows the actual proof tree. Users select one or more formulas in the proof tree and select a rule, which will subsequently be applied to the selected formulas, resulting in a new level of the proof tree.

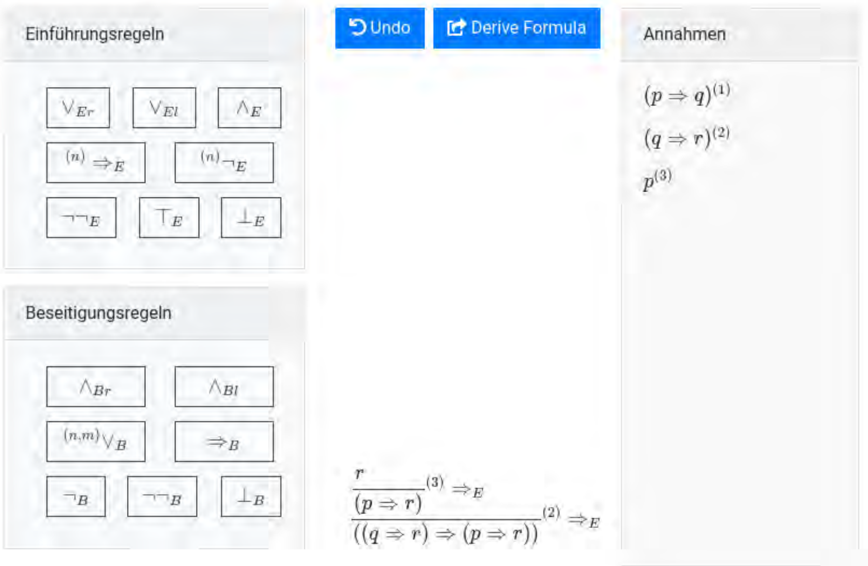

Figure 2: Editor for Natural Deduction by example of an exercise about propositional logic

Proofs using Natural Deduction can be either built beginning with the formula to be proven or with the assumptions. Depending on the actual exercise, one way or the other or a mix of both makes sense. Therefore, the editor generally works bottom-up, but allows users to derive parts of the proof in a separate window top-down and add those parts of the proof afterwards to the main tree.

The editor for Natural Deduction provides feedback on the overall correctness of exercises as well, which is especially important for beginners since it is often not obvious when a proof is correctly finished. Feedback is provided when applying rules as well: If a rule was applied incorrectly, users are provided with an error message describing what error has been made. If an applicable rule was selected, users can immediately check if the application of the rule matches their expected result and thereby gain better understanding on the application of the rules. Feedback on rule application works both on task and process level, as the rules are independent from the exercise and applicable for all proofs using Natural Deduction. Similar to the editor for Resolution, scaffolding is achieved by the automatic application of rules and the possibility to provide partly constructed proofs. Following the concept of didactic reduction, the editor keeps track of the used and generated assumptions so that users do not have to manage assumptions at all, removing another potential roadblock on the way to a correct proof.

4. Evaluation

For the evaluation, both editors were integrated into the Backstage learning platform (https://backstage2.pms.ifi.lmu.de:8080). Additionally to the features of the editors described in Section 3, Backstage provided the students with exemplary solutions after they attempted an exercise and an overview on how their peers performed in the exercise.

A total of 13 exercises were provided to students in the week before the examination in July 2018. Five of the exercises were on Resolution and consisted of three exercises on propositional logic and two exercises on first order logic. Within each group and across those groups, the difficulty of the exercises increased.

The remaining eight exercises were exercises on Natural Deduction. The first four exercises focused on the usage of the implication rules, which is generally one of the more intuitive rules. Therefore, these exercises were considered easy. These exercises were followed by two exercises requiring a more extensive set of rules, therefore being considered as medium difficulty. The last block contained two difficult exercises which required large proof trees and use of *counter-intuitive* rules.

4.1 Methods

Two data sources were polled so as to evaluate the editors: A survey conducted after the course's examination and data collected from the Backstage system. The survey consisted of three parts:

- A block of six questions referring to the editor for Resolution.
- A block of six questions referring to the editor for Natural Deduction.
- Two questions to be answered with free text asking about positive and negative aspects of both editors.

For (1) and (2) a six-point Likert scale ranging from strongly agree (assigned value of 6) to strongly disagree (assigned value of 1) was utilized.

Data collected directly from the system included all attempts to all exercises and for each attempt the start and the end time. The time a student spent working on an exercise was calculated from those values. Attempts that took less than 30 seconds and empty submissions were not considered in the results below, as well as attempts that took more than 13.5 minutes. For the former, it can be assumed that those attempts were no serious tries, for the latter, that the student interrupted for a while and resumed the solving of the exercise at a later point in time.

4.2 Results

A total of 603 students were registered to the course on Backstage, of whom 193 attempted to solve at least one of the exercises. For the evaluation of the collected data, four performance measures were considered for each exercise:

- Number of students attempting the exercises
- Number of students solving the exercise correctly
- Number of students solving the exercise correctly in their first try
- Average time students spent working on an exercise until their first correct submission

The results for (1) and (2) can be seen in Table 1. For both Resolution and Natural Deduction, the number of students attempting subsequent exercises decreases steadily. For Natural Deduction, the number of students attempting subsequent exercises drops by 10 students per exercise, for Resolution by 20. The number of students submitting correct answers decreases as well: For Resolution exercises, a clear difference between correct answers for propositional logic (R1, R2, R3) and first order logic (R4, R5) can be observed, with the number of correct attempts decreasing by more than 50%. For Natural Deduction exercises, the number of students that submitted a correct answer remains more constant compared to the Resolution exercises, settling on around 66 with the beginning of the second and until the sixth exercise. 31 students attempted every Resolution exercise, with 20 of them solving each exercise correctly. All of the Natural Deduction exercises were attempted by 27 students, 9 of them solving each exercise correctly.

Table 1: Number of unique students and number of students that submitted a correct attempt per exercise

Exercise	**ND1**	**ND2**	**ND3**	**ND4**	**ND5**	**ND6**	**ND7**	**ND8**	**R1**	**R2**	**R3**	**R4**	**R5**
Unique students	133	109	92	86	78	85	96	80	135	137	119	94	54
Students who submitted correct answer	85	66	69	66	64	66	44	19	108	91	92	45	37

Figure 3 shows the number of students correctly solving Natural Deduction exercises on their first tries: Except for the last two exercises, there were always more than 40 students with an average of 55 students (Median: 57.5) submitting correct answers on their first tries. The results for Resolution, which are not displayed here due to space limitations, again show a cut happening between propositional and first order logic. Up to 80 students with an average of 64 (Median: 73) submitted a correct answer on their first try for propositional logic, while the first order logic exercises were only solved by less than 30 students on their first try.

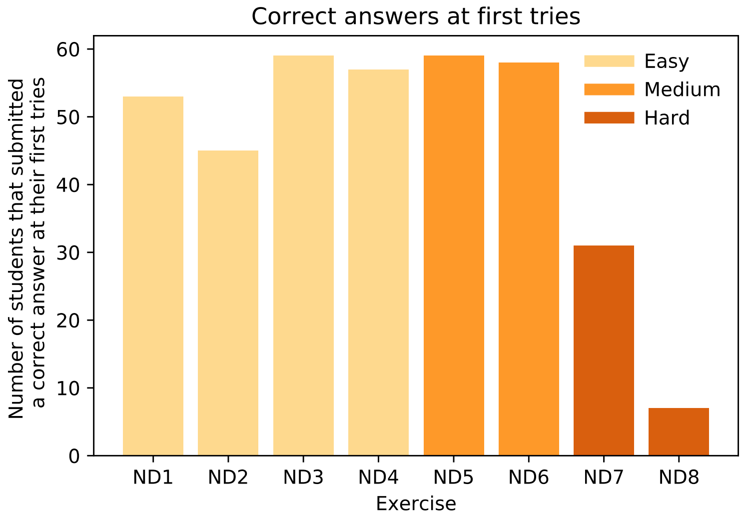

Figure 3: Number of students that submitted correct answers at their first tries for exercises on Natural Deduction

Figure 4 and Figure 5 show the average working time for Natural Deduction and Resolution exercises respectively. For Resolution exercises, students generally required twice as much time to solve exercises on propositional logic compared to exercises on first order logic. For Natural Deduction, the average working time decreases after the first two exercises until the fifth with an average working time of two minutes. After that, working time increases again with increasing exercise difficulty.

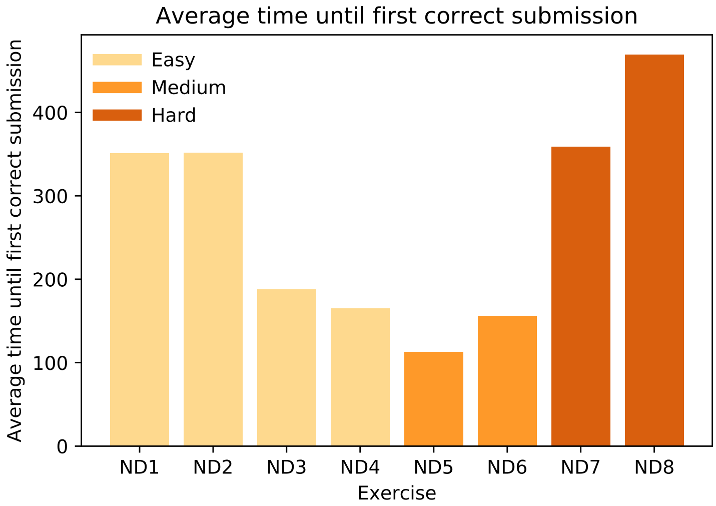

Figure 4: Average work time until first correct submission for exercises on Natural Deduction

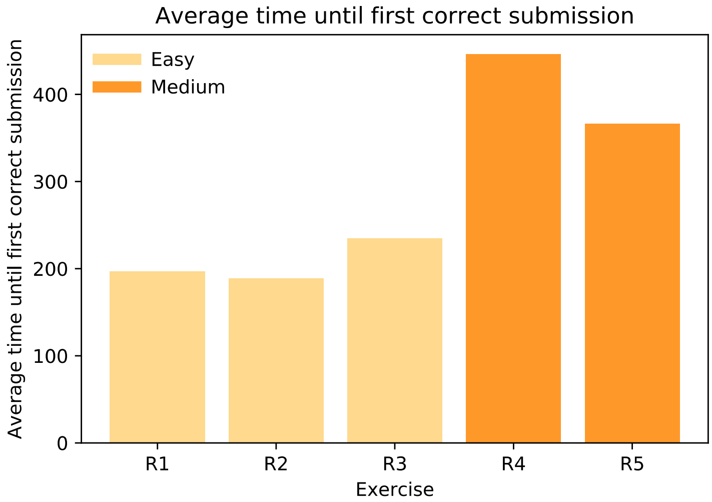

Figure 5: Average work time until first correct submission for exercises on Resolution

The questionnaire was answered by 17 students, but as four of those did not answer the questions on the editors the results refer to 13 students. Table 2 shows the results of the survey: Results are fairly consistent between the editors. Both editors and the feedback they provide helped students clearing up misconceptions, with feedback being the more important facilitator in both cases. Students were in disagreement whether the editor made doing the exercises easier than on paper.

Table 2: Results from the survey about editors for Resolution and Natural Deduction (n = 13). Statements were shortened due to lack of space

Statement	Resolution		Natural Deduction	
	Avg	SD	Avg	SD
Proof technique understood before using editor	4.14	1.51	3.85	1.72
Exercises using editor easier than doing exercises on paper	3.46	1.76	3.46	1.80
After familiarizing with the editor able to solve exercises	4.77	1.48	4.61	1.76
Feedback of the editor helped learning the proof technique	4.23	1.59	4.23	1.54
Editor helped me to clear up misconceptions about the proof technique	4.31	1.65	4.23	1.54
Feedback helped to clear up misconceptions about the proof technique	4.46	1.56	4.31	1.55

4.3 Discussion

When looking at the first six Natural Deduction exercises, results show a decline in average working time, with the number of students that submitted a correct solution and the number of students that submitted a correct solution at their first tries remaining constant. This result suggests that students attempting the exercises were getting better while working through the exercises. However, it is not possible to determine if students were only getting more familiar using the editors or if students were getting better in understanding the principles of Natural Deduction. Furthermore, no small number of students dropped out of the exercises at some point, which could mean that the editors were not able to give them the scaffolding and feedback required for them to successfully solve the exercises. Indeed, the decline in average working time could be explained if only students with prior knowledge continued with the next exercises, as the scaffolding and feedback required students to have a basic understanding of the proof techniques, which the dropouts may have been lacking. While the number of attempts for the last two exercises in Natural Deduction stay consistent with the number of attempts of the previous exercises, the number of students successfully solving the exercises drop sharply. This may be explained that the two last exercises where extremely difficult and required the use of more "counter-intuitive" rules. Nevertheless, authors were positively surprised by the high numbers of students that were able to solve those two exercises.

The results for Resolution are not in accordance with those for Natural Deduction: None of the performance measures shows students improving while working through the exercises. The number of students attempting an exercise as well as the number of students submitting a correct solution drop sharply from propositional logic to first order logic, something that could not be observed in such magnitude for Natural Deduction exercises. This drop could be explained by the editor for Resolution requiring more *manual work* (calculating a most general unifier without support of the editor and entering it by hand) from students.

Students felt that they were supported by the editors and the feedback provided by them throughout the working process which indicates that the feedback and scaffolding provided by the editors worked as intended. However, as only about two percent of the students of the course took part in the survey, conclusions stemming from the survey have to be viewed critically. The survey items referring to feedback and scaffolding were rated worse for Natural Deduction than for Resolution, which could be explained by the difference in previous understanding of the proof techniques – less students agreed with having understood Natural Deduction than Resolution what could have led to those students not being able to process with the feedback and scaffolding provided by the editor. The results on the question asking whether the editors made solving the exercises easier than on paper show an unclear picture for both editors: Some students found working with the editors easier than working on paper, some not. As the answers to that question do not correlate with previous understanding of the proof techniques, it seems that other factors determine whether users prefer interactive editors or paper.

5. Conclusion and perspectives

This article introduced interactive editors helping students to work on exercises requiring the use of the proof techniques Resolution and Natural Deduction. Throughout the working process, the editors support students with feedback and scaffolding. As proof trees are generated by the editors, students are prevented from making formal mistakes and can completely focus on the steps of the proof. The correctness of each step is checked immediately, and if the step is valid, the proof tree is updated. Otherwise, an error message with information about the mistake is shown.

For evaluation, both editors were provided to students for examination preparation where students expressed that the editors and the feedback provided by them supported them in clearing up misconceptions and in learning the proof techniques. For Natural Deduction, results suggest that a learning process took part while students worked on exercises using the editor. This result could not be reproduced for Resolution, which could be explained by the editor for Resolution requiring more work outside of the editor from students, what could have deterred them from sufficiently engaging with the editor. However, although the evaluation indicates that the editors help students in learning logical proof techniques, the data collected is not sufficient to prove this assumption. However, this case study is intended as a foundation for further research. The authors are currently planning another study to determine the impact of the editors on students' performance.

The evaluation suggested potential improvements: The dropout across both types of exercises was fairly big, which could be addressed in various ways, e.g., by providing inexperienced students with a partly constructed proof tree, or adaptively determining which exercise to solve next to provide each student with an exercise they most likely can solve.

Generally, interactive editors could be deployed for most STEM activities involving formal languages, as the correctness of single steps or at least complete solutions can easily be checked for correctness by a machine, e.g., chemical equations or electrical circuits. Going further, even in cases were automatically generated feedback is not possible, peer reviews opens up ways for generating feedback: Technology enables a form of peer review where students can immediately start reviewing other students' submissions providing instant feedback.

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A Study of Investigating Pre-Service Teachers' Attitudes Towards Using e-Learning Resources

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Abstract: Electronic resources have become a more accessible and convenient method for teaching. However, the rate of using e-learning resources and materials between different education levels is not equal. Many kindergarten teachers think that hard copies of picture books are preferable to electronic picture books. Most people assume that early childhood education teachers have lower rates of utilization of electronic materials. This study investigated the usage of e-learning resources and materials of the pre-service teacher, and the survey research design was used to carry out the study. Two hundred and eighty-five pre-service teachers from eight universities offering teacher education programs in Taiwan completed the web-based survey. We developed a scale called The Computer Attitudes Test for Pre-service Teacher as our survey instrument. The Computer Attitudes Test for Preservice Teacher consists of thirty-six items, and the format of the response to each item was five-point Likert type scale. Three components of attitudes towards computers, namely, cognitive, affective, and behavioral components, construct these survey tools. The internal consistency was calculated using Cronbach's Alpha for each of the three components, and the correlations were also calculated for the scores between each o components and the total score. Coefficients indicate a high level of internal consistency for each attitude component. Confirmatory factor analysis was conducted and supported the construct validity of the three factors model. The results revealed that the respondents who enrolled in public schools, studied in technical universities, major in natural science, and with disadvantaged status were more favorable toward using electronic learning resources than those who enrolled in private schools, studied in tertiary universities, major in humanity or social science, and without disadvantaged status. The differences did not exist when their gender was taken into account. According to our result, some limitation and suggestion to the future study were discussed.

Keywords: pre-service teachers, teacher education, attitude, e-learning, e-resources

1. Introduction and aim

Educators of today face a diverse range of challenges; educational staff must face complex pressures related to their daily work. Today's teachers encounter an ever-changing professional territory with a persistently fast-paced evolution, which rapidly makes their knowledge and skills obsolete and transforms the entire educational context inadvertently (Fullan, 2007). They must sustain the continuous creation of pedagogical strategies that are aimed at widening and improving their educational potential (Robinson, 2008), and the use of Information and Communication Technologies (ICT) emerges as a great potential alternative to overcome such a challenge. One major challenge is the development and usages of electronic material, for the upcoming generation, are digital natives. These children get in touch with the smartphone, pad…etc. They are more apt to learn through these digital facilities. So teachers must keep pace and design their curriculum and the teaching materials in digital forms instead in print forms. These children not only read picture books that print on paper, but they also want to hear the story-telling voice, even want to interact with the characters in the story through multimedia. These children not only draw their pictures on paper, but they also scribble on the pad, and will not worry about the shortage of some colors of crayons. These children also solve mathematics problems more often through googling than asking the teacher. The ability of the teacher in this new era is not how much they know and how much they memorize. It would be while addressing a growing and complex media landscape and a technological avalanche of tools and content that they are not trained to manage, how soon they adapt to the updated educational technology, and how well they can arrange the activities and materials in their teaching careers(Houghton, Miller, and Foth, 2014; Schibeci et al., 2008). These future teachers' attitude of using the e-resource will decide whether they can survive in the next education era. So this study was aimed at understanding the attitudes or the pre-service teacher, and the following research questions were addressed:

- 1. What are the pre-service teachers' attitudes towards using e-learning resources?
- 2. Do the pre-service teachers' attitude towards using e-learning resources affected by their demographic characteristics?

2. E-learning resources for teaching and learning

'E-learning resources' or 'e-resources' are the terms that generally encompasses several kinds of digital materials for teaching and learning, such as an electronic library, virtual library and cloud library are used as the terms to describe collections of e-learning resources. Additionally, people usually access e-learning resources the aid of devices such as computer, radio and television sets, mobile phone. Moreover, people often reach e-learning resources as converting the teaching subjects into electronic forms, so that many distance learners can access the materials without differences in the location and time (Reitz 2004). However, Uziak and Oladiran (2012) argued that e-learning is not just the application of ICT in teaching, but also the expanding of learning possibilities to a new frontier in education. In this manner, e-learning challenges require more effort for equivalent or improved learning outcomes and require joint efforts from lecturers and students.

Many researchers have compared e-learning to traditional teaching in several ways, such as the improvement of learning outcome, the satisfaction of students, and the rate of course completion (Chigeza and Halbert, 2014; Israel, 2015; Southard, Meddaug and Harris, 2015; Northey et al., 2015; Ryan et al., 2016) . As a cognitive and knowledge-oriented process, the complexity of learning makes the establishment of an effective e-learning platform more complicated. When reviewing the literature, we often find that teaching and learning are not only influenced by teaching format; many other factors also play significant roles. So in this study, we focus on discussing some of the factors developed by these studies.

3. Pre-service teachers' attitudes towards using e-learning resources

Studies on pre-service teachers' attitudes and beliefs have revealed that future teachers are optimistic, highly confident, and humanistic as they enter teacher education programs (Richardson, 1996; Wideen et al., 1998). Several studies have examined entering pre-service teachers' beliefs and their effect on learning to teach within a teacher education program (Holt-Reynolds, 1992; MacKinnon & Erickson, 1992; Ross, Johnson, & Smith, 1992). Some research has revealed that pre-service teachers who are familiar with using e-resources may have more positive attitudes and advocated for a closer examination of the relationship between teachers' beliefs and teaching practices (Pajares, 1992; Pomeroy, 1993). The attitudes of pre-service teacher will lead to their self-efficacy and beliefs, and most teachers hold beliefs about their work, their roles and responsibilities, and the subject matter they teach. These beliefs provide an active link to classroom action and, ultimately, to students' classroom learning (Brownell & Pajares, 1999; Peterson, Fennema, Carpenter, & Loef, 1989). Pre-service teachers also enter teacher education programs with healthy views of teaching acquired during their previous life and schooling experiences (Brookhart & Freeman, 1992).

A range of studies reported their result and implication of developing e-learning resources, and discuss some factors that predict the teachers' attitude toward using e-learning resources. For example, Yang and Chang (2013) reported that the students designed e-resources based on biology course content to increase retention of critical thinking skills. Davis (1985) used the Technology Acceptance Model to predict an individual's likelihood of technological innovation and computer-based systems acceptance. This model were applied by other researchers on different technological innovation, such as online education (Ngai, Poon, and Chan, 2007), mobile learning (Liu, Li, and Carlsson, 2010), the adoption of mobile internet (Hong, Thong, and Tam, 2006), internet banking (Lai and Li, 2005), and mobile commerce (Wu, and Wang, 2005). These studies also identify many motivational variables that mediate between system characteristics and the actual use of the system, such as perceived usefulness, perceived ease of use, attitude to use. Brown and Stayman' (1992) study finds a direct and positive relationship between a person? Attitude towards an object or behavior and that person? Behavior and attitude is the result of individuals' beliefs concerning the behavior and the results of that behavior. Ajzen (1991) stated that attitude refers to an individual's general willingness to engage in a given behavior, it is an individual's positive or negative evaluation of a given object or behavior and affective responses. Bagozzi and Burnkrant (1985) suggested that attitude has three components: cognitive, affective, and behavioral. Bagozzi and Burnkrant (1985) defined that the cognitive component refers to an individual's specific beliefs about the object, Chaiken, and Stangor (1987) elaborated that the cognitive component consists of a value-based assessment, judgment, reception or perception of the object. Fishbein and Ajzen (1975) thought that the behavioral component refers to an individual's subjective probability that he or she will perform a specified behavior. McGuire(1985) argue that the affective component refers to what extent a person likes the object of his thoughts. Based on the Fishbein and Ajzen (1975) model of attitude, an instrument that measures attitudes would need to load onto the three different components of attitude: cognitive, affective, and behavioral. We brainstormed our original items, and those items were categorized into three pools by the researchers independently to assess whether there was an agreement in the labeling of the categories for the initial pilot.

4. Methodology

4.1 Method and tools

This study adopted a quantitative method to collect data that provided answers to the research questions for the study. We applied the survey method as our research methodology in the study, and a questionnaire containing closed-ended questions based on Likert scale was developed to collect our research data. To answer the research question, we used a self-developed questionnaire- The Teacher Attitudes toward Using E-resources Scale (TAUES) to evaluate the attitudes of pre-service educators toward using e-resources. The TAUES measures the three domains of attitude: (1) Cognitive: teacher perceptions of using e-resources; for example, I know how to find the e-resources. (2) Affective: beliefs about the efficacy of using e-resources; for example, 'I like using multimedia books rather than a printed book.' (3) Behavioral: perceptions of professional roles and functions; for example, 'I read books more often on electronic devices.' We invited several educational technology experts to validate the questionnaire.

4.2 Sample

Pre-service teachers of eight universities in Taiwan served as the participants for this study. Among these eight universities, two universities are located in northern Taiwan, both northern Taiwan and central Taiwan has selected three universities as our sample. Of these universities, four types of teacher education programs are included, two for special education, four for elementary school, four for high school and two for early childhood education. A total of 285 pre-service teachers completed the questionnaire.

5. Results

5.1 Demographic information

This study aims at discussing the attitude of pre-service teachers' attitude toward e-resources. In order to address pre-service teachers' attitude toward using e-resource, the Teacher Attitudes toward Using E-resources Scale (TAUES) was administered. Pre-service teachers responded to their demographic information and thirty-six items on a Likert-type scale (i.e., from one for not important to five for very important). Demographic information collected from the pre-service teachers included gender, academic status (public or private school; technical or tertiary university; major in humanity and social science or natural science), and disadvantaged status. Table 1 shows the demographic and descriptive information of the participants.

Of our respondents, 23.9% are males, 76.1% are males ; 73.0% enrolled in public schools, 27.0% enrolled in private schools; 23.5% were from technical university, 76.5% respondent were from tertiary university; 54.0% major in natural science, 46.0% major in humanity or social science; 7.4% were disadvantaged students, 92.6% were ordinary students.

Table1: Demographic and descriptive information of the participants

Variable	level	Frequency	Percent
Gender	male	68	23.9%
	female	217	76.1%
Public	public	208	73.0%
	private	77	27.0%
University	technical	67	23.5%
	tertiary	218	76.5%
Department	natural science	154	54.0%
	humanity or social science	131	46.0%
Disadvantaged	disadvantaged	21	7.4%
	ordinary	264	92.6%
	Total	285	100.0%

5.2 Reliability and validity analysis

Before the survey of the questionnaire, TAUES was presented to several experts to improve face and content validity. Reliability was examined using Cronbach's alpha values for each variable. As shown in Table 2, the values of all subscales were above .82, which is a commonly accepted level. The reliabilities of cognitive, affective, and behavior subscales are .825, .861, and .968. We test the construct validity through the first-order Confirmatory Factor Analysis based on the Fishbein and Ajzen's three components model of attitude was conducted. Results indicated a good fit for the three components construct: As for model fit index, $\chi 2$ = 26.383, df= 24, p= .334, $\chi 2$/df= 1.099. Model fit statistics determine how well the various models fit the data, the chi-square tests the consistency of the covariance pattern among the observed variables, and the smaller the chi-square statistic is, the better the model fit. The chi-square/ degrees of freedom ratio ($\chi 2$/df) is most often used to determine fit, for the chi-square statistic is sensitive to sample size. This CFA model had a goodness-of-fit according to this standard.

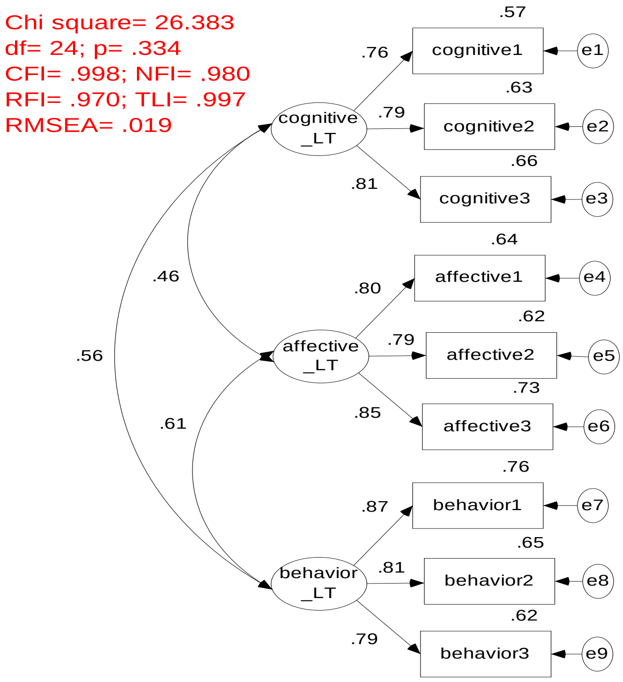

Figure 1: Construct validity through first-order CFA

As for Goodness-of-fit statistics of the CFA model, GFI= .980, AGFI=.962, all larger than .90, and showed a goodness-of-fit, for the closer the GFI and AGFI are to 1.0 the better the model fits the data. Generally, GFI and AGFI values larger than 0.9 indicate a good model fit (Hu & Bentler,1999; 1998). This CFA model also had a goodness-of-fit according to this standard. As for comparative fit index of the CFA model, NFI=.980, TLI=.997, CFI= .998, RMSEA=.019. The NFI, TLI, and CFI all compare the improvement in the fit of the proposed model over the null model, with measures closest to 1.0 indicating ideal fit. Values above 0.9 are considered excellent. The RMSEA considers the error of approximation in the population. Thus the higher the RMSEA value, the more errors in approximation, a value closer to 0, ideally below 0.8, is preferable (Weston & Gore, 2006). All the index reach an excellent standard, which means our survey data support this CFA model. The first-order CFA model is shown in Figure 1.

5.3 Descript analysis of pre-service

To address pre-service teachers' attitudes toward using e-resources, we computed the TAUES's total scores of the whole scale and subscales on by averaging individual item's scores. Higher scores on the TAUES indicate that respondents felt the statements about using e-resources were important or agree, and lower scores indicate that respondents felt the statements were not important or disagreed. For the whole scale, the range of individual item's mean scores was 3.04 to 4.10, total whole scale's mean scores were 4.02 (*SD* = .89).

For the cognitive subscale, the range of individual item's mean scores was 3.04 to 4.10, total cognitive subscale's mean scores were 4.02 (*SD* = .89). Average scores on six of the items were above three points five, indicating that the respondents felt the statements were more important than not important. For the affective subscale, the range of individual item's mean scores was 3.10 to 4.05, total affective subscale's mean scores were 4.00 (*SD* = 1.06). Average scores on six of the items were above three points five, indicating that the respondents felt the statements were more agree than disagree. For the behavioral subscale, the range of individual item's mean scores was 3.16 to 4.04, total behavior subscale's mean scores were 3.98 (*SD* = 1.08). Average scores on eight of the test items were above five, indicating that respondents felt the statements were more frequently than rarely. Table 2 shows the mean scores, standard deviations, maximum scores, and minimum scores of the whole scale and each subscale.

Table 2: Descriptive statistics and correlation among study variables

	mean	standard deviation	max	min	whole scale	cognitive	affective
whole scale	4.02	.89	4.10	3.04			
cognitive	4.05	.98	4.10	3.04	.82		
affective	4.00	1.06	4.05	3.10	.86	.57	
behavior	3.98	1.08	4.04	3.16	.87	.57	.63

Correlation between the whole scale and each subscale are .82, .86, and .87 demonstrated a strong relationship on the construct of TAUES. All correlations reach significance at $p<.001$, illustrating that each component contributes to the total score. Correlation values among subscales were also excellent, measuring .57 between the cognitive component and affective component, .57 between the cognitive component and behavioral component, and .63 between the affective component and behavioral component. The results of the bivariate Pearson's correlation coefficients are shown in Table 2.

5.4 T-test and analysis of variance

To identify the differences in pre-service teachers' attitude toward using e-resources depending on gender, we performed an independent sample T-test, where gender, enrolled in public schools or private schools, study in technical universities of tertiary universities, major in humanity and social science or natural science, and with disadvantaged status or ordinary status served as the factor, and the total mean score of the TAUES served as the outcome variable. The Levene's test for equality of variance showed that homogeneity of variance was assumed in gender, and not assumed in the other variables, and we check their corresponding t-values, the only gender showed no significant difference($t(283) = -1.65$, $p=.100$), and for the other four factors, there were significant differences between their different levels. For public/ private schools, $t(124.04) = 8.66$ ($p<.001$); for technical/ tertiary universities, $t(258.02) = 11.42$ ($p<.001$); for humanity and social science/ natural science majors, $t(154.72) = -4.45$ ($p<.001$); for disadvantaged/ordinary status, $t(154.72) = 12.91$ ($p<.001$), the results of the independent sample t-test are shown in Table 3.

Table 3: Independent t-test on attitude whole scale

	N	*Mean*	*SD*	*F*(Levene's Test)	*Sig.*	*t*	df	*Sig.* (2-tailed)
male	68	3.86	.11	.83	.362	-1.65	283	.100
female	217	4.07	.06					
public	208	4.28	.76	4.12*	.043			
private	77	3.32	.85			8.66***	124.04	<.001
technical	67	4.69	.38	59.07***	<.001			
Tertiary	218	3.81	.90			11.42***	258.02	<.001
humanity and social science	154	3.81	.90	5.53*	.019			
natural science	131	4.26	.82			-4.45***	281.73	<.001
disadvantaged	21	4.81	.17	28.37***	<.001			
ordinary	264	3.96	.90			12.91***	154.72	<.001

5.5 Multiple linear regression analysis

A multiple linear regression analysis was used to develop a model for predicting pre-service teachers' attitude toward using e-resources from their gender, enrolled in public schools or private schools, study in technical universities of tertiary universities, major in humanity and social science or natural science, and with disadvantaged status or ordinary status. All five predictors were entered into the model, as shown in Table 4.

The resulting model was statistically significant, and the five factors accounted for 37% of the variance of the total score of attitude, $F(5, 279) = 32.80$, $p< .001$. Among these five factors, three predictors had significant positive effects on pre-service teachers' attitude to use e-learning resources. An examination of the standardized beta weights indicates that the greatest contributors to the prediction model were enrolled in public/private schools ($\beta = .39$, $p< .001$), study in technical/tertiary universities ($\beta = .27$, $p< .001$), and major in humanity and social science or natural science ($\beta = .16$, $p< .001$). Besides, there were no multicollinearity problems since the VIFs for the constructs ranged in value from 1.02 to 1.18.

Table 4: Results of the multiple regression analysis predicting total score of attitude to use e-resources

	B	Std. Error	Beta	t	Sig.	VIF
(Constant)	6.13	.43		14.12	.000	
gender	.07	.10	.03	.69	.489	1.02
public	-.79	.10	-.39	-8.03	<.001	1.05
university	-.58	.11	-.27	-5.32	<.001	1.18
department	.29	.09	.16	3.36	.001	1.04
disadvantaged	-.34	.17	-.10	-1.96	.052	1.12

6. Discussion and conclusion

In this paper, we addressed the question of whether pre-service teachers hold the positive attitude of using e-resources, and whether the academic factors and demographic factors could have some effects on the using of e-resources. We tackled these questions by investigating a sample of the pre-service teacher through our survey instrument- The Computer Attitudes Test for Pre-service Teacher, which consisted of cognitive, affective, and behavioral components as the construct. As the results in the above section show, a confirmatory factor analysis supported the three-factor construct according to the collected data of our survey. Base on the result presented in this paper, strong correlations exist among the three components, and cognitive component was higher than the affective component and in turn, higher than the behavioral component. This is consistent with the previous finding and that the attitude of using e-learning resources could be applied into a wide range of subject such as health education (Sung, Hwang and Yen, 2015), energy education (Yang, Chien & Liu 2012), Newtonian physics (Shute, Ventura and Kim, 2013), citizenship education (Lim and Ong, 2012), language teaching (Reinders and Wattana, 2014). Therefore, Teacher Training Programs should be used to broaden teachers' perspective and applications of teaching technology, and consistent with previous research which found that teachers believed they lack appropriate education on how to use educational technologies because of their lack of time, training, and economic support as the key factors. (Demirbilek & Tamer, 2010; Mumtaz, 2000). Our survey also elaborated four factors of academic attributes that have impacted pre-service teachers' attitude to use e-resources. In our multiple regression analysis models, these variables significantly influenced the total score of attitude, and this outcome confirmed existing literature that the academic attributes delivered consistent results (Zhang et al., 2004).

The future study could extend the survey to some environmental factors and users' experiences factors, such as modern tools, media-rich content, and innovative pedagogical approaches. Engaged online communication and meaningful presentations could also motivate pre-service teachers to use web resources, and enabling them to be capable of managing the resources. People often perform better and set higher achievement goals when they made some effort and felt satisfied in the learning process. That means when an appropriate condition is met, a specific type of learning can be best promoted. When someone is in the process of self-discovery, it urges him to anticipate new goals and purposes, and become less fearful of new learning opportunities. So, our further aim is to study the attitude of the pre-service teachers through regular evaluation of their performance, and see how they are accepting feedback and benefiting from the processes.

Although this study was designed with our utmost care, inevitably, there are some limitations. One main limitation of this study was to use convenience sample that may not have a good representation of the target population, and future research should control this variable to overcome this limitation that better represents the target population. Secondly, it was evident that results would be influenced by specific characteristics and culture of the group and might fail to bring generalizations applicable to any other group because culture affects human behavior, future research should be developed within a cross-cultural framework in order to gain a better knowledge of cultural differences. Thirdly, the modes sample size was a potential problem, and a more extensive and representative sample will be needed in our future study. Finally, we admit the subjectivity associated with the analysis concerning the using e-resources, the sensitivity of the results due to this subjectivity should be investigated in future work. Despite the limitations, this study contributes to our understanding of pre-service teachers' attitude and its factors toward e-learning resources and supports the literature that the utilization and development of electronic teaching material are favorable for the instructor and the students.

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Structures for Mapping Learning Content

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Abstract: Our research group is interested in different attempts at systematically mapping learning objects within a subject matter. We believe this will help in designing different curricula targeted for specific groups using specific resources, as well as for designing adaptive learning systems. What constitutes a learning object is left open, but can be of the following types; competencies, skills, knowledge, approaches and more. Of special interest is overviewing the different attempts at visuospatially or structurally arranging learning objects in relation to each other. To achieve this, we have conducted a systematic qualitative literature review. This has involved a highly iterative development of a query for use in various research databases (ProQuest, ERIC, Web of Science and EbscoHost). Here the emphasis has been on not excluding work that uses very different phrases to describe structure and types of learning objects, while attempting to eliminate work that uses these otherwise common phrases without describing a concrete notation for mapping learning objects in relation to each other. The full reading of 50 works allowed us to identify a number of structuring mechanisms: lists, tables and multiple types of directed graphs. Furthermore, the semantics of identified objects and the relations between the objects are considered. Representative examples are used to illustrate these variations and the strengths, weaknesses and trade-offs of these different approaches are reflected on. Of particular interest is a trade-off between structures that are flexible enough to express complex relations between learning objects and structures that are simple enough to provide simple overviews of the subject matter.

Keywords: literature review, learning objectives, competencies mapping, structuring principles

1. Introduction

Massive amounts of learning content is available online in-general and within specific educational platforms like Kahn Academy, Coursera, Udemy and edX. This makes it complex for teachers and learners to navigate and decide on content to teach or learn. A common way of addressing this issue is to impose curriculums that make decisions of learning content for the teacher or student. This approach in principle solves the problem, but compromises teacher or student autonomy (John, 2006). An alternative possibility is to support teachers or students with something comparable to a geographical map of learning content. Geographical maps provide overview which help users make informed decisions on where to go, and it can be hoped that maps of possible learning content could help teachers or students to make informed decisions on what to learn.

Maps intended to serve these purposes have been explored recently by Nøhr et al. (2019) and Allsopp & Misfeldt (forthcomming), but prior to further development of these, it is important to get an overview of previous attempts at mapping learning content. This is partly to avoid reinventing existing mapping notations, and partly to get inspiration and learn from other earlier attempts at mapping learning content. To do this we decided to conduct a literature review to look for papers that either propose, describe or use any technique for mapping learning content. We understand this work to be part of a longer process, but have started with the following tentative question: Which ways are there of visuospatially mapping units of learning content in relation to each other and what kind of affordances do they support?

2. Approach

We chose to conduct a systematic qualitative literature review (Grant & Booth 2009) and recorded all decisions along the way in a log document so as to be able to return later and reconsider them. We started by looking at the web sites on journals with the word “curriculum” in their title (such as “Journal of Curriculum Studies”, “Journal of Curriculum and Teaching” and “The Curriculum Journal”) and in special issues in general education journals that could include papers with a focus on learning content. In these journals, we looked for words that indicated a discussion about mapping learning content. Relevant keyword identified in this way where grouped into three categories: a curriculum category, a structuring category and a context category. We also identified some phrases to exclude.

Using the web interface to the ProQuest online research database, a query was structured around the four categories identified above. Papers were required to contain at least one keyword from each of the first three categories and none from the last. Examining these results, we identified other relevant keywords, but more often recognized how relevant words often consisted of roots with multiple relevant endings. This was expressed in the query using a word root followed by an asterisk. Keywords were also recognised as being too encompassing and removed.

This process went through several iterations, but continued to show papers among the first few results that were clearly not relevant for our topic. We extracted a small group of common general words from the curriculum category that we decided that at least one of which needed to appear in the title of a relevant paper. Furthermore, papers with sufficient focus on our area of interest were required to have at least one keyword from both the curriculum category and the structuring category in its abstract to warrant our attention. Versions of the query and reasons for changing were all logged.

Working within this basic query structure, we eventually arrived at our final query on 9th of Oct 2018. The query is shown in Figure 1. and gave 248 peer reviewed English language papers.

ti(“curricul*” or “Syllab*” or “objectives” or "learning outcomes”) AND ab(“curricul* making” or “curricul* development” or “curricul* framework” or “curricul* design” or “curricul* content” or “curricul* structur*” or “Syllab*” or “objectives” or "learning outcomes") AND ab(“mereolog*” or “fragment*” or "composition* structur*" or “cartog*” or “aggregat*” or “graph” or “topolog*” or “topograph*” or “mesh” or “arrange*” or “layout*” or “configurat*” or “holon” or “part*whole” or “sum of parts” or "relation* structur*" or "relation* of content*" or "content relation*") AND (“school*” or “educati*” or “universit*” or “college*” or "training*") NOT ("social network*" or "policy network*" or "concept map*")

Figure 1: The final ProQuest query string

We wanted to ensure that we did not get a skew set of papers due to relying on a single database and decided to repeat the query across a number of other databases. The final ProQuest query was modified to the query syntaxes of three other research databases which were considered relevant for education (ERIC, Web of Science and EbscoHost). The combined result sets from the four queries amounted to 629 papers and were compared to eliminate duplicates (258) giving us a total of 371 unique papers.

We read the titles and abstracts of the remaining papers and assigned them to one of three categories: clearly about, possibly about and not about mapping learning content. The last group contained 313 papers that could not be interpreted to relate to our purpose and were excluded to leave 58 papers. When attempting to download copies of all the screened papers, 6 could not be found. 2 were ignored because only their abstracts were in English. The remaining 50 papers were read in full.

Our approach to data treatment was inspired by grounded theory - we simultaneously tried to identify the important relevant themes while capturing how the individual papers addressed these themes. This was done in a codification scheme where we listed the papers as rows in a matrix and then repeatedly revisited the columns of the matrix to show themes that could be used to relate and compare the papers. This required us to many times return to previously read papers to consider them in relation to newly identified themes. The way that individual papers addressed the themes were captured in the cells.

No themes were identified that non-trivially spanned all of the papers, but two themes emerged as useful in understanding existing ways of mapping learning content. These themes are:

- Structure: concrete proposed, described or used visual structures showing how individual leaning objects are connected to each other.
- Semantics: concrete proposed, described or used semantics for how to interpret the shown connections and the types of leaning objects involved.

Examining the papers with these two themes in mind allowed us to identify 26 papers where it was clear how these themes were addressed. Underway, individual papers become representative of individual structuring approaches and this allowed us to group together different approaches to mapping.

3. Structures

By prioritizing the two themes of concrete structures and concrete semantics in our analysis, 24 of the 50 papers that had matched our final query string and initial reading of title and abstract no longer seemed relevant and where not used in our analysis. This was considered appropriate because on closer reading, failing to include these themes coincided with a failure to say anything sufficiently concrete about notations for mapping learning objects. Instead, these papers addressed ideas that were more interesting for the process or purpose of creating curriculums than maps of learning content. Several of these ideas relate to the desire to move from more traditional subject matter content to content that serves specific purposes as discussed in our introduction. One of these papers (Dahlgren 2000) provides another, similarly meta discussion about what level of granularity learning objects should be expressed at in a curriculum to allow teacher or students to formulate their own fine-grained goals within a curriculum.

The remaining 26 papers that did address our two themes helped us to identify a number of types of structures that are used to relate learning objects. These structures will be discussed in turn.

3.1 Lists

The papers often used lists to structure learning units. These lists are used to say what learning units are or should be included in some context. Lists can be *unordered* where although the items are presented in the order, this order is not important, or they can be *ordered* where the order is considered important. Unordered lists are often presented with bullet points and ordered list are often presented with numbers. One paper (Sitlington & Coetzer 2015) provides an example of an ordered list used to show experts ranking of knowledge, skills and attitudes relevant for strategic human resource management.

Beyond ranking, lists do not show how different elements relate directly to each other beyond that they are relevant to or relatively more or less relevant to a given context. This interrelation of elements only happens in lists when we consider lists of lists (or indented lists) which is addressed latter as *trees*.

3.2 Tables

The papers also often used tables to structure learning units. Typically in this context, tables consists of a number of rows and two or more columns. In the two column situation, one column may consist of a list of categories and the second column shows for each row a number of learning units that belong to this category. In the multiple column situation, one column again consist of a list of categories, but also one row consists of a list of categories. Then individual learning units are distributed in cells that represent the intersection of the one category with the other. One paper (Ullmann, 1982) provides an example of the latter use of tables when it describes the objectives of a second language curriculum as each belonging to one of the categories/rows: language syllabus, communicative activity syllabus, culture syllabus and general language education syllabus and one of the categories/columns: proficiency, knowledge, affect and transfer as columns.

We saw many alternative ways of imposing a grid over units, and while this is fine for developing alternative high-level understandings about learning units, the structure seems too limited to be considered a map on par with a geographical map. While these grids can divide units into cells, they do not say anything more about how units in the same cell relate to each other - there are only two levels or layers to this organization: headers and cells. Furthermore, there seems no reason to assume that the most important distinctions can be captured in terms of units belonging to the intersection of only two categories (or three if we imagine 3D tables).

Many papers used some type of graph to structure learning units. All of these graphs use nodes to represent learning units and arcs to represent relations between learning units. Using West (2001) we were able to distinguish between three types of graphs in the papers, which are called trees, directed acyclic graphs (DAG) and directed graphs (DG). These types are exemplified in Figure 2, and we will describe how each of them are used in the papers.

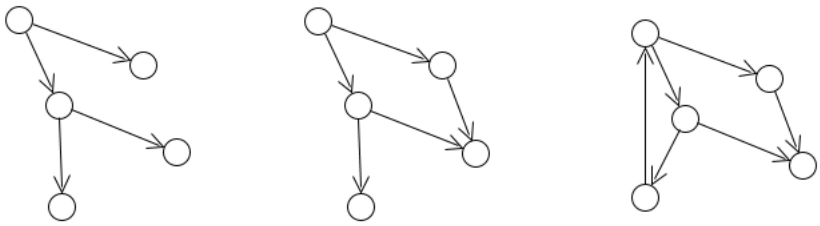

Figure 2: Examples of three different types of graphs; a tree, a DAG and a DG

3.3 Trees

Most of the papers that use graphs to structure learning units specifically use trees. Trees, like their biological namesake, have branches that divide, and sub-divide indefinitely. The nodes are the points where they divide, and one can talk about how nodes relate to each other in the tree with terms like parent, grandparent, sister and child. A defining aspect of tree structures is that they have only one edge pointing to any one node. At least since Aristotle, trees have been used to divide and conquer complex information.

Komenda et al. (2015) describes a typical way of organizing learning units using a tree structure. MeSH (Medical Subject Headings) is a standardized catalogue of medical subjects divided and sub divided up many times in a tree. The relation between parent and child is in this case (and in many other papers using the tree structure) that of the parent including the child. One can read any node-edge-node sequence as saying that the subject represented by the first node includes the subject represented by the second node.

One feature of organising learning units in trees is that each learning unit can have any number of child learning units. This allows them to show lists of lists. Another feature of trees is that these lists can be nested in each other any number of times. At the same time there is a clear sense of *layers* of nodes corresponding to how many generations they are from the root node. These features make it easy to navigate and overview huge amounts of information organised in trees. The most obvious challenge with trees is that it is easy to imagine situations where one would want to consider a learning unit as the child of multiple other learning units. For example, the MeSH system does recognise that multiple parent subject headers can include the same child subject, but because this cannot be shown in a tree, the MeSH tree needs to repeat the same child subject headers as separate nodes for each parent subject header.

3.4 Directed acyclic graphs

Some of the papers that use graphs to structure learning units specifically use directed acyclic graphs (DAGs). DAGs resemble trees in that they have edges pointing from parent nodes to children nodes, but a critical difference is that a node can also have multiple parents. With the semantics described above one can structurally show that multiple learning units can include the same sub unit. The word “acyclic” in the name directed acyclic graph means that despite their greater freedom in where arcs point, DAGs do not allow cycles in the form of descendants of a node being that node’s ancestor.

Chrysostomou (2004) describes a way of organizing learning units in a DAG structure. The paper describes the relations of learning units in the form of units of content, processes and products in planning of interdisciplinary curriculums. Here it is important that multiple units can contain the same sub units. Interestingly the described DAG is one with a limited number of edges pointing from nodes and a limited number of layers.

It is clear that DAGs are freer than trees in that nodes can point to another node that already have a node pointing to it. This allows more relations to be captured and therefore makes DAGs freer than trees. However, there seems to be some consequences to this. Although it is possible to arrange nodes in layers, this can be an arbitrary choice when two or more paths lead to the root. Laying out a DAG also often requires arcs to cross, and arbitrary decisions about placing a given node closer to its one parent than another. On top of this, the restriction on cycles means that some imagined relations between units cannot be captured in the structure.

3.5 Directed graphs (DG)

Several papers that use graphs to structure learning units specifically use DGs. DGs allows any arc that a DAG would allow but differ from DAGs by allowing cycles where arcs can point from a node to an ancestor of that node.

Martínez-Zarzuelo, Roanes-Lozano & Fernández-Díaz (2016) describes a way of organizing learning units in a DG structure. The article describes how mathematical skills like addition, subtraction, multiplication and division are related in a DG structure where the edges point from supposedly easier-to-learn skills to harder-to-learn skills. What makes the structure clearly a DG is the showing of an immediate cycle of subtraction pointing to multiplication while multiplication points to subtraction. It is understood that both of these directions are worth showing.

Clearly DGs are more flexible then DAGs. There can be many reasons that one wants to allow cycles. Perhaps one want to capture disagreement or different dependencies that are relevant in different contexts. However, allowing any node to point to any other node seems to come at a price. It makes it unclear how to layout DGs in a way where they have an orientation with a clear top and bottom. It also makes it unclear if we will be able to identify layers in the same way as it is possible for trees and DAGs.

4. Discussion

Visuospatial structures is one way to make it easier for teachers to make and students to overview and understand curricula. There are, however, issues about structures used for relating learning objects that seem important even while one remains agnostic about the specific semantics of the learning objects and their relations. It is clear that graphs are more flexible structures for relating learning objects than lists and tables. Lists and tables can be seen as isomorphic with particularly restrictive forms of graphs. For example, an unordered list can be thought of as a shallow tree of only two layers where a single root node representing the list points directly to a number of nodes that each correspond to one item in the list.

It is also clear that the different types of graphs as they were presented in the previous section show a progression as more and more flexible structures for relating learning objects. Specifically DAGs are more flexible than trees because they allow multiple nodes to point to the same node, and DGs are more flexible than DAGs because they allow cycles.

4.1 Lower flexibility is restrictive

It is obvious that low structural flexibility means that there are connections between learning objects that cannot be shown. This is ok if one believes that what we want to represent does not need these connections. Crudely put, simple structures are ok if reality is simple. If, for example, one believes that any specific medical subject only meaningfully belongs to at most one parent subject, then a tree structure is sufficient.

However, simple structures are not satisfactory if what one finds important to represent cannot be shown in these structures. If, for example, one thinks it is important to structurally show that the study of say psoriasis is relevant for, and should be include in both the study of skin diseases and the study of immunology, then using a tree structure to map this is not satisfactory. The approach of duplicating nodes for the same medical subject heading, as described above for MeSH, does not seem map-like. Specifically Allsopp (2013) claims that a common property of the representations that we call maps is that they are *unitokenal*, which means that for each represented meaning there is only one token, mark, or instance of a symbol representing it.

Alternatively, one may choose to refrain from duplicating nodes and simply make more or less arbitrary choices about which arcs to not include. This however also seems unsatisfactory. We imagine that in most situations, making these sorts of arbitrary decisions will detract from a sense of the map representing the system one wants to represent. In the example of psoriasis above, one would have to pretend that it either belonged to *only* skin diseases *or* immunology. Furthermore, it seems possible that early arbitrary choices between which arcs to include will tend to create path dependencies where those earlier choices influence attention towards only identifying learning content and relations that confirm or justify those earlier choices. Other learning content and relations will need to be ignored. We imagine that using too simple structures will develop a form of conservatism in the face of new ideas about learning content. This could build up tensions in our understanding of the learning content as one struggles to reconcile what one can represent with what one actually believes. In summary, the desire to create maps of learning objectives that are believable seems to depend on using structures that are sufficiently flexible.

4.2 Higher flexibility is overwhelming

Unfortunately, structures with higher flexibility also seem to come at a price. More restrictive, or less flexible, structures like lists, tables and trees are all very common in our daily work. Smaller lists, tables and trees (in the form of indented lists bullet lists) are regular inline parts of normal text documents. Tables are also seen in our spreadsheets and trees in the folder views of our operating systems, website navigation and in mind maps. It seems that in general, knowledge workers are very comfortable working with these structures.

DAGs and DGs are different. That DAGs allow multiple parent nodes to point to the same child node often requires arbitrary layout choices about which parent to place a child nearest to. More importantly, arcs often need to cross each other which is generally considered to undermine readability or overview (Di Battista, 1999). Even relatively small DAGs like those presented in (Allsopp 2017) seem to require more concentration then when navigating trees of a similar size. However, the restriction on cycles means that DAGs can still always be laid out in layers and therefor allows DAGs to be presented with an overall direction making them somewhat readable even if they are not as readable as a tree.

The restriction on cycles does not apply to DGs and this makes them even harder to read or overview. Here one has even more arbitrary layout choices to make and typically many more arcs need to cross each other. Nodes sometimes pointing to nodes that are also their ancestors makes it impossible to meaningfully impose layers on the graph. The permission of cycles makes it impossible to layout in a way were all arcs point in roughly the same directions. This adds to the difficulty of overviewing large numbers of learning objects arranged in this structure.

It is also worth noting that the size of the graphs described in the papers varied considerably with the type of graph structure involved. Trees, like for example the MeSH structure, could contain thousands of nodes, while the examples of using DAGs always involved less than 100 nodes. The DAGs seem to have been used more for a high level overviewing of the learning content of a topic than for exhaustively providing details. DGs in the papers always involved fewer than 10 nodes, and were used much more to illustrate more abstract discussion about learning content then actually mapping it. An example of DGs used in this way is the discussion described earlier about whether subtraction should precede multiplication or vice versa. The way different types of graph structures are used in the papers seems to confirm the suggestion that more flexible structures are less well suited for overviewing large numbers of learning objects.

The above considerations point to there being a trade-off between flexibility and readability when choosing a structure for mapping learning content. When specific semantics are added to the graphs, this can be expected to translate into a trade-off between expressiveness and understandability of the maps produced. The more flexible the structures the more relations that can be captured and the less support in overviewing it. This trade-off is illustrated in Figure 3.

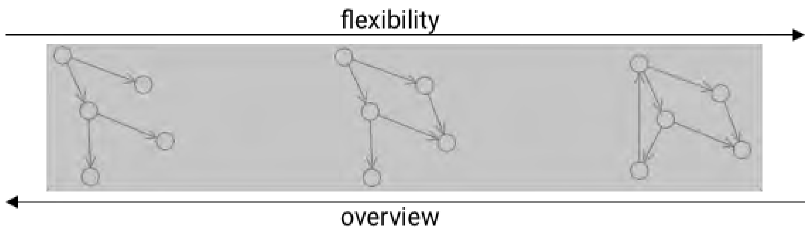

Figure 3: The trade-off between flexibility of graph structures and the overview they provide

Although this trade-off seems pervasive, it does not necessarily mean that we are forced to sacrifice expressiveness of the underling representation to achieve overview and easy navigation of the learning content. It may be possible to use a flexible structure to capture expressive relations between learning objects in a database, and then dynamically draw visualisations of parts of the graph using simpler structures when it comes to viewing this content. This sort of dynamic reduction of complexity may be an important part of the overall goal of creating maps of learning content.

5. Conclusion

This paper describes a literature review of papers for the purpose of identifying concrete attempts at visuospatially mapping learning content. It is based on multiple iterations of a query string that was then used on multiple research databases. The identified papers were evaluated for relevance based on their title, abstract content, accessibility and language, before a full reading of those considered to pertain to the mapping of learning content. Using an approach inspired by grounded theory, we identified and tried to use different themes in a codification scheme. Two themes that seemed most relevant for categorizing attempts at mapping learning content were concrete structure and concrete semantics. The concrete structures theme was used to identify a small number of structures used to relate learning objects. These consisted of lists, tables, trees, DAGs and DGs. Each of these were explored with examples from the literature. Based on this exploration, we were able to identify an apparent trade-off between structural flexibility and overview in the mapping of learning content.

6. Future work

While the current literature review has been adequate for identifying common patterns in the types of structures used to map learning content, we have not done any quantitative analysis of the occurrence frequency of different types of structures. This has seemed less relevant for the purpose of identifying types of maps useful for overviewing learning content. However, there are other omissions in this paper that seem more unfortunate for this goal.

We have given examples of how semantics have been applied to each of the identified structures. However, we understand there to be a great many different ways to use the identified structures to relate learning content. We have not in this review discussed the range of semantics used to map learning content. More specifically, we have not asked; what is the full range of different meaningful relation types or learning objects that we need to consider? These issue of semantics seem as important as identifying the structures and we consider them an obvious next step in this process of learning from existing attempts at mapping learning content.

Unfortunately, we are not convinced that the papers identified in our current literature search are a sufficiently complete set for us to be able to speak confidently about the range of semantics involved in mapping learning content. While the papers seem sufficient for identifying patterns in the structures that allow us to create maps of learning content, there are many more ways to add semantics to these structures then there are structures. Can we expect to find all the attempts at this with our current query string? We began to think of the literature review described in this paper as a first iteration when it became apparent how difficult it was to design a query that exclusively identified concrete attempts at mapping leaning content.

A revised attempt at identifying relevant literature could start with a more inclusive query string and then use additional techniques for identifying relevant papers before reading them. One idea for this is to use a tool like CorTexT (www.cortext.net) to create cluster maps of the identified papers based on the co-occurrence of terms. These maps may reveal clusters around papers that we already know to propose, describe or use concrete attempts at mapping learning content. Another idea for identifying relevant papers before reading them is to scan the identified papers for figures that can be interpreted as attempts at mapping learning content. The assumption here is that papers addressing issues of mapping learning content will have a high likelihood of containing figures that illustrate these structures.

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Effects of Personalized Learning With Preferred Digital Media Types on Learning Motivation

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Abstract: In recent years, the developments on online learning have grown in leaps and bounds. In addition, the growth has expanded in various aspects including learning materials which are essential as they affect students' learning. With the advancement of learning materials, corresponding students prefer online learning support systems which also have been rapidly developed. Many developing learning systems have been improved based on single digital media types such as a game, web-based, or Computer-Aided Instruction (CAI) of personalized learning, while the preferred digital media types are usually disregarded. Hence, this developed system is created and designed for individual digital media types which students prefer to learn. This paper proposes to develop such personalized learning with three digital learning materials to individual students on preferred technology types in SQL topic. This study recruited forty-one university students to participate in digital learning materials which they prefer to learn. The materials empirically evaluated the effectiveness of personalized learning in each preferred digital media types, and the experiment was based on a pre-test and post-test design. The results of the experiments show that the assistance of the preferred learning material, and personalized learning materials demonstrated good performance learning achievement. Moreover, there are differences between the correlation of learning motivations and personalize learning in digital media types.

Keywords: personalized learning, digital media types, learning materials, computer science education, higher education, preferred digital media

1. Introduction

Due to the progress of wireless technology together with devices with a variety of uses, online instructions have become more popular. With distinguish properties, E-learning in the formats of CAI (Computer-Aided Instruction), WEB, and GAME require different development. However, in each topic, only one format of the teaching material is used without the concerning for the needs or the interests of each student. For example, game-based learning is used with every student in a classroom. Even though some students may not like such method, they still have to learn this way as it is applied to everybody. Therefore, using only one type of teaching material might not suit every student.

There have been a lot of learning materials developed in the academic world for helping students' learnings and achieving utmost performance. These different learning materials are catered to students' individual needs and learning styles such as learning experience, and learning achievement. Such materials are beneficial to the online learning environment as personalized learning can promote learning efficiency and motivation. However, as the recent new innovations on online learning materials have not been used widely by instructors in a tertiary level, many studies have not focused on their importance on students' learning styles.

Many universities have faced the difficulties to use online learning method in terms of learning achievement, content recognition, the effectiveness and the motivation to use the technology as well as the problems in the motivation of the technology users affecting the active learning leading to the new development. Therefore, this study has developed the online learning system to serve the needs of individual students to use digital materials. In the course of the database management system, many online learning systems have been implemented in order to serve the learning topic of SQL in higher education levels. However, the motivation of the students between the types of digital materials has never been studied. Therefore, this system was developed to apply in the classroom in order to examine the learning achievement results and the motivation of the students at the university level. The results of this study can primarily answer whether the students have high learning achievement while it does not state whether the motivation to use different materials is different.

2. Related work

2.1 SQL and digital learning materials learning

Structured Query Language (SQL) is a descriptive language with simple grammar used to find the results from the database. Nevertheless, SQL is difficult and complex to learn (Boada et al, 2004). According to the standard of ISO, SQL is divided into two types based on the function of its operation. The first type is Data Data Definition Language (DDL), which refers to the function of managing structure and index. The Functions, CREATE, ALTER, RENAME, and DROP Table, are used relatively often in DDL. The Function, CRATE, is used to create a new table while the function, DROP, is used to delete the table. The second type is Data Manipulation Language (DML) related to the operation of data; for instance, browsing the data, adding the data, editing the data, or deleting the data. For example, the function, SELECT, is used to select the data from the table and the function, INSERT, is used to add the data (Connolly and Begg, 2014). SQL is an important skill which is essential to apply to the computer, and it also links to a database for computing science students (Kearns et al, 1997). Typically, SQL is included in the curriculum of Bachelor's Degree or higher degrees related to computer and IT (Soflano et al, 2015). General problems found when learning about SQL are the problems in using the grammars such as insert, update, distinct, ordering, grouping, having, and join statement (Kearns et al, 1997; Renaud and Van, 2004).

According to previous research, many researchers have studied digital learning materials to support the learning of SQL. The digital learning materials are divided into CAI, WEB ,and GAME (Thanyaphongphat and Panjaburee, 2019). For example, computer-assisted instruction (CAI) was developed by using a cycle model for university students to identify grammatical errors. The study discovered that the learning achievement of the students using this method was higher than those learning from lecture base method (Piyayodilokchai et al , 2013). Furthermore, the study on the web-based development to teach the grammar in SQL showed similar results (Latham et al, 2012). Also, some researchers presented the game with the integration of learning style. The results showed that the game helped students learn the functions faster, compared with the conventional method. Although game motivated students to learn SQL, students' motivations about a digital game with preferred digital media types have not been investigated yet. (Soflano et al, 2015)

Digital learning material refers to the characteristics of the learning platform to help students learn about digital contents. The characteristic of the computer lesson is to use with drill down contents with exercises so that the students will have many chances to practice. There are evaluations and suggestions during the learning process; there are also situations for the students to solve unexpected problems. This promotes the skills to solve problems. With these properties of CAI, it leads to more effective and better learning achievement and the positive attitude of the students (Yusuf et al, 2012). For the properties of WBL, it can be used with dynamic contents so the students can skip to the contents in which they are interested. The learning system allows integrating work or responding during the learning session if it is connected to the internet. This also includes online learning materials, online evaluation, and online suggestion. With these properties, students can show their recognition to WBL. They tended to have a positive attitude and confidence to learn (Cheng and Tsai, 2011). Besides, DGBL is also vital to integrate the process in the game and present it excitingly with criteria, goals, challenges, consistency, stimulators, and imagination; stimulated situations are created to solve the problems. It also affects motivation (Bourgonjon et al., 2010).

2.2 Students' motivation about technology

The thought on how people learned stemmed from Maslow's hierarchy of needs and then moved to Herzbergs' Motivators and Hygiene Factors and ended up with Vroom's hope theory at the end of the 50s or early 60s. These gave rise to a more explicit classification of intrinsic and extrinsic motivating factors. Eventually, later at the end of the 20th century and the early of the 21st century, self-determination was added.

Many factors can motivate students to use technology when they are in the classroom. Liu (2016) studied the classrooms in a primary school. Thirty-one teachers were followed for eight weeks. They were asked questions related to the use of technology in their class. The results were different. 14.8% of the teachers stated that the technology could serve the individual needs of the students. 17% stated that it could help manage behaviors and routine. The majority of the participants (31.1%) stated that it promoted students' participation, motivated the students, and helped the teachers connect with related literature. It was more fun and more interesting for the students. Another piece of research studied whether mobile phones could increase the learning achievement of the students. More than half of the participants (59%) stated that mobile phones increased more engagement and motivation of the students. Previously, mobile phones were considered as an obstacle for the students, and it destroyed the learning environment of the students (Thomas et al, 2013).

A lot of research is related to the property of the technology as a motivator. However, there are some pieces of research related to the strict use of technology in an academic program. As previously mentioned, teachers and students have to understand the needs to use technology in the classroom. Nonetheless, very little technology is used (Gray et al, 2010).

3. Online development of digital learning material preference

This study shall summarize how the personalized learning system was implemented on SQL topic of database management course. The focused learning activities of SQL cover Data Definition Language (DDL and Data Manipulation Language (DML). With the installed wireless communication network, individual students were able to interact with a computer access digital learning material preference, such as CAI, WEB, or GAME for the SQL learning.

The CAI learning activity has been designed and allows students to follow the sequence of SQL content, and practice and repeat exercises as shown in Figure 1. In figure 2, the features of WEB learning activity have allowed students to jump into the preferred contents and search for more information and provided online exercises, and instant feedback to students. Moreover, the SQL content and exercises have been embedded in the GAME. The GAME learning activity has been developed basing on the storyline, which a Thai boy needs to safeguard his sister from a criminal to return home. As for figure3, it represents mission as a problem solving to help gain content knowledge for achieving the game goals. Students need to recognize the structure SQL knowledge and apply what they learn to pass each level.

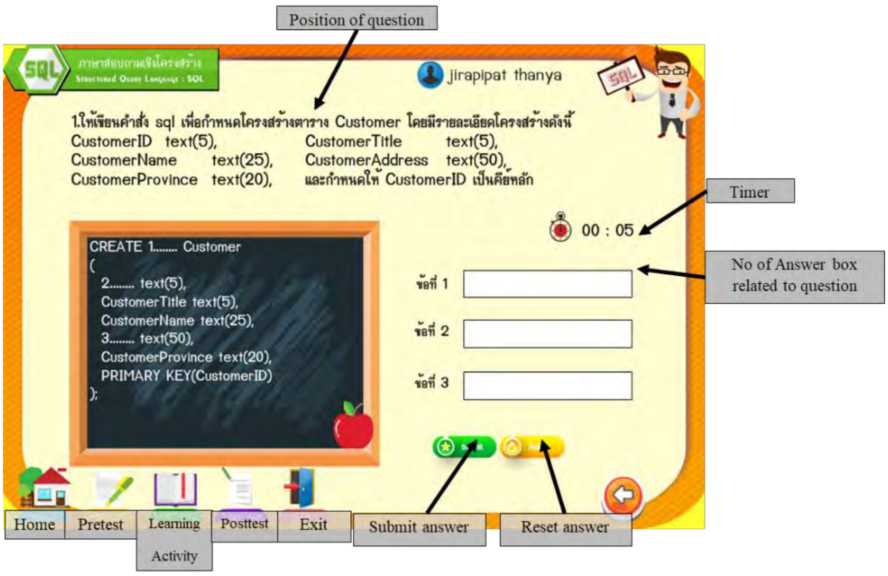

Figure 1: Digital learning materials of computer-assisted instruction (CAI)

4. Research methodology

4.1 Participants

In this study, the participants were second-year undergraduate students majoring in Business Computer from a university in Bangkok, Thailand. A total of forty-one students, who registered in the database management course including SQL topic, were invited to participate. The groups of students divided the following digital materials that they preferred to learn in this class. There were 7 students (17%) in CAI class; 17 students (41.5%) in WEB-preferred class, and also 17 students (41.5%) in GAME-preferred class.

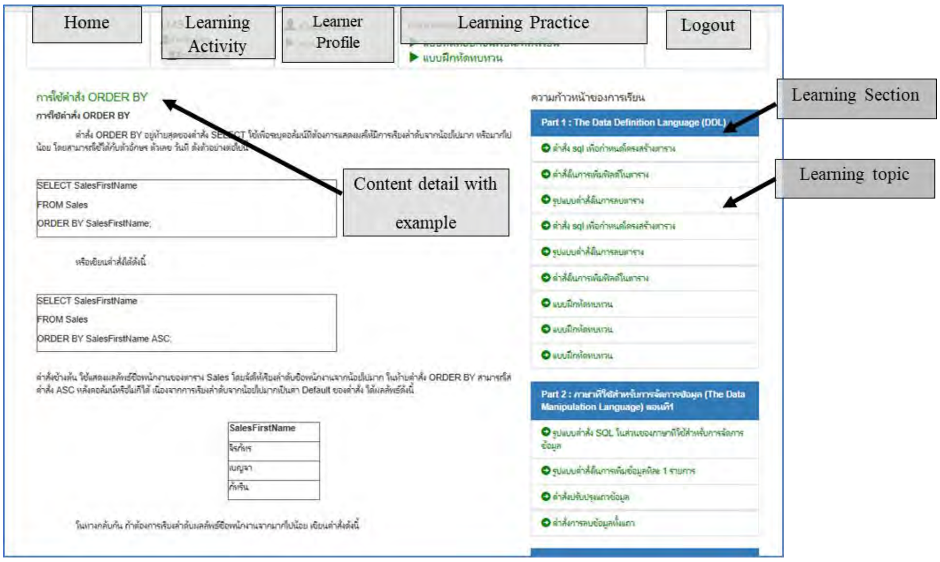

Figure 2: Digital learning materials of Web

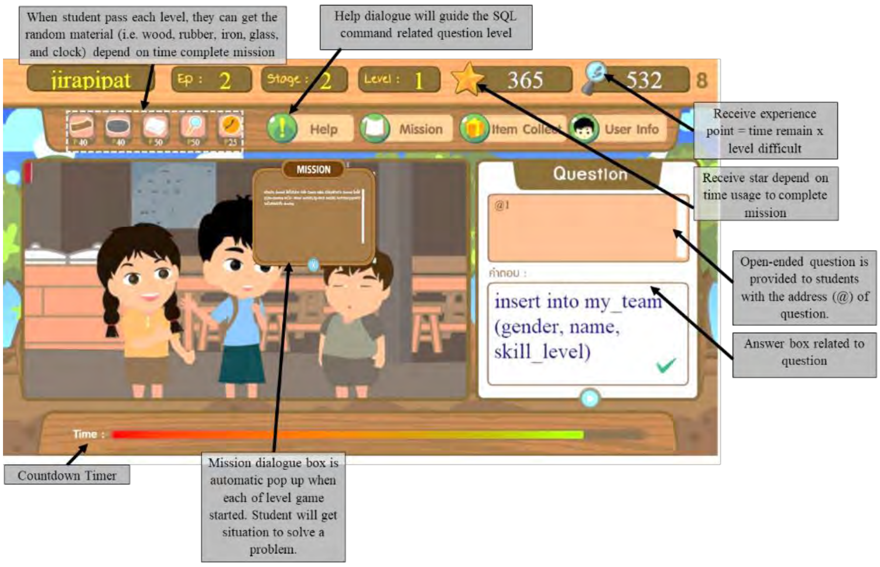

Figure 3: Digital learning materials of Game

4.2 Research tools

The conceptual pre-test and post-test aimed to measure the knowledge of the students in data definition language and data manipulation language of SQL content. Each consisted of 15 multiple-choice items and 5 open-ended writing SQL code items, each of which was scored fifteen points for the multiple-choice question and five points for the open-ended question, intending to test the students' knowledge related to the content of data definition language and data manipulation language in SQL. The items of pre-test and post-test are the same content of data definition language and data manipulation language of SQL, but there are different question items. All students had never done these tests before participating in the experiment. The Cronbach's alpha value confirms that the reliabilities of these tests were 0.814 and 0.826 for pre-test and post-test, respectively, indicating that the tests are reliable.

After learning activities were completed, the students took the 5-point Likert-type scale questionnaire. The questionnaire is ranged from 1 'strongly disagree' to 5 'strongly agree'. The motivation evaluated for learning questionnaire was adopted from Glynn and Koballa (2006) and was translated into Thai language. It consists of 30 items divided into six dimensions, including intrinsic (INM), extrinsic (EXM), relevance of learning SQL to personal goals (REM), self-determination (SDM), self-efficacy (SEM), and anxiety about assessment (ACM). Thai version was used and obtained Cronbach's alpha of 0.94, showing acceptable reliability in the internal consistency. Moreover, the composite reliability values for the INM, EXM, REM, SDM, SEM, and ACM were 0.76, 0.76, 0.78, 0.73, 0.91 and 0.80, respectively, showing good internal consistency of each dimension.

4.3 Research design

Before the experiment, the students took a pre-test for evaluating their prior-knowledge in SQL (20 mins). They participated in learning activities where they chose a preferred digital learning material type (i.e., CAI, WEB, GAME) (180 mins). After completing the learning activities, a post-test was conducted (20 mins); moreover, the students were asked to complete the questionnaire to elicit their motivations to learn SQL through the developed system (10 mins).

5. Results

In order to establish, explore the effect of the personalized learning with preferred digital learning material of SQL of students with different achieving-levels, an analysis was performed to compare the learning improvement of the students in the three groups (i.e., CAI-, WEB- and GAME-preferred group). Before conducting the inferential statistic test, in a CAI-preferred group, the normality of pre-test and post-test scores was tested. It was found that both pre-test ($p = 0.064$) and post-test ($p = 0.614$) scores were normally distributed as indicated by Shapiro-Wilk test ($p < 0.05$). Similarly, in WEB-preferred group both tests, pre-test ($p = 0.178$) and post-test ($p = 0.343$) scores showed a normal distribution as indicated by Shapiro-Wilk test ($p < 0.05$). For the Final group, Game-preferred group was normally distributed by Shapiro-Wilk test ($p < 0.05$) with both pre-test ($p = 0.\ 304$) and post-test ($p = 0.998$) scores. However, an outlier is a rare value that appears on the pre-test. Consequently, Wilcoxon signed rank test, which is a non-parametric test, and decided to analyse the pre-test and post-test scores as shown in Table 1. The results of the learning improvement were significant in all groups. Obviously, the students in the WEB-preferred group and GAME-preferred group improved significantly on their learning achievement after participating in the preferred learning material on the SQL topic. Moreover, the GAME-preferred group got higher average post-test scores than the other group.

Table 1 Wilcoxon signed rank test results of pre-test vs post-test

Learning Material	N	Pre-test (M±SD)	Post-test (M±SD)	Z	p-value
CAI	7	4.43±1.397	12.57±3.047	2.375	0.018
WEB	17	5.29±2.144	13.82±2.899	3.630	0.000*
GAME	17	4.88±1.691	13.88±2.870	3.627	0.000*
Overall	41	4.98±1.837	13.63±2.879	5.587	0.000*

Note: $p < 0.001$

In order to explore the effect of the preferred digital learning material provided by the developed system on students, Kruskal-Wallis H test was conducted to compare the learning motivations of the students in the three groups. The students' motivation for the developed system was investigated after completing SQL learning activities. As shown in Table 2, it shows that overall students' learning motivations after learning with the preferred digital learning material were good. Furthermore, the anxiety about assessment dimension had a moderate level in WEB-preferred group and GAME-preferred group. It implies that the students were not worried about the post-test. The results also reflected that the students among groups showed no significant difference in learning motivations. These results confirm that the preferred digital learning material can be motivated by learning to all students.

Table 2 Comparison of students between groups on learning motivation (Kruskal-Wallis H test)

Motivation Dimension	Groups	N	Mean	SD	H-Value	P-Value
INM (Intrinsic)	CAI	7	3.74	0.550	0.405	0.817
	WEB	17	3.62	0.670		
	GAME	17	3.71	0.510		
EXM (Extrinsic)	CAI	7	3.63	0.335	0.978	0.613
	WEB	17	3.58	0.556		
	GAME	17	3.78	0.509		

Motivation Dimension	Groups	N	Mean	SD	H-Value	P-Value
REM (Relevance of Learning Science to Personal Goals)	CAI	7	3.63	0.315	0.545	0.762
	WEB	17	3.59	0.687		
	GAME	17	3.72	0.505		
SDM (Self-Determination)	CAI	7	3.57	0.407	4.729	0.094
	WEB	17	3.62	0.440		
	GAME	17	3.91	0.490		
SEM (Self-Efficacy)	CAI	7	3.51	0.575	0.108	0.947
	WEB	17	3.31	0.965		
	GAME	17	3.47	0.751		
ACM (Anxiety about Assessment)	CAI	7	3.00	1.089	1.164	0.559
	WEB	17	2.49	0.506		
	GAME	17	2.44	0.617		
Note: *p < 0.05						

6. Discussion and conclusion

This paper evaluated the performance of personalized learning systems based on student' preferred in digital media. To answer the main objective is to explore students' achievement, learning motivation regarding the personalized learning systems. As a result of learning motivation, it may affect students 'learning efficiency because positive motivation affects students' learning ability (Dorji et al, 2014). Thus, the students can improve their learning achievement of SQL knowledge when learning with the personalized learning system. In this study, the results also indicate that students in CAI-, WEB- , and GAME-preferred group show no significant differences from the motivation to participate in the system. It implies that the personalized learning systems in this study could close the learning performance gap and promote positive learning motivation in this system. In addition, the GAME-preferred group showed higher learning gains than others; thus, the motivation of game may affect the learning of SQL.

The success of this study suggests that the developed system would be used to motivate the student to learn in the classroom. However, this study represents the positive results. There are some limitations for discussion. In this study, there are no participants in the conventional-tools preferred group or non-preferred tools group. For this research, it was hard to balance size among three groups, because students were allowed to choose preferred media types after participating in the online system.

For the further study, it may include the traditional group of students who receive learning activities in SQL tools to compare and confirm the effectiveness of the developed system in terms of learning performance, and learning motivation. Secondly, the next study may increase participants of CAI-preferred group for empirical evidence by using the statistical tests. Thirdly, the further study may include the preferred e-learning tool of students who receive learning activities in learning the online system with preferred digital media compared to students group who receive learning in a non-preferred tool for evaluating the effectiveness of the developed system in term of learning performance and motivation.

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Effects of Digital Learning on Students' Learning Achievement in Learning Computer Programming

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Abstract: Computer programming is one of the major courses that students in the department of Modern Management and Information Technology learn. Learning to program in any language such as PHP is not an easy task, and programming lecturers are aware of the numerous problems that arise during a class. Therefore, in this study, digital learning is proposed for helping students to reduce their anxiety and improve their learning achievements in learning programming. To evaluate the learning achievement of the proposed approach, an experiment was conducted on a second-year undergraduate student in a web programming course. The students were divided into an experimental group (n=27) and control group (n=27). The students in both groups started by taking a pre-test to measure their prior knowledge of PHP programming, followed by a questionnaire about their computer profile. The students in the control group participated in a conventional learning support system, whereas those in the experimental group learned with the newly suggested system. After finishing the learning activities, the students were evaluated in their learning achievement and then participated in a questionnaire. The results of the experiment showed that the proposed digital learning effectively increased the students' learning achievement and promoted positive perception towards the system.

Keywords: digital learning, learning achievement, computer programming, PHP, computer education

1. Introduction

Digital tools have become popular in the instructions of every level at university. For example, in university, a digital tool is used with final year undergraduate hospitality students (Ali, Murphy & Nadkarni 2014); in secondary school, the digital learning tool is used to evaluate CPR knowledge, retention and motivation in secondary schools (Bellekens 2017); in primary school, a digital tool is used through design-based learning for teaching children in schools (Bekker et al 2015). The digital tools are also used in a variety of fields such as the scientific research (Christ and Thews 2016), medical research (Zehry, Halder and Theodosiou 2011; Tabakov 2016; Back et al 2019) and linguistic research (Bradac and Walek 2017; Troussas, Chrysafiadi and Virvou 2019). This is because the tools allow learners to practice everywhere, at any time. Learners are required to practice regularly in order to understand the structures of programming languages and how they work. The curriculum requires learners to complete the obligate courses related to programming languages. It was found that many students lack the basics to analyse (Tan, Ting, and Ling 2009; Milne and Rowe 2002; Robins, Rountree and Rountree 2003). This includes regular practices of programming. Programming is difficult for learners to understand and challenging for the teachers to teach especially in the program lessons. For example, to teach about Array or Loops and other functions to solve specific problems are relatively complex. Even though many studies have attempted to develop a system to support programming learning process, it is still a huge challenge for teachers to teach the study and to reduce the gap between teachers and students. Many teachers have tried to use electronic learning materials to support teaching programming, for example, the u-learning system is used to promote students' learning achievement in web-programming course (Thongkoo, Panjaburee, and Daungcharone 2019). The results demonstrated that it can better the learning performance of the students. They understand the lesson more efficiently. Therefore, the researcher would like to use learning digital tool to promote the learning performance in programming of bachelor's degree students.

2. Theoretical framework

2.1 Digital learning

Digital learning is an effective learning method which uses innovative tools and current information technology to transfer the body of knowledge to learners before, while, and after learning in the classroom (McDonald, Boulton and Davis 2018; Kong 2014; Thongkoo, Panjaburee and Daungcharone 2019). It can be said that digital learning is a highly effective teaching technique. For this reason, many educational institutes have developed their own digital learning method. This has lead to a radical change in Thai education, whereby students can learn and practice by themselves through the digital materials that have been prepared by their instructors. The learning material is convenient for the learning process of the learners as they can learn anywhere at any time they want (Cidral et al 2018; Wan and Niu 2018). Moreover, they can store important information such as the questions and answers. This can be tracked or searched later on. The material can also be used directly in the classroom, in order to promote better understanding of the learners.

2.2 Digital learning in computer programming

Digital learning has been applied in various fields such as mathematics, English, and science. Currently, many educational institutions have brought digital learning in computer programming because the contents of this course are complex and difficult to understand for beginners. Therefore, many researchers have developed teaching materials to promote computer programming skills of the learners (Thongkoo, Panjaburee and Daungcharone 2017; Thongkoo, Panjaburee and Daungcharone 2019) in order to help learners prepare before attending the class. After that, the instructors can review the learners in the classroom setting. Furthermore, learners can review each lesson for a better understanding of the contents. A number of studies found that the digital learning tool can promote learning process inside and outside classrooms. Learners can learn more efficiently resulting in an improved learning performance (Yilmaz 2017; Kakosimos 2015; McLaughlin and Rhoney 2015).

2.3 Learning achievement

Learning achievement has become one of the most significant issues in education today, especially for instructors in the tertiary level. Learning achievement is the main goal for instructors as it can increase the learning potential of the students, enabling graduates to enter the workforce with a newfound self-reliance. Learning achievement can be measured by the amount of the academic content that students can learn in a given time under the learning goals or standards set up the instructors. The learners have to study, practice, and have a test on their academic performance based on the standards of the curriculum. Similarly, Shah (2008) stated that learning achievement was equivalent to the scores of the standard test in each chapter. On the other hand, Weon and Kim (2001) stated that learning achievement was the knowledgeable skills from the content in each subject that was evaluated by the instructors in the form of grading. Thus, it can be concluded that learning achievement of the students can be measured numerically. The learning achievement of the students also depends on the teaching process and the tools to support their learning as well as the measurement of the students' learning achievement. For this reason, I have developed a digital learning system with u-learning. This had been developed to promote learning achievement in computer programming of the students.

3. Development of a digital learning environment based on a ubiquitous learning

In this study, digital learning system has been developed to promote computer programming on a basic website using HTML, CSS and PHP. In this supporting system, basic information and exercises for each lesson have been prepared for the students to practice independently and search for information to solve the problems given by the instructor. This will help the learners to better their understanding of the basic concepts of computer programming.

As many pieces of research have been reviewed, the digital learning system has been developed to solve problems related to computer programming. The system consisted of two main processes: 1) learning system of coding and related contents management and 2) the cooperative learning system comprised of chatting system and learning tracking of the learners as shown in Fig.1.

This system consists of six modules:

- User interface module: Users must log in to the system to identify themselves.
- Code editor module: A tool for write programming for individual and group activity
- Course management module: A tool for lecturer to upload, add, edit and delete course materials
- Students tracking module: Ability to keep track of students' actions during learning sessions.
- Chat support module: A chat room and messaging tools that support collaboration with other students.
- Annotation support module: Annotation management comprises 4 types of annotation (1) definitions (e.g., descriptions and explanations), (2) comments (e.g., opinions and arguments), (3) questions (e.g., problems and answers), and (4) associations (e.g., links to other resources).

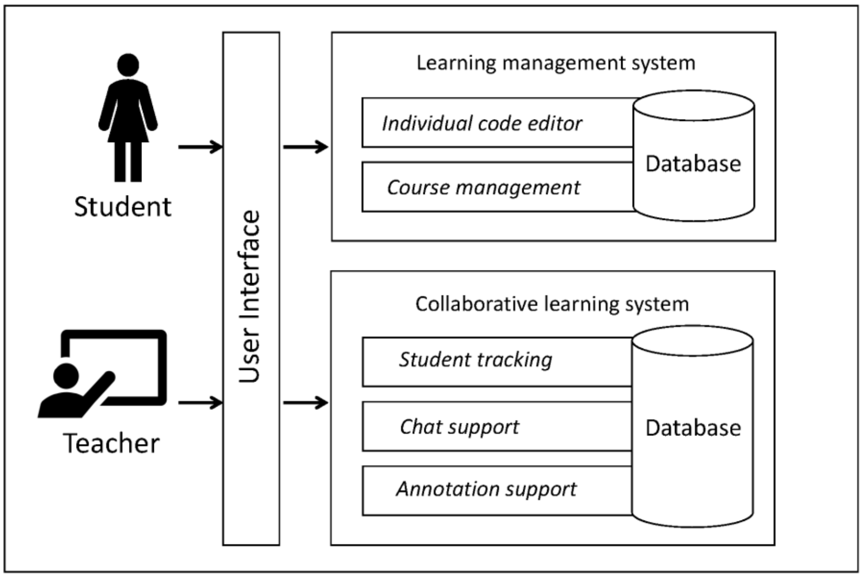

Figure 1: System architecture of the digital learning system

4. Experiment and results

4.1 Participants

The participants evaluating the efficiency of digital learning supporting system consisted of 50 sophomores registered in web programming. This was the part of Modern Management and Information Technology's curriculum. The contents used to collect data was related to PHP. The contents composed of three topics which were "Creating forms for Information receiving and sharing", "Database management" and "Session management".

4.2 Result of conceptual pretest

This research studied the effects of digital learning on student's learning achievement. The pretest was implemented to measure the prior knowledge in PHP of the students who enrolled in computer programming course. The pretest was composed of the multiple-choice examination of fifteen items. One item accounted for one score, so the total score was fifteen. The pretest was developed to cover the function of PHP in the three topics of Creating forms for Information receiving and sharing, Database management and Session management. All of the participants had never taken the test before. According to the data analysis in Table 1, it was discovered that the pretest scores of both student groups were insignificantly different with t = 0.95 and $p > 0.05$. This illustrated that the learners in both groups had the same level of knowledge in PHP.

Table 1: Displays the result of pretest of the two groups

Group	n	Mean	SD	t	Sig.
Experimental Group	27	6.44	1.91	0.95	0.1749
Control Group	27	6.85	1.63		

1.3.Result of conceptual posttest

After the learning activities prepared by the instructor were implemented, the post-test was used to measure the knowledge in PHP of the students. The post-test was composed of fifteen multiple-choice questions. The total score was fifteen. The pre-test was developed to cover the function of PHP in the three topics of: Creating forms for Information receiving and sharing, Database management and Session management. According to the data analysis in Table 2, the experiment group scored significantly better than control group with statistical significance at $F_{(1,52)}$ = 14.345 and $p < 0.05$.

Table 2: Displays the result of posttest of the two groups

Groups	N	Mean	SD	Adjusted mean	Std. error	$F_{(1,52)}$
Experimental Group	27	10.19	1.495	10.235	0.301	14.345^{*}
Control Group	27	8.67	1.710	8.616	0.301	

1.4.Result of learners' perception

After finishing the learning activities, the students participated in a perception questionnaire about learning support system. A Cronbach's alpha test was used to measure the internal consistency reliability of the scales. The alpha values for five dimensions such as 'user interface design (UID)', 'perceived usefulness (PU)', 'perceived ease of use (POU)', 'attitude (AT)', and 'intention to use (IU)' were 0.76, 0.88, 0.91, 0.89, and 0.86, respectively. Additionally, the Cronbach's alpha test result showing the reliability of the perception questionnaire was 0.92, implying that it was reliable. The results of the experiment showed that the proposed digital learning promoted a positive attitude among students.

The data analysis in Table 3 shows various categories. They include: students in experimental and control group learning with the difference learning approach, experimental and control students' attitude toward 'user interface design', 'perceived usefulness', 'perceived ease of use', 'attitude' and 'intention to use' the learning support system similarly.

Table 3: The descriptive data of the perceptions of the students who learned with different learning approaches

Dimension	Learning approach	N	Mean	SD
User Interface Design	Experimental Group	27	11.52	2.17
	Control Group	27	10.41	3.15
Perceived Usefulness	Experimental Group	27	23.56	3.14
	Control Group	27	22.15	5.05
Perceived Ease of Use	Experimental Group	27	18.81	3.22
	Control Group	27	17.48	4.01
Attitude	Experimental Group	27	11.78	1.87
	Control Group	27	10.70	2.51
Intention to Use	Experimental Group	27	7.52	1.25
	Control Group	27	7.22	1.78

5.Discussions and conclusions

The digital learning supporting system was developed to promote computer programming skills among students. It was also intended to increase the effectiveness of learning programming languages such as HTML, CSS and PHP in the department of Modern Management and Information Technology, Chiang Mai University. To evaluate the results, fifty participants registered in web programming course and were tested before and after the experiment. The results from the tests demonstrated that the experiment group that learnt by digital system, scored higher in the post-test with statistical significance when compared with the control group learning through the conventional Notepad ++ program. This was similar to the study of Thongkoo (Thongkoo, Panjaburee and Daungcharone 2019) as it mentioned that the developed digital learning system was able to effectively increase learning achievement of students, as well as promote a positive attitude towards this system.

For future research, it is recommended that a bigger sample group should be used. More learning channels should be provided as an option to learn. Furthermore, the system should allow the instructors to track learning activities of computer programming students. This system can also be integrated and used with other subjects in the future.

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Collaborative Online International Learning: A Pedagogical Intervention to Enrich Students' Learning

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Abstract: Against the changing global higher education environment, the Collaborative Online International Learning (COIL) project has emerged. This project aims to create team-taught coursework that links university classes in different countries, while providing students from different disciplines and from different cultural environments with opportunities to develop cross-cultural awareness, knowledge in discipline, skills in communication, and teamwork. The Durban University of Technology (DUT) in South Africa recently implemented a COIL project that enabled Dental Technology students to collaborate internationally. The collaboration involved Business Management students from Nassau Community College (NCC) in New York to understand the business applications in developing a prototype that reduces material wastage in dental laboratories. This paper aims to elicit students' opinions on COIL as a pedagogical intervention in enhancing their learning. A cross-sectional research design within a quantitative framework, which followed a positivist paradigm, was used. The participants involved were the second year Dental Technology students (n=14) from DUT and the Business Management students (n=21) from NCCC. Data was collected by means of an anonymised questionnaire, which was analysed using descriptive and inferential statistics ($p<0.05$). Results measured positively within five categories, namely: project introduction and preparation; cultural and diversity competence; impacts on personal behaviour; quality of learning; and overall experience and course quality. The COIL project facilitated the epistemological development of students by providing them with an opportunity to learn collaboratively with partners possessing cultural and professional perspectives different from their own. Overall, the salient features of this paper foregrounds how students engaged globally to acquire discipline-specific knowledge using different technology mediated tools, enhanced their abilities to make informed decisions, and learned to think critically and to problem-solve.

Keywords: dental technology, business administration, voice thread, cultural competence, and diversity

1. Introduction of the study

Several studies (Carey and Trick, 2013, Bowen *et al.*, 2014, Baran *et al.*, 2011, Rosenbaum, 2012, Asiry, 2017, Keengwe and Kidd, 2010, Cifuentes and Shih, 2001, Xiaojing *et al.*, 2010) have reported on the changes that have occurred in the global higher education landscape from face-to-face classes into fully online, blended, or e-Learning courses. Apart from being more accessible to a growing and diverse student population, online learning facilitates an active student-centred learning process across multicultural contexts (Cifuentes and Shih, 2001) . This does however, according to Rodriguez *et al.* (2008), require students to have the know-how by investing in learning the necessary technical skills while being expected to simultaneously master new course content. Resonating with them, Ally (2011) critically emphasised that if designed appropriately online learning systems can be used to determine students' needs and current level of expertise. Concomitantly, a selection of appropriate materials can also be assigned for them to achieve the desired learning outcomes. Importantly, Ally (2011) further highlighted that teachers can update online materials regularly thereby enabling students to see these changes immediately. Notwithstanding this, a document by the Council on Higher Education (2016) noted that online learning environments provide "opportunities for group problem-solving and peer-to-peer collaboration and for making personalised learning scalable". This critically aligns with the strategic objectives of the Durban Univerisity of Technology (2017), specifically to "deepen the innovative use of technology to improve the quality of learning, teaching and assessment". Two key priority areas underpin this objective, namely, providing students with epistemological access to discipline-specific knowledge, and digital literacies to enhance learning and to use educational technologies and tools to enable teaching and learning. It is against this background that DUT continually strives to be more proactive in terms of broadening the scope of its international activities while fulfilling the specific institutional objectives. This was made possible through the Collaborative Online International Learning (COIL) model, an initiative of the State University of New York (SUNY), which serves to connect local and global entities as strategic partnerships are developed between higher education institutions in different countries.

According to the SUNY COIL Centre (State University of New York, 2018), the purpose of the COIL model is to create equitable team-taught courses where teachers from two different cultures work together to develop a shared syllabus, give new contextual meaning to the ideas and text they explore, and to co-teach and manage coursework. Using internet-based tools and innovative online pedagogies, COIL can foster meaningful exchanges between university-level teachers and students with peers in geographically distant locations and from different lingua-cultural backgrounds. The COIL system is not just a technology. Instead, it is a new teaching and learning paradigm that develops intercultural awareness across shared multi-cultural online learning environments. The COIL model aims to create team-taught coursework that links university classes in different countries, while providing students with opportunities to develop cross-cultural awareness, knowledge in discipline or complementary topics, communication and group collaboration skills. The objectives of COIL collaborations complement, enhance and support DUTs internationalising the university agenda, which aims at engendering "… an international dimension into the teaching and learning activities to help our local staff and students to move towards becoming global citizens." (Durban University of Technology, 2015). Significantly, this further aligns with the sustainable development goals (SDGs), specifically SDG 4, which is to "ensure inclusive and equitable education and promote lifelong learning opportunities for all" (Swanson, 2015). Apart from exchanging cultural perspectives, COIL also provides students with an opportunity to learn new technologies and communicate ideas from interdisciplinary perspectives.

Technology-mediated tools, such as WhatsApp instant messaging, provide alternative dialogic spaces for teams to communicate effectively and enhance their collaborative engagements. This is consistent with Barhoumi (2015), who argued that the integration of Internet Technology and WhatsApp mobile learning forms powerful and effective tools in helping students construct and share knowledge and rapidly exchange ideas. As revealed by Vonderwell *et al.* (2007), asynchronous online discussions facilitate a multidimensional process of reflection, metacognitive processes, and articulation of students' own learning. They elaborated that students recognize "the importance of writing skills to understand, interpret, and implement the content knowledge" thereby ultimately enabling them to actively assess their own learning. Equally significant, He and Huang (2017) asserted that synchronous communication in combination with asynchronous tools promotes effective teamwork, higher levels of communication and satisfaction with online learning. They concluded that synchronous communication fosters student engagement as it allows them to experience each other as actual humans "rather than as text on a screen". Arguably, COIL can be typified as a high-impact practice (HIP) as it enables students from diverse backgrounds and geographical locations an opportunity to engage in a relevant, globally focused and experiential learning experience. A benefit of using a HIP is to enrich students' learning experiences, especially first generation, minority and low-income students (Kuh, 2008, Kilgo *et al.*, 2015). This paper therefore aims to elicit students' opinions on COIL as a pedagogical intervention in enhancing their learning.

2. Details of the COIL Project (COILP)

2.1 Design and development of COILP

Initially, the first and second authors of this paper completed a six week online COIL Course Orientation (CCO) programme (State University of New York 2019) between 21 August and 22 September 2017. The CCO is the first step in developing a partnership to collaborate on and create a COIL course, module or project, which is a prerequisite for the COIL Academy. As outlined on the SUNY/COIL website (http://coil.suny.edu/page/partnering-orientation), the online course introduces faculty and staff from SUNY/COIL nodal and global partner networks to the concept of COIL and provides them with guidelines to develop necessary skills to co-teach cross-cultural courses. Modules in the CCO included professional and institutional profiling, international partner selection, discussion and negotiation of "critical issues including intercultural sensitivity, flexibility, and the development of consistent protocols" (State University of New York 2019). The CCO uses a 'learning-by-doing' approach as participants engage in asynchronous and synchronous activities to learn about various digital tools and pedagogies, while engaging in online group discussions. At the end of the CCO, participants have the knowledge and confidence to navigate and develop successful partnerships with global partners from the SUNY/COIL global network. From 22 October to 15 December 2017 both authors subsequently participated in an eight-week COIL Fall Academy (http://coil.suny.edu/page/academy-coil-course-development). The Academy presents advanced coursework; working within a modular format; and providing partners with the tools and knowledge to develop their project through a systematic process. Partners have opportunities to discuss and develop learning outcomes, design and sequence tasks, write a course syllabus and collaborate on the design and implementation of their project.

The authors collaborated both within the Fall Academy online course, as well as through frequent Skype discussions. They co-developed a COILP titled 'The 4Ps of Digital Business Practices in Dental Technology' and used web-based technology to enable students to engage in communication and collaboration synchronously and asynchronously. The purpose of the COILP is to enable Dental Technology students from DUT in South Africa (SA) to collaborate with Business Management students from NCC in New York in order to understand the business applications in developing a prototype that reduces material wastage in dental laboratories. Dental Technology students were therefore required to complete a business plan, identify the target market and develop a prototype that will reduce material wastage in dental laboratories, prior to commencement of the COILP. Through virtual exchanges, students were required to discuss the different perspectives and worldviews in connecting the 4Ps of Business Practice namely, product, place, promotion and price to the 4Ps of Dental Technology, which are to be patient and passionate in persevering to produce precision-made appliances. Students also had opportunities to discover similarities and differences in their educational and personal lives. These are essential experiences to enable students to have enriching intercultural experiences and to encourage them to develop critical thinking skills.

2.2 Implementation of COILP

The COILP was conducted through NCC Blackboard course management system using a separate course shell template. The DUT facilitator was granted development access in May 2018 to allow time for collaboration with the NCC facilitator on module development, design and co-ordination. The NCC facilitator also provided formative feedback to DUT students on the description and initial marketing ideas of their prototype in July 2018. A noteworthy point is that DUT students had a two-hour induction session into the NCC COIL classroom on the 20 August 2018, and the NCC facilitator participated virtually in the training sessions. Students also learned to use Skype, google docs and drop box during this training session. The COILP was implemented over a five-week period from 5 September to 5 October 2018. A critical point that deserves to be mentioned is that the semesters between DUT and NCC are different. The Dental Technology programme commenced in February 2018 whereas the Business Administration course commenced in August 2018. This difference in semester structures resulted in a month long COILP within the context of DUT and NCCs courses. Furthermore, for DUT the COILP was the assignment component for the Dental Technology Theory subject (DTTH 2211), specifically for the discipline-specific section of 'Prosthetics'. For NCC, the project was included in the 'Introduction to Business' course and was incorporated throughout existing learning modules covering the topics on the 4P's of marketing, SWOT analysis, environmental analysis and the Target Market. As presented in Table 1 an initial 'ice-breaker' task was designed, which required students and each course facilitator to create a Voice Thread video. The purpose of the video was to provide an introduction of their partner and themselves together with their cultural background. This task initiated the cultural component to the project. The task also allowed students to begin working with the technology called Voice Thread, which would be utilised throughout the project.

Students selected the form of communication that served their team most effectively. Asynchronous and synchronous tools including Facebook, Skype, and WhatsApp were options for team communication and collaboration. Facilitators did not control the form of communication, however they periodically monitored the threads. Students were required to post all communication interchanges on Blackboard for final assessment and grading. The final project task required NCC students to assist DUT students with the marketing sections of the business plan. Student teams were provided with grading rubrics detailing the expectations for each of the project tasks, including the Voice Thread video, team communication discussions, and business plan.

Table 1: A Five-Week COIL module implemented in 5 September to 5 October 2018.

ONE & TWO	Ice Breaker: Introductions of the facilitators and students Activity One: *Introductory Videos* To create and post a "*4-minute*" Voice Thread video. The first 2 minutes is to introduce a partner and the second two minutes to introduce yourself. Post your videos into the Voice Thread Assignment Document.	Task: Individual Introductions Describe your background (cultural/academic/ Personal). Share any interests you have. Identify your field of study. Share any goals or future perspectives. At the start or at the end, tell us something in your "mother tongue" which may not be English.

THREE, FOUR & FIVE	Collaborative Group Project Activity Two: *Case Study Scenario* Teams are to use any appropriate asynchronous and synchronous communication tool to discuss the concepts of Environmental Scans, SWOT analysis and 4Ps of Marketing. Discuss the different perspectives and worldviews in connecting the 4Ps of Business Practice namely, product, place, promotion and price to the 4Ps of Dental Technology, which are to be patient and passionate in persevering to construct precision-made appliances.	Task: Team members will communicate and work together to: Discuss how an environmental scan is developed and define your competitors. Develop the methodology for the SWOT analysis, including the internal and external factors. Identify the 4Ps of marketing and contrast it against the 4Ps of Dental Technology. Identify the competitors – Who are they? What kind of threat do they pose, or are they truly your competition? Discuss whether the product/concepts is economically feasible. Identify the strengths and weakness (intrinsic factors) and the opportunities and threats (external factors) of developing the prototype. Explain the strategies used to overcome the threats and weaknesses identified.
FIVE	Final Reflection Activity Three: *Completing a questionnaire*	

3. Research design and methodology

A cross-sectional research design within a quantitative framework, which followed a positivist paradigm, was used. Positivism in this case emphasised the observation of human behaviour, which is quantified objectively (Howell, 2013). The participants, who were from different cultural contexts, consisted of the 2018 second year Dental Technology students (n=14) from DUT and the Business Management students (n=21) from NCC. After completion of the COIL project, students completed an anonymised and descriptive questionnaire. The questionnaire included four sections, namely:

- Section A, focused on students' demographic details.
- Section B, assessed students' use of technology.
- Section C, measured students' use of online tools.
- Section D, used a 5-point Likert scale to gather students' opinions about COIL. There were five sections, namely: Project Introduction and Preparation; Cultural and Diversity Competence; Impacts on Personal Behaviour; Quality of Learning; and Overall Experience and Course Quality. It is to be noted that this section was adapted from the questions developed by the Global Learning Experience (GLE) team at DePaul University. In an email communication to the authors on the 11 April 2018, permission to use and adapt the questions was granted by Rositsa Leon (Assistant Director) on behalf of the Global Engagement and Online learning.
- In addition, three open-ended questions allowed free responses regarding suggestions to better support learning, improvements to the delivery and implementation, and the use of technology within the COIL project.

Ethical approval was granted via DUTs Institutional Research Ethics Committee (IREC 068/18). Written consent was further obtained from participating students. Descriptive (univariate and bivariate analysis) and inferential (Correlations and Chi Square Test) statistics were used to analyse the data with $p<0.05$ set as statistically significant (SPSS-Version 25®). Factor Analysis was performed for the data obtained from the Likert Scale to identify underlying variables, or factors, and to explain the pattern of correlations within a set of observed variables. Content validity was used to ensure the questionnaire focused on concepts and constructs that emerged from the literature review on online learning. The internal consistency of the survey was assessed through Cronbach's alpha.

4. Results and discussion

The reliability scores for all sections exceeded the recommended Cronbach's alpha value of $\alpha=0.70$, thereby indicating consistency of scoring. Bivariate correlations were computed among the five sections of the Likert Scale. As illustrated in Table 2, the results show nine out of the ten correlations were statistically significant. In general, the results suggest that impacts on personal behaviour, quality of learning and overall experience and course quality are potential predictors of students' positive experiences of the COILP. From the rotated varimax Factor Analysis, the average loading of items per theme was above the acceptable Eigen values (> 1.0). With reference to Figure 1, significant differences in the scoring patterns with higher levels of agreement were observed ($p<0.05$). It can further be inferred that the majority of the students were prepared for COILP from the perspectives of culture and diversity (68.6%) and technology (77.1%). Some students, however, conveyed that they experienced difficulty using Voice Thread. They therefore recommended that facilitators should "maybe make videos on how to post on the discussion page and voice thread for people who aren't really good with technology." An induction course with more appropriate training for students is to be provided for future COILPs.

Table 2: Correlations

		Project Introduction and Preparation	Cultural and Diversity Competence	Impacts on Personal Behaviour	Quality of Learning	Overall Experience & Course Quality
Project Introduction and Preparation	**Pearson Correlation**	1				
	Sig. (2-tailed)					
	N	35				
Cultural and Diversity Competence	**Pearson Correlation**	0.115	1			
	Sig. (2-tailed)	0.512				
	N	35	35			
Impacts on Personal Behaviour	**Pearson Correlation**	.340*	.648**	1		
	Sig. (2-tailed)	0.046	0.000			
	N	35	35	35		
Quality of Learning	**Pearson Correlation**	.402*	.639**	.719**	1	
	Sig. (2-tailed)	0.017	0.000	0.000		
	N	35	35	35	35	
Overall Experience & Course Quality	**Pearson Correlation**	.575**	.493**	.547**	.652**	1
	Sig. (2-tailed)	0.000	0.003	0.001	0.000	
	N	35	35	35	35	35

*. Correlation is significant at the 0.05 level (2-tailed).
**. Correlation is significant at the 0.01 level (2-tailed).

As illustrated in Figure 2, students' generally agreed that the COILP enabled them to gain knowledge on different cultural practices and worldviews, and to communicate and interact with partners from diverse backgrounds. For instance, NCC students declared that they "personally enjoyed working with the students in South Africa because it introduced me to completely new cultural people". Including the icebreaker task in the COILP could have facilitated the positive student responses. It was however, observed that the scoring patterns for Questions 5 ($p=0.06$), 6 ($p=0.69$) and 7 ($p=0.38$) were not significantly different. These results will be considered in improving the cultural and diversity competence aspects of future COIL initiatives. With reference to Figure 3, significant differences in the scoring patterns with higher levels of agreement were observed ($p<0.05$). Regardless of the positive responses received, some students were unsure or disagreed on the overall impact of the COILP on their personal behaviour in terms of: providing opportunities for discussion and debate outside the online classroom; finding the need to maintain the connections with their international partners; and the experience affecting their future career (Figure 3). Time-zone differences between SA and the United States of America (USA) could have attributed to this, as students "…had to find and balance time where it was convenient for both parties". Reports from other international online classrooms reflect similar challenges to those experienced during the COILP (Cifuentes and Shih, 2001, Xiaojing *et al.*, 2010). Another factor contributing to the negative responses in Figure 3 was the different semester structures, particularly the implementation time of the COILP for the NCC students. This is supported by the *verbatim* statements in Figure 4, which were conveyed by the NCC students' in the open-ended questions.

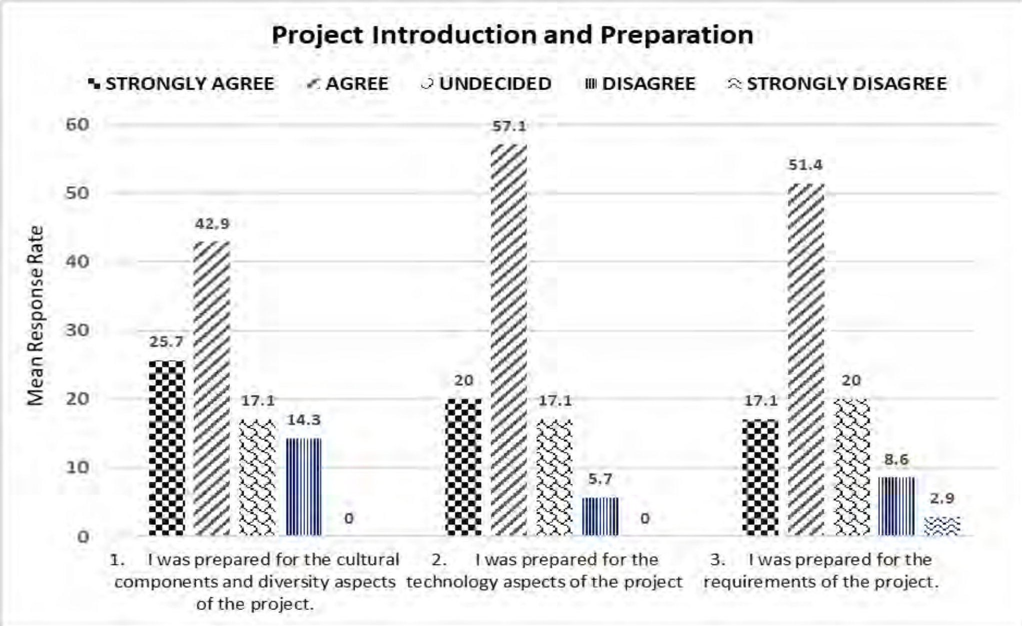

Figure 1: Project introduction and preparation

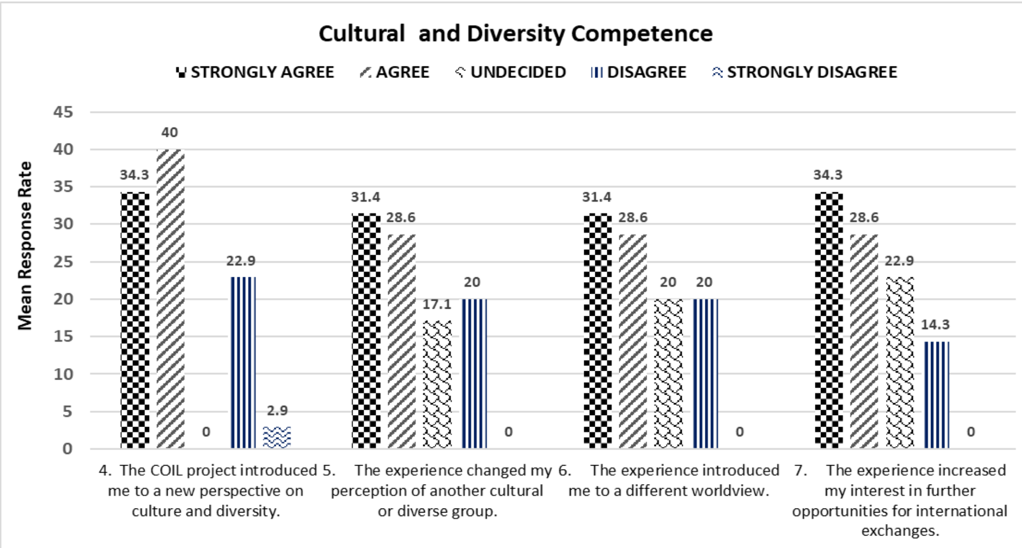

Figure 2: Cultural and diversity competence

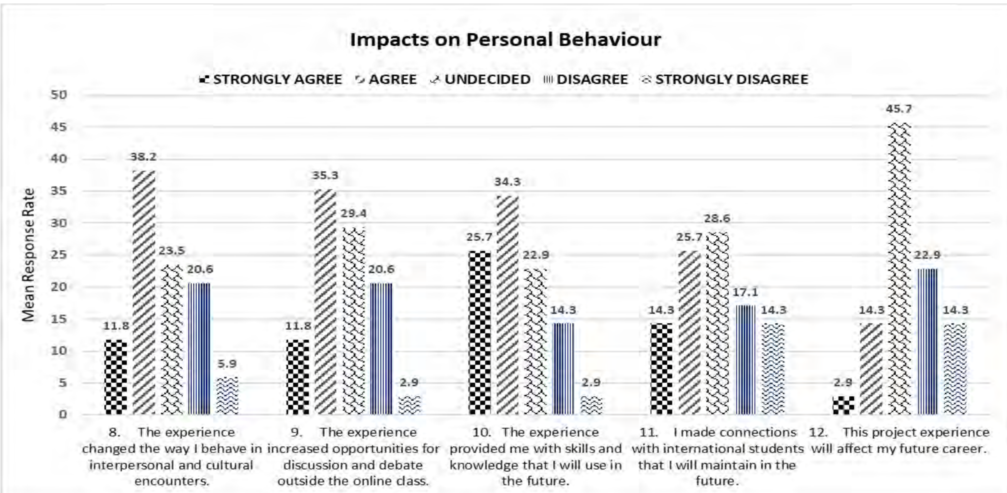

Figure 3: Impacts on personal behaviour

"My mainly suggestion to improve it is that it should be done after a while in the semester when we at least have learnt most of our business course".

"Learning the marketing component before starting the project would be easier. Have exam on marketing component and start project right after to ensure people can give helpful advice".

"Don't do this in the beginning where people don't know much about business".

"Not do it in the beginning of the semester. Do it more towards the end".

"If the project could be at the end of the semester. It would have been better".

"Do the project towards the middle or end of the semester."

Figure 4: Suggestions made by the NCC students to improve the COILP

Consistent with Rodriguez *et al.* (2008) and Rosenbaum (2012), it can be inferred from Figure 5 that students' positive experiences in participating in COILP ($p<0.05$) partially emanated from their motivation and expectations to enhance their own academic and personal growth. It had little to do with them being motivated to learn technology skills as more than 75% of the students used social networks such as Facebook, Pinterest, Snap chat, etc. every day or quite a few times of the week. Students' comments in Figure 4, particularly not having sufficient knowledge prior to participating in the COILP, could have contributed to the negative responses in Figure 5.

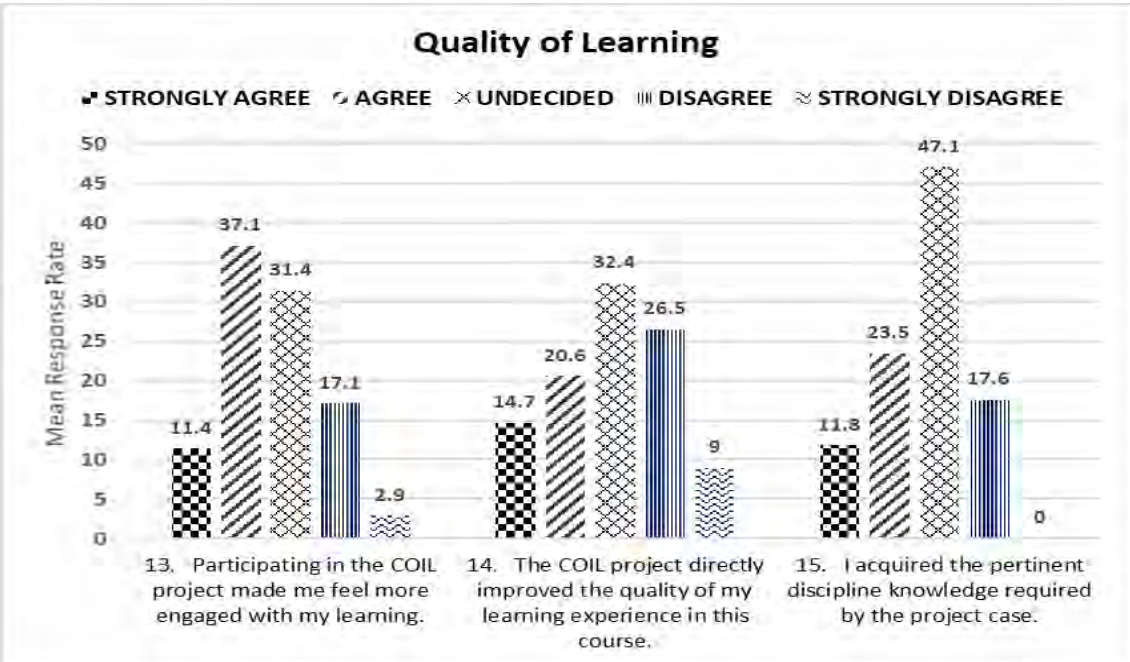

Figure 5: Quality of learning

Generally, and as shown in Figure 6, students' interaction and engagement in the COILP supported their learning ($p<0.05$). They "…thought that the COIL project was interesting because we got to experience what it's like when a businessperson talks to someone overseas and help one another into becoming a better businessman and helping the business grow." Others positively conveyed that the COILP "…took me out of my comfort zone…taught me how to be responsible at all times…" and "…improved the quality of my learning experience in this course and introduced me to a different worldview". Hence, it is "…a good project because instead of doing what every other class is doing we get to communicate with people from around the world. I would love to do another project like this". It is also highly probable that students' comments in Figure 4 could have contributed to them devaluing their overall COIL experiences reflected in Figure 6.

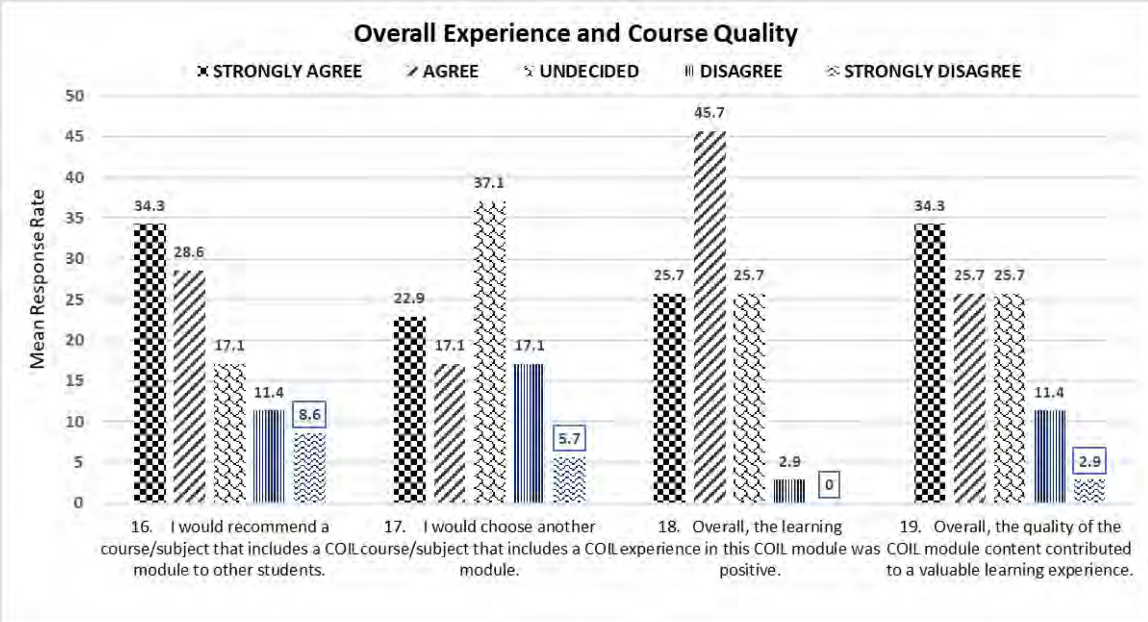

Figure 6: Overall experience and course quality

5. Limitation and conclusions

The findings of this research may only be applicable in similar contexts. Although positive outcomes were achieved, other variables such as different semester structures, time-zone differences, and prior knowledge of discipline-specific content might have influenced students' participation, satisfaction and commitment to the COILP. In conclusion, this study confirms that students' perceived satisfaction are positive indicators that infusing a COILP into the curriculum enriches the epistemological development of students by providing them with an opportunity to learn collaboratively with partners possessing cultural and professional perspectives different from their own. The COILP is a nuanced HIP and e-Learning approach that can be applied across multicultural contexts in a productive and sustainable way.

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Threshold Concepts in Online Music Education: Transforming Conservatoire Training

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Abstract: In 2016, Trinity Laban Conservatoire of Music and Dance launched the Certificate in the Practice of Music Making (CPMM), a one-year distance-learning course developed in partnership with the Open University. The CPMM uses reflective learning to enable musicians of any adult age and from any musical genre or tradition to develop a better understanding of their personal culture and practice of music making in relation to others. Through asynchronous interactions in a virtual learning environment, students are encouraged to observe each other's differences of approach, leading to a heightened awareness of their own musical identity and culture in return. On this course, educational technologies enable musicians, who may never normally meet due to barriers of distance and culture, to work together and synthesize their learning experiences into new and original musical interpretations at a residential learning week that takes place near the end of the course. As part of a continued commitment to improving the student experience, the CPMM course team conducted a qualitative research study in which concept maps were employed to assess the learning that had taken place. A number of students completed concept maps near the beginning and the end of their studies; this process captured changes in their perceptions of the role that practical music making played in their identity formation as musicians while studying on the course. Qualitative and quantitative data extracted from the concept maps enabled the course team to evaluate the effectiveness of teaching delivery, as well as the extent to which learning outcomes were achieved. This paper reports on that study, the results of which inform methods whereby established pedagogical practices can be adapted to provide an inclusive and engaging online learning environment that facilitates embodied learning in Higher Education performing arts programmes.

Keywords: pedagogy, online learning, music, performing arts

1. Introduction

The Certificate in the Practice of Music Making (CPMM) is a distance-learning course in practical musicianship offered by Trinity Laban Conservatoire of Music and Dance. It was developed in partnership with the Open University and is a 60-credit, one-year part-time programme at Level 6 of the UK Credit Framework for Higher Education. It can be taken as a stand-alone certificate, or as part of the Open University's BA (Honours) Music. Learning is facilitated through discussion in the form of asynchronous interactions managed by tutors in a virtual learning environment, the design of which encourages students to observe each other's differences of approach, leading to a heightened awareness of their musical identity in relation to the world around them. The course represents a departure for the conservatoire sector, which has traditionally focused its provision on campus-based face-to-face tuition. This paper reports on the results of a study that used concept mapping as a method of qualitative inquiry into the effectiveness of online pedagogies when facilitating embodied and experiential learning in a discipline traditionally taught in-person and deemed unsuitable for delivery in virtual learning environments.

2. Pedagogy

In online learning environments, tutor support frequently takes one of two forms: synchronous (in which participants communicate in real time through text-, audio- or video-based tools) or asynchronous (in which participants use a system—often text-based—at different times). Bach, Haynes and Smith argue that a 'flexible time of entry and departure [in the discussion] usually gives students more time to prepare and to plan their own intervention' (Bach et al., 2007, p. 132). This has been corroborated by wider research into student-tutor interaction. Laurillard notes that in real-time interaction 'the need for quick reactions […] works against careful thought and reflection' (Laurillard, 2012, p. 148). She stresses that in asynchronous discussions 'students can take their time to reflect on what has been said, and consider carefully how to adapt and phrase their contribution as a result' (Laurillard, 2012, p. 147). Furthermore, in her research she has long argued that asynchronous tuition allows for greater student engagement than synchronous methods (Laurillard, 2002; Laurillard, 2012). Such greater engagement, combined with the flexibility afforded by asynchronous discussion, facilitates the reflective learning that is expected from CPMM students.

A defining feature of arts training is the absence of pre-determined, correct answers to exercises and assessments that instead demand a personal response to an initial provocation. For students to develop confidence in responding to such provocations, educators have often used discussion and debate as pedagogic tools (Brookfield and Preskill, 2005 [1999]). In an online learning environment, asynchronous discussion facilitates peer learning when supported and moderated by a tutor, who plays an active role in shaping the discussion to create an effective social constructivist learning environment. A substantial body of research into social constructivism has identified learning through discussion as a useful pedagogical framework if certain criteria are met. Laurillard suggests criteria that were of particular relevance to the instructional design of the CPMM. She notes that in order for students to learn through discussion, they must provide evidence and explanations for the arguments they put forward, and engage (either through consideration, response or challenge) counter-arguments that are presented by their peers. Furthermore, learners must reflect on their own perspective in relation to those of others, and apply what they have learned (Laurillard, 2012, p. 143). Furthermore, Brookfield and Preskill (2005 [1999], pp. 242-3) stress the importance of facilitating such asynchronous interactions in small groups to encourage greater levels of engagement, a strategy adopted by the CPMM teaching team.

3. Methodology

As noted by Bourner, a 'main impediment to assessing reflective learning is that a significant and variable proportion of the learning outcomes of reflection is subjective knowledge rather than objective knowledge' (Bourner, 2003, p. 268). However, concept mapping, as developed by Joseph D. Novak, provides a method for assessing the extent to which newly acquired knowledge integrates with prior learning and experience. Concept maps, which have their origin in constructivist pedagogy, are graphical representations of knowledge. Similar to mind maps and spider diagrams, they link related concepts in a hierarchical fashion from the most inclusive and general concepts to the more specific. However, the method for creating concept maps proposed by Novak (2010 [1998]) distinguishes itself from other graphical representations of knowledge in the use of propositions, or linking words, that describe relationships between concepts. These prove particularly useful in maps that illustrate the subjective knowledge constructed through personal reflection. Furthermore, comparative study of pre- and post-instruction concept maps can provide insight into the thought-processes by which newly acquired knowledge or experience integrates with existing cognitive structures.

For the purposes of this study, a sample of sixteen CPMM students each completed a concept map before commencement of their studies (during induction week) and at the end, following submission of their final assessed portfolio. The demographic makeup of the sample reflected students that worked in diverse musical genres, including various jazz, pop, folk and classical subgenres, and ranged in age from 32 to 70. These students were provided with instructions on how to create a concept map, and a word bank consisting of thirty-eight concept words. In acknowledgement of the diversity of musical cultures represented by the sample, participants were encouraged to add concept words of their own choosing that were relevant to their practices of music making. Students were then asked to capture their perception of how practical music making impacts and develops their identities as musicians. A focus question was articulated to encourage them to examine a variety of ways in which their musical practice impacts and reflects its social contexts and how this contributes to the formation of their individual—as well as collective, where relevant—identities.

Quantitative and qualitive analysis of pre- and post-instruction concept maps was carried out to determine changes in cognitive structures. These changes were then examined to elucidate how the design of the programme had impacted on the artistic identity formation of the students. The methods of analysis were informed by research into measuring quality of e-learning conducted by Hay et al. (2008). First, concept maps were analysed for structural change, based on the concept map models identified by Kinchin, Hay and Adams (2000): spokes, chains and networks. Spokes are radial structures in which related concepts are linked exclusively to a single core concept, without any form of cross-linking. Students who display spoke structures in their concept maps assimilate new knowledge without adequate understanding of the interplay between associated concepts. Such students are normally able to access newly acquired knowledge only by reference to the core concept. Chains reflect a linear sequence, with each concept linked to the ones immediately above and below it. Concept maps displaying a chain structure are indicative of students who fail to integrate new knowledge with prior learning. Typically, these students are only able to assimilate new information that can be related to concepts near the top or bottom of the chain; the inability to synthesize new knowledge within the chain suggests a surface approach to learning. Finally, a net is an integrated and hierarchical network that demonstrates an in-depth understanding of the subject matter, with students able to access newly acquired information via a number of cognitive pathways, thus evidencing a more complex understanding of the subject matter.

Following analysis of the structural composition of the maps, quantitative comparison of pre- and post-instruction maps was carried out that focused on the number of concepts selected from the provided word bank, the number of own concepts added, and the number of concepts retained post-instruction. Finally, this comparative study was complemented by qualitative analysis in which two members of the course team scored the maps on a 5-point Likert scale, examining four constructs (informed by Hay et al., 2008): conceptual richness, linkage quality, evidence of understanding, and hierarchy and structure. A further qualitative indicator of change that was assessed was the degree to which new concepts integrated with retained concepts.

Finally, the participants' contributions to the asynchronous forum discussions were examined for corroborating evidence to support conclusions drawn from the qualitative analysis of pre- and post-instruction concept maps. The reflective nature of the discussions provided invaluable insight into students' thought-processes and, consequently, their development as practising musicians. Forum posts therefore contributed crucial data that illuminated concept linkage and use of propositions in participants' pre- and post-instruction maps.

4. Results

The primary aim of the study was to evaluate students' changes of perception in relation to their musical identity that had taken place as a result of personal reflection during the one-year CPMM programme. The spiral curriculum of the course encourages students to reflect in ways that have increasing impact on their personal cultures of music making; their reflections lead to changes of understanding and behaviour that have, in several cases, motivated significant changes of artistic identity, including changes of musical genre or ensemble, and career changes. Qualitative inquiry was therefore focused on the results of personal reflection, rather than knowledge acquisition, and maps were examined for evidence of effective integration of experiential learning into existing cognitive structures.

The majority of students showed no structural change in their concept maps. However, a trimmed mean average increase of 42% in the number of concepts used post-instruction, with an average 49% of concepts retained, indicated that students had developed a heightened awareness of the complex interplay between music making and identity formation. How well these new experiences integrated with pre-existing perceptions of music making and identity formation was evaluated by expert scoring of the maps by members of the course team. This evidenced that an average of 89% of participants developed a more meaningful understanding of the impact of a range of music-making activities on identity formation, as well as the role that musical culture and collective identity played in the types of music-making activities that they engaged in.

A small number of students demonstrated meaningful assimilation of David Kolb's cycle of experiential learning (Kolb, 1984). These students' post-instruction concept maps illustrated increased complexity with new concepts cross-linked to concepts that showed they had become active participants in their own learning journey. One student in particular incorporated 'improvisation' and 'freedom' as concepts in her post-instruction map, linking it in a meaningful way to 'review' and 'performance', which were both retained concepts. Following an exercise in guided improvisation through abstract drawing, the student noted in the asynchronous forum discussions that she found engagement with the exercise 'quite freeing [after] having previously been terrified of doing improvisation' (Student A, CPMM online discussion forum, 11 December 2017). Increased awareness of the benefit of reflection on her music making was further acknowledged in a forum post on 20 February 2018:

> *Back in September my practice journal consisted of dry notes such as wrong notes/rhythms played or articulations missed. I am now thinking more about my tone and my contribution to the whole ensemble sound and then [use] these as the basis [for] my private practice instead of mechanical practice.*
>
> *(Student A, CPMM online discussion forum, 20 February 2018)*

This student's pre- and post-instruction concept maps evidenced experiential learning in which new concepts were integrated into existing cognitive structures in a meaningful way, leading to a heightened awareness of her own practice of music making in relation to those around her. This was further corroborated by her contributions to the asynchronous discussion forums.

Another student who demonstrated elements of Kolb's cycle of experiential learning in his post-instruction map also acknowledged in the discussion forums that improvisation had had a positive impact on his music making. The concept of 'improvisation' was linked to 'creativity' in the post-instruction map, albeit without an adequate proposition to explain the relationship between the two terms. The lack of propositions extended to other concepts that were linked to 'creativity', suggesting an inability to integrate the concept of creativity into his practice of music making. This was corroborated by his contributions to the asynchronous discussion forums: 'I have found […] creativity doesn't work for me' and 'I [am] still getting to grips with the concept of creativity' (Student B, CPMM online discussion forum, 11 March 2018).

On occasion, analysis of maps evidenced increased focus post-instruction, with a reduction in the number of concepts and an increased sophistication in the hierarchical structure of the maps. One such student, whose concept maps showed a reduction from 41 to 27 concepts with only 16 concepts retained post-instruction, developed a heightened awareness of the impact of personal practice and reflection on the quality of her musical performance. This student had struggled with performance anxiety, a consequence of negative associations stemming from previous, harmful experiences of collaborative music making. The impact of these experiences on her artistic identity were expressed in her pre-instruction concept map, in which 'culture' and 'diversity' were linked with 'identity'. These concepts were subsequently dropped in her post-instruction map, which showed a greater focus on personal development and reflection, with numerous related concepts meaningfully linked to 'performance'. This demonstrated that the student had developed increased confidence in her abilities as a musician, and this confidence had then positively impacted her performance practice. In the discussion forums she noted:

> *I have learnt that it takes me longer to process information and put it into practice and I used to beat myself up about this, but I have learnt to accept this.*
>
> *(Student C, CPMM online forums, 20 December 2017)*

Furthermore, a heightened awareness of the impact of reflection and planning on efficacy of practice was evidenced in her post-instruction map, in which 'learning' (a retained concept) moved down the hierarchical levels as taking place as a result of various music-making activities, including those of a collaborative nature. Reflection and planning proved recurring themes in her contributions to the forum discussions also, with her acknowledging that 'observing and planning are the areas that I am really concentrating on at the moment' (Student C, CPMM online forums, 17 February 2018).

The pre- and post-instruction concept maps of another student showed a lack of ability to integrate newly acquired experiences with existing cognitive structures. The pre-instruction concept map showed a lack of complexity and poor linkage between related concepts; the post-instruction map retained all but one concept (17) and added a further 22 concepts, 6 of which were not present in the word bank provided. Both maps displayed a combination of spoke and chain structures with occasional cross-linking, albeit with propositions that failed to adequately identify relationships between linked concepts. The results extracted from analysis of the maps were further corroborated by a lack of adequate engagement in the asynchronous forum discussions.

Qualitative analysis of pre- and post-instruction concept maps showed an overall positive change in 89% of the students analysed, even if improvements were not always evident among the four constructs that were evaluated: concept richness, linkage, propositions, and hierarchy and structure. The study showed that the majority of students achieved one of two outcomes: an increased understanding of the complexities surrounding practical music making and identity formation (55%) or a shift in focus or altered perception of how music making impacts upon their artistic identities (34%). A small percentage of participants (11%) failed to meaningfully integrate new knowledge into their existing cognitive structures.

5. Limitations of the study

No correlation between integration of knowledge with established cognitive structures and participants' age or musical culture was evident from the study conducted. However, in order to adequately identify such potential correlation, a larger sample of participants would be required that covers a wider age range, particularly including ages from 18 to 32 (who were not represented in the current sample), and a greater diversity of musical genres and subgenres. In addition, a more in-depth qualitative inquiry into engagement with the course could establish, to a degree, a correlation between participation in the asynchronous forum discussions and concept map development. Finally, expert scoring of the maps by a larger team of assessors, including members from outside the CPMM course team, could reduce the risk of subjective validation.

6. Conclusion

The effectiveness of the asynchronous online discussions in creating a cohesive community of musicians positively impacted the personal practices and perceptions of the CPMM students. The asynchronous nature of the tuition model has enabled a deep level of reflection from the students, which may not have occurred through real-time interactions. However, the conclusions that were extrapolated from the experiences of a small sample of participants are informative but limited. The study highlighted that for a small proportion of students the course did not provide sufficient reflective space to assimilate newly acquired concepts surrounding practical music making and identity formation, and further study needs to be conducted into the underlying causes for this lack of assimilation.

For the purposes of this study, concept mapping proved an effective method of qualitative inquiry. It has laid the foundation for a larger research project into the effectiveness of digital learning technologies in facilitating embodied and experiential learning in disciplines traditionally taught in-person, and deemed unsuitable for delivery in virtual learning environments. In addition, the study goes some way towards the establishment of a framework for the assessment of experiential and reflective learning in performing arts disciplines, such as music, dance and drama.

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Assessments Used in an Open Distance e-Learning Environment to Promote Self-Directed Learning

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Abstract: The low throughput rates for computer programming courses worldwide, especially at the first-year level, have been researched for many years. This has led to research being published on different methods in terms of teaching and/or pedagogy, e-learning, as well as testing and assessments, which can be used for such programming courses. However, implementing these suggested methods in an Open and Distance e-Learning (ODeL) environment poses challenges. The relevance to the themes of this conference and value-added contribution to academic debate of this paper, as well as potential impact on galvanising Open and Distance e-Learning research, will lie in discussing the combination of testing and assessment methods implemented via the Learning Management Systems (LMSs) in a first-year programming course to promote Self-Directed Learning (SDL), in an attempt to improve the throughput rate. The research will further show that the testing and assessments utilised reliably measured the essential theoretical, practical and communicational skills of first-year programming students. Apart from those mentioned otherwise, sub-themes related to researching technology-supported trends in ODeL and stimulating capacity for ODeL research through digital literacy were also considered. In terms of the appropriateness of the research/study method, research paradigm and educational research methodologies used in the ODeL environment, the research was quantitative in nature, and an approach focussing on data analysis was followed. The results in this paper will show what impact the implementation of online teaching, e-learning and these testing and assessment methods had on students' self-directed learning. Experiences and outcomes shared in this paper offer opportunities towards supporting and motivating e-learning teachers and the e-learning community, in general, as well as an opportunity to make decisions on the extent to which they can use the teaching, e-learning and testing and assessment strategies employed in this research in their own settings at their Higher Education Institutions (HEIs). This paper finally represents an effort towards capacity development and capacity-building with regard to mentoring a young and emergent scholar.

Keywords: testing and assessment, computer programming, open distance e-learning, self-directed learning

1. Introduction

This research is based on a first-year introductory programming course presented as part of the Diploma in Information Technology (IT) offered through the University of South Africa (UNISA), which allows students to show that they understand problem statements provided by users from various industries. The students should be able to apply fundamental programming principles and JavaScript in the development of a working program. They should also be able to use web design tools to develop a specific solution to the satisfaction of a client.

Since the first semester of presenting the course in 2010, pass rates have been below 50% of the students, who wrote the examination. This is in line with the challenges faced by Higher Education Institutions (HEIs), related to low throughput rates in first year programming courses, which have been reported in various research studies.

In terms of the influence of supporting and motivating e-learning teachers and comfort-levels when learning to program, Bergin and Reilly (2005, p. 293) noted more than a decade ago that it was well-known in the Computer Science (CS) education "community that students have difficulty with programming courses and this can result in high drop-out and failure rates". Researchers have looked at factors including, but not limited to, mathematical proficiency, programming language, learning styles, teaching styles, as well as intrinsic and extrinsic motivation.

More recently, Vihavainen, Airaksinen and Watson (2014, p. 19) stated that despite decades of research, "no factor to date has been shown to influence programming performance across a range of different teaching" environments. This persistent problem of low throughput prompted the authors of this paper, as e-learning teachers from the College of Science, Engineering and Technology (Goosen & Gouws, 2018), to implement different approaches in terms of relevant and quality IT teaching, e-learning and assessment, and promoting research-based opportunities related to a first-year programming course at an Open and Distance e-Learning (ODeL) institution (Goosen & Van Heerden, 2019).

This paper reports on combining innovative teaching, e-learning and the usage of online assessment, project-based assessment and blogging for assessment approaches towards promoting continued support of self-directed learning and improve throughput rates (Vorster & Goosen, 2017).

The authors furthermore propose answers to the questions of how the effectiveness of combining different types of assessment strategies can be evaluated, and how reliable methods can be identified to assess essential theoretical, practical and communication skills of first-year programming students in an ODeL environment. Assessment strategies utilised with the expectation of dependably enhancing the theoretical, practical and communication skills of first-year programming students are presented.

In line with suggestions made by Lok, McNaught and Young (2016), criterion-referenced and norm-referenced assessment approaches, in terms of compatibility and complementarity for assessment and evaluation in higher education, were followed to measure activity and proficiency on an individual achievement basis, to determine success.

The remainder of this paper will start with a literature review that will focus on various teaching, e-learning and assessment strategies, indicating the current ideas in these fields. The theoretical framework, which positions the paper within the body of knowledge and indicates the underlying principles on which the research is based, follows this. The appropriateness of the research/study method and quantitative research methodology used is discussed, and the data analysis explains how the research problem was investigated. Next, the results are presented, including a brief description of the assessment methods, and the results thereof are provided. In the following section, the results are discussed in depth, with the final section containing conclusions and implications for HEIs, as well as suggestions for further research.

2. Literature review

Goosen (2016) suggested that when selecting the teaching, e-learning and assessment methods for any course, the outcomes, the broader aims of the qualification and the qualities of the graduating student must be kept in mind. Further considerations in this regard are the current qualities and abilities of students, as well as the systems and requirements of the institution (Van Heerden & Van der Merwe, 2017). e-Learning teachers of vocational courses, such as programming, find it difficult to identify appropriate teaching, e-learning and assessment methods, which take the aforementioned into consideration (Goosen & Van Heerden, 2013a), especially in an ODeL environment.

Matthíasdóttir and Arnalds (2015) provided a summary of research related to the teaching, e-learning and assessment of programming courses. The latter authors included traditional teacher-lead classes, intelligent tutor-lead systems, demonstration classes, live and static coding, event-driven pedagogy, and automated assessments. Their research, as with the majority of research in this area, was based on students, who have access to face-to-face teaching (Goosen, 2018). The course used in this research is presented online only, with no face-to-face teaching. The students doing the course do not attend any classes and cannot be assessed practically, as is the case for students attending institutions offering face-to-face tuition (Goosen & Van Heerden, 2013a).

Despite the fact that writing code is viewed as the core ability for programming and IT professionals, an evaluation by Ahmed, Capretz and Campbell (2012) pointed out that there is likewise an additional demand for soft skills in students of software development, requiring aptitudes such as communication, analytical, problem-solving and critical thinking skills. According to Wang, Dong, Li, Zhang and He (2012), the incorporation of these aptitudes in the teaching, e-learning and assessment of programming courses requires a constructivist approach, which enables students to effectively engage with their material on various levels.

In line with what was suggested by Goosen and Van Heerden (2017), the teaching, e-learning and assessment practices developed for the course used in this research thus had to take all these factors into consideration, within the scope, systems and timeframes of an ODeL institution. e-Learning teachers therefore needed to go beyond the horizon of learning programming with educational technologies, to also incorporate the suggestions made by Goosen and Pieterse (2005), with regard to the highs and lows of learning to understand programming.

According to Wiliam (2011), studies in educational evaluation have shown that teaching and e-learning for assessment should not be seen as separate entities but should work in conjunction with each other.

The assessments for the course was thus developed to be part of the teaching and e-learning process. Students are required to work through a piece of theory, watch a short video, where the theory is implemented practically, and then complete the practical exercise, before studying the next piece of theory. On completion of each of the chapters in their prescribed book, they have to complete both theoretical and practical self-assessments, as well as reflect on what they have studied.

In an examination of the consistent programmer hypothesis, Hayes and Offutt (2010) indicated that students are considered to be ‘competent programmers’ when they are able to practically demonstrate their ability to design and develop programs in accordance to specific requirements provided by the user, which are as close to correct as possible. In order to demonstrate their abilities practically, the students need to understand the theoretical concepts, be able to apply the theoretical concepts practically in different environments and be able to communicate with the user (Van Heerden & Van Der Merwe, 2017). The main purpose of the course under investigation is to teach students the basic concepts of writing code using JavaScript, and to convert user problem statements into functioning solutions. This requires students to write code, using the syntax and semantics of the language, check for errors, make corrections, test and then execute their programs.

According to Goosen and Van Heerden (2013b), especially in an ODeL environment, teaching, e-learning and assessment should promote and support self-directed learning. Self-directed learning “refers to the cognitive and self-management procedures learners deploy while attending class, doing assignments, and studying for tests” (Goosen, 2004, p. 38). In the light of the ODeL environment, students do not attend class, but are required to make use of the online support facilities provided to them, such as discussion forums, online meetings and e-tutors.

A hallmark of distance learning, according to West (2011, p. 136), “has been its reliance on learner autonomy, also called independent or” Self-Directed Learning (SDL). A review of “the research on autonomous learning … described two useful frameworks for understanding the complex nature of independent learning”, which posited two dimensions of autonomous Distance Learning (DL): “self-management of pedagogy and self-monitoring of cognition, or metacognition”. Towards a comprehensive model of self-directed learning, and specifically in an adult education environment, Garrison (1997) added motivation as another dimension.

3. Theoretical/conceptual framework

The theoretical framework is mainly based on the different assessment methods used in the Learning Management System (LMS) and the contribution these methods make towards the effective teaching, e-learning and assessment of programming in an ODeL environment (Goosen & Van Heerden, 2015; Van Heerden & Goosen, 2012). The assessment methods are presented, together with the concepts applicable to the environment within which the research takes place, to address online and open distance education environment challenges (Goosen & Van Heerden, 2016). The research also considers how e-learning teachers are using their institutional e-learning management system technologies and tools, for example, vodcasts, for Information and Communication Technology (ICT) education in the cyber world (Goosen & Naidoo, 2014). It also shows how each assessment method is utilized in the course, the uptake of the assessment method, as well as the results achieved by the students. The validity, reliability and authenticity of each of the assessment methods used are then discussed.

The theoretical assessments are completed and submitted online via the LMS. Students receive immediate feedback in the form of a reference to the page in their prescribed book where the correct answer can be located. This happens after they submit their self-assessments.

In a synthesis report on assessment and feedback with technology enhancement, Gilbert, Whitelock and Gale (2011) reported that high-quality statistical evidence is available to support the effectiveness of formative assessment coupled with directed feedback, using technology, which impacts positively on teaching and e-learning. The students can complete the theoretical self-assessments as many times as they choose and will receive a different set of questions on each attempt. These self-assessments assist the students in their preparation for their formative and summative assessments.

In terms of the implementation and assessment of project-based learning in a flexible environment, and as also described by Doppelt (2003), the practical self-assessments require students to complete simulated user requests, for which they need to design and develop solutions. The suggested solutions to these simulations are provided to the students and they can compare their answers to it. The practical self-assessments assist the students in their preparation for their formative assessment project.

According to Havenga (2015), Project-Based Learning (PBL) in higher education is ideally suited to assessment for learning in programming courses using the constructivist approach, since programming students actively participate, explore, learn by doing, implement their learning and solve real or simulated problems towards the development of self-directedness. In an environment where students need to move from theory to reality, Hung (2011, p. 530) explained a few issues in terms of the implementation of problem-based learning, which were pointed out when several "meta-analyses examined the effect of PBL on various aspects of students' learning outcomes, such as domain knowledge acquisition," group processing, problem-solving skills, self-directed learning "and social and psychological soft skills."

With regard to possibilities for keeping ICT education relevant, as described by Goosen and Van der Merwe (2017), ICT undergraduate studies normally concentrate on teaching students about various technologies and programming languages, but they provide little to no skills with regard to communicating in discipline-specific language. Similar to when He, Maly, Wu and Xu (2015) used a scaffolding-based blogging approach to improve IT and CS undergraduate students' disciplinary writing skills, ICT students should be able to write reports, technical materials, user manuals and, in general, communicate their ideas using disciplinary language.

Improving a student's ability to communicate in disciplinary language, especially if it is not their first language of communication, is important to the student's overall success. For this reason, students doing the course are required to reflect on what they have studied by writing a blog for each of the chapters studied as part of their formative assessment. In their article on the use of knowledge blogs in programming courses, Van Heerden and Van der Merwe (2014, p. 189) found "knowledge blogging to be a constructive learning tool in a programming environment since it promotes metacognition and differentiated instruction by nurturing multiple learning skills."

Whether a course is presented face-to-face, blended or online, there are three major considerations to take into account when conducting any form of assessment. Gikandi, Morrow and Davis (2011) identified these fundamental issues of assessment as validity, reliability and dishonesty. The latter auhtors stated that the validity of an assessment, especially in an online environment, is categorized by the authenticity of assessment activities, effective formative feedback, multidimensional perspectives, and learner support. Reliability within the environment of online formative assessment can be characterised by opportunities for documenting and monitoring evidence of learning, multiple sources of evidence of learning and explicit clarity of learning goals and shared meaning of rubrics. Gikandi, et al. (2011, p. 2340) further indicated that the issue of dishonesty "is closely related to the issues of validity and reliability. This implies that within the" environment "of online formative assessment, aspects of dishonesty can be addressed by enhancing validity and reliability." In the ODeL environment, it is challenging to verify the real identity of students, thus ensuring the work being submitted was actually completed by the student submitting it.

4. Methodology

4.1 Method

The appropriateness of the research/study method discussed in this paper is mostly focused on the criterion-referenced approach (Lok, et al., 2016). The results of this paper are based on the discussion of quantitative data gathered from the university systems.

The quantitative design for the study was appropriate, because the research involved analysing variables to gauge the strength of a relationship between these. The study compared student uptake of different assessment methods and the results of their assessments to determine whether there was an improvement in their e-learning, and whether the assessment methods were valid, reliable and authentic.

While both Matthíasdóttir and Arnalds (2015) and Van Heerden and Van der Merwe (2017) used case studies, the latter authors (Van Heerden & Van der Merwe, 2017) specifically did so in the environment of open and distance e-learning.

4.2 Research questions

Two research questions guided this study – How can:

- the effectiveness of combining different types of assessment strategies be evaluated to improve self-directed learning?
- reliable methods be identified to assess essential theoretical, practical and communicational skills of first-year programming students?

4.3 Population

The target population for this study was restricted to students registered for the course 'Introduction to Interactive Programming' (N=1720). The study took place during the first and second semesters of 2016 and 2017.

4.4 Data collection

The data presented in this paper was extracted from the UNISA institutional database and included the results for the seven formative assessments students were required to submit. The number of formative assessment submissions was also extracted. Following a cross-case analysis of three case studies on online collaborative learning for healthcare continuing professional development by Sandars, Langlois and Waterman (2007), observations were made by viewing data patterns available, with a single statistical procedure implemented.

The constrained quantitative confirmation exhibited was extracted from the institutional database. The researchers explored insights mirroring the uptake of the assessment tools utilised as a part of the course, and in addition, marks granted in the formative assessments.

4.5 Ethics

Ethical clearance for the study was obtained from the relevant board (055/DVH/CSET/SOC).

5. Results

5.1 Uptake of multiple-choice formative assessments

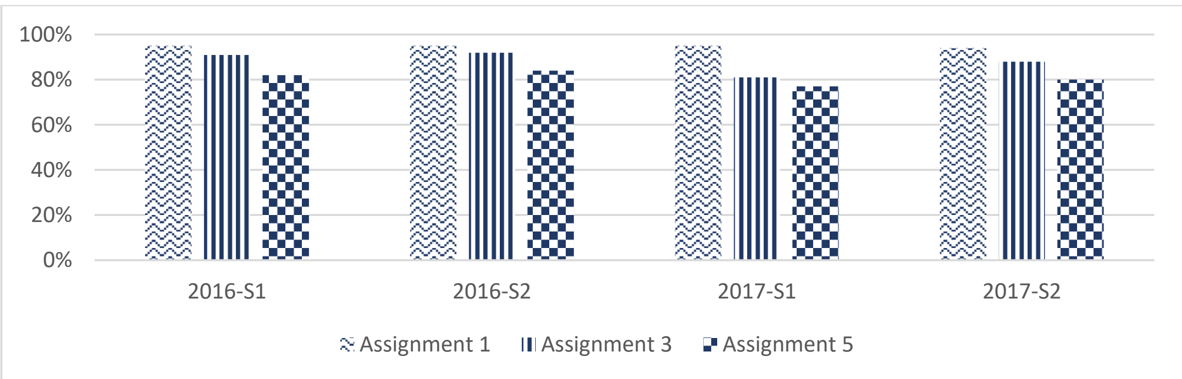

Figure 1: Uptake multiple-choice assessments

The multiple-choice formative assessment consists of 25 questions from three chapters in the prescribed book. It may be completed twice, with a new set of questions on the second attempt, and the highest score between the two attempts is used as the final mark for the assessment.

Similar to what was reported in Goosen and Van Heerden (2018), the uptake of multiple-choice formative assessments in Figure 1 indicated a steady decline across assignments as each semester progressed, across all four semesters.

5.2 Uptake of blog assessments

For formative blog assessments, students are required to critically reflect on both the theoretical and practical aspects of what they have studied. Their posts must be a personal reflection, not a summary, of three chapters at a time. The minimum requirement is 600 words (200 words per chapter) per post. Students are also required to read and comment on at least three of their fellow student's posts as part of the assessment. The formative blog assessments contribute 25% towards the students' predicate mark.

Similar to the uptake of the multiple-choice assessments, Figure 2 shows that the uptake of the blog assessments steadily declines as each semester progresses for all four semesters. The uptake of the blog assignments is also lower, compared to those for the multiple-choice assignments.

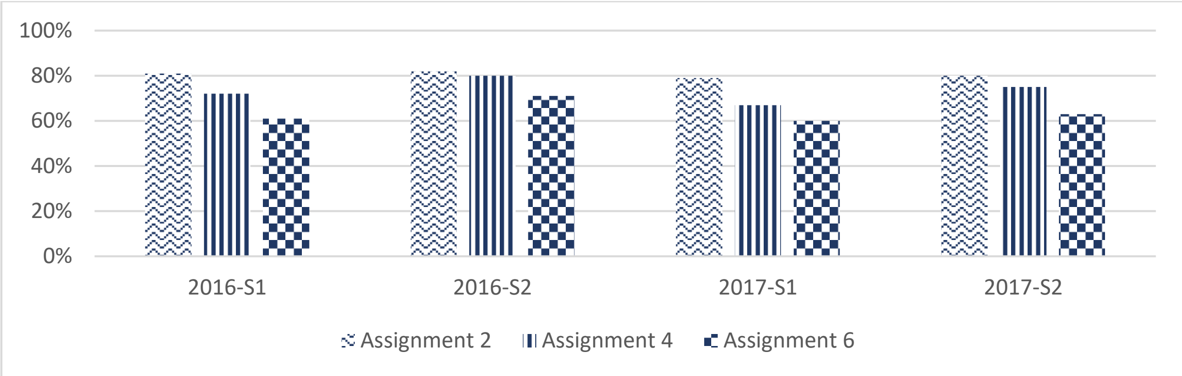

Figure 2: Uptake blog assessments

5.3 Uptake of project-based assessment

The project-based assessment varies from semester to semester to allow students to experience the development of site pages in a real-life situation. Students need to contact a business, school or organization in their community and obtain their permission to develop three interactive web pages using their information and images. Specific requirements are given to the students, in the form of a rubric, regarding what will be assessed in their project.

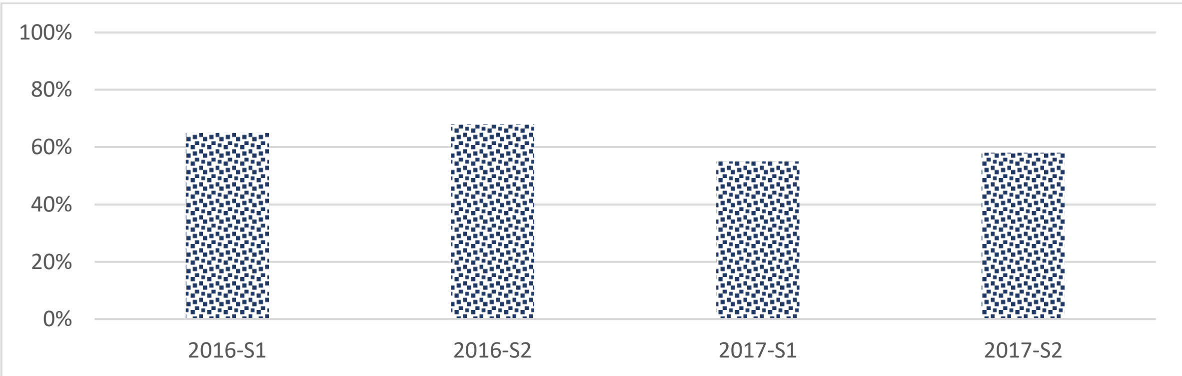

Figure 3: Uptake project-based assessment

Figure 3 shows that the uptake of the project-based assessments was consistently lower than the other two forms of assessment, for all four of the semesters.

5.4 Multiple-choice assessment results

Figure 4 shows that the results for the multiple-choice assessments are consistently lower in each of the semesters, with an increase in the third multiple-choice assignment results.

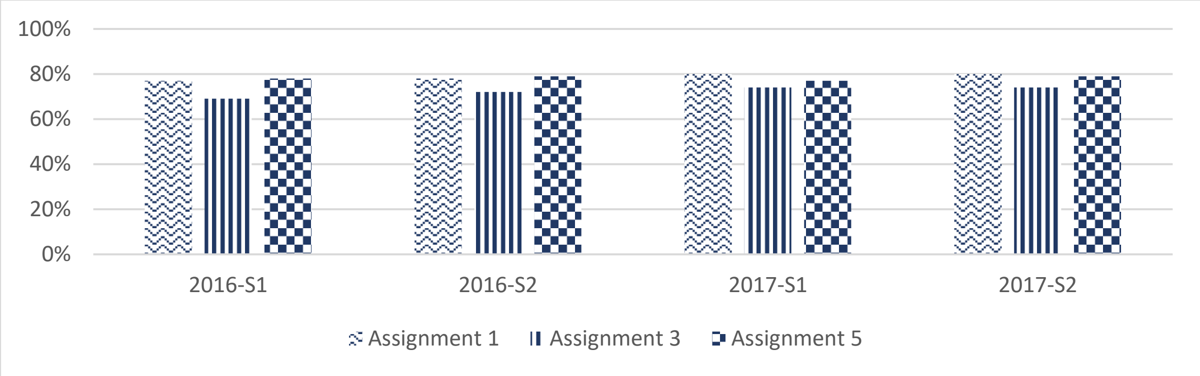

Figure 4: Multiple-Choice assessment results

5.5 Blog assessment results

Figure 5 shows a slight increase throughout each semester for the results of the blog assessments.

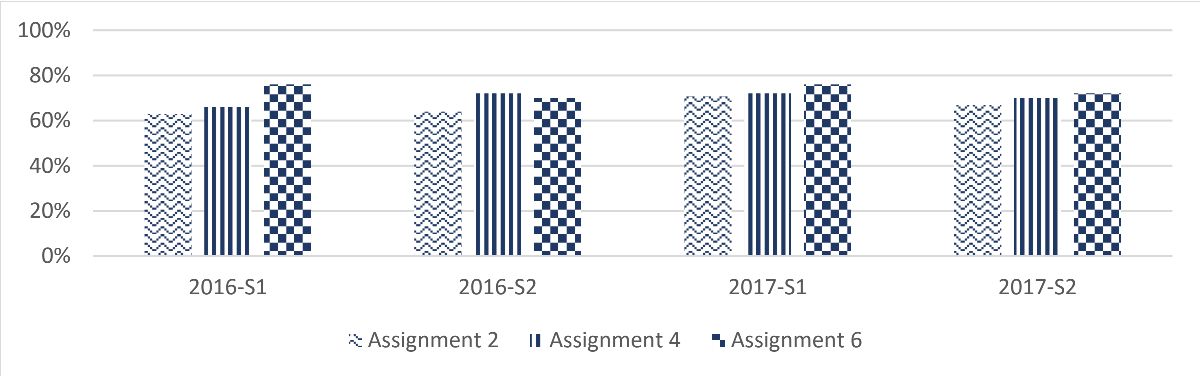

Figure 5: Blog assessment results

5.6 Project-based assessment results

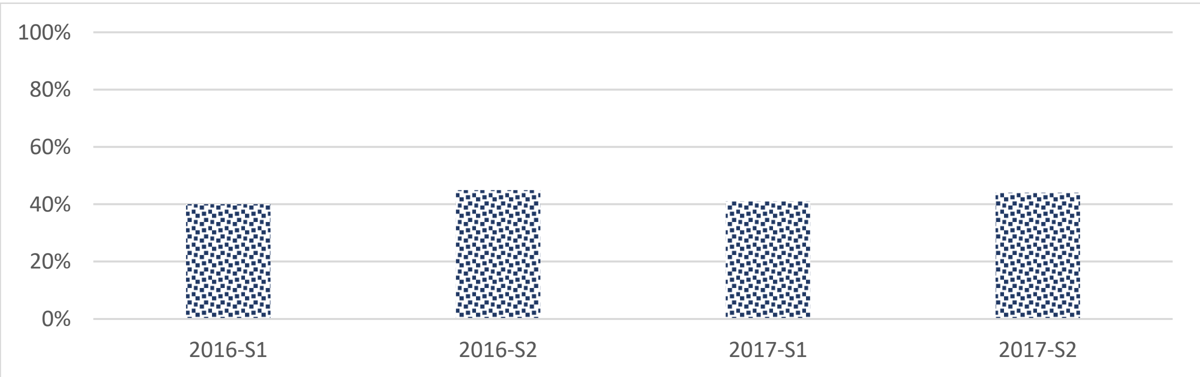

Figure 6: Project-Based assessment results

Figure 6 shows that the results for the project-based assessments were very low, especially when compared to the results for the multiple-choice and blog assessments.

6. Discussion

6.1 Multiple-choice assessment

Merrel, Cirillo, Schwartz and Webb (2015) studied multiple-choice testing using immediate feedback-assessment technique forms, and specifically compared second-chance guessing to second-chance learning. According to the latter authors (Merrel, et al., 2015), to lead students into becoming self-directed learners, they must be able to monitor and adjust the way they learn. The multiple-choice assessment is preceded by several self-assessments consisting of multiple-choice, true-or-false and fill in the missing word questions, which students may complete as many times as they wish, in order to prepare for the formative assessment. Similar to the formative assessment, they receive immediate feedback on submission with reference to the page in the prescribed book for incorrect answers. This should allow for monitoring and adjusting the way they learn the theoretical concepts. In their model and seven principles of good feedback practice with regard to formative assessment and self-regulated learning, Nicol and MacFarlane-Dick (2006) pointed out that the fact that the feedback is not merely the correct answer, is part of the teaching and learning strategy to improve self-directed learning.

The decline in the submission of the multiple-choice assessments are concerning to the researchers, and further investigations are underway to determine the reason for this. Although the second multiple-choice assignment results are consistently lower in each of the semesters, the results remain stable and are significantly higher than one would expect if students were merely guessing the answers.

Using the online assessment tool for multiple-choice formative assessments provides a level of validity and reliability to the formative assessments, as each student's formative assessment is individually created from the database of questions; students thus cannot copy answers from each other. Because of the immediate feedback students receive, eliminating turnaround time in the ODeL environment, more assessments can be done; this helps the student to keep to the study schedule set.

6.2 Blog assessment

As also detailed by Fierke, Bastianelli, Vogelsang, Tornabene and Lepp (2016) in relation to enhancing an international experience for students through reflective writing exercises and self-directed learning, students were required to articulate what they gained, found interesting or challenging from studying both the theoretical and practical work in a chapter, thus leading them into self-directed learning. Feedback on the blog assignments included both peer-review feedback and teacher feedback, encouraging dialogue around learning (Nicol and MacFarlane-Dick, 2006).

Similar to the decline in the submission of multiple-choice assessments, the decline in the submission of the blog assessments is under investigation. The increase in the results of the blog assessments shows that the students adapt their posts as they become more self-directed.

Because no two students can have similar reflections on what they studied, the blog formative assessments have high validity and reliability, which is extremely important in an ODeL environment.

6.3 Project-based assessment

Goosen and Van Heerden (2013a) previously showed that project-based assessment influenced the pass rates in an ICT course.

As this assessment contributed 50% towards the student's predicate, it would be expected that the uptake would be very high. Submission rates for this assessment are consistently lower than 70% and well below the submission rates of the multiple-choice and blog assessments. The results of the project-based assessment are consistently below 50%; this is an indication that there is a disconnect between students' theoretical foundations and practical implementation of the theory (Van Heerden & Van Der Merwe, 2017).

To ensure the validity and reliability of the project-based formative assessment when educating in the changing environment of ICTs, as detailed by Goosen and Breedt (2012), the requirement is changed every semester, from developing a website for a business, to a school or an organization within their community. The basic requirements, however, stay the same; students just need to apply these to a different environment. It is also not possible for two students to write the exact same code as a solution to the assessment, as no two programmers code alike, thus further ensuring the validity, authenticity and reliability of the assessment.

7. In conclusion

In terms of originality, we believe that the intention of this paper has been achieved: to make a contribution to academic debate in the field of expertise, towards discussions on self-directed learning and reliably measuring essential theoretical, practical and communicational skills of first-year programming students of an IT course in an ODeL environment. The standard and depth, as shown by original research, also takes the paper beyond the horizon of merely the teaching, e-learning and assessment of programming with educational technologies (Goosen & Van Heerden, 2017).

The purpose was to answer questions on whether the effectiveness of combining different types of assessment strategies can be evaluated to improve self-directed learning, and whether reliable methods can be identified to assess essential theoretical, practical and communicational skills of first-year programming students. Through our research, we have shown that different assessment methods can be used to improve self-directed learning and that these assessment methods are reliable, valid and authentic. e-Learning teachers and the general e-learning community should be able to make decisions on how they can use the teaching, e-learning and assessment strategies employed in this research in their own settings.

As researchers, we have also learnt from previous research: firstly, as stated by Van Heerden and Van der Merwe (2017: 7772), "one should be careful to not view the pass rate achieved as the sole indicator of" a particular course's failure or success. We were also encouraged to identify the factors that impact the uptake of the assessments, as well as the results of the project-based assessment.

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How can Flipped Classroom Activities Support Teacher Motivation?

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Abstract: This paper proposes an alternative way of engaging the students. Instead of written assignments, the students are to hand in Podcasts or recordings of a selected topic in groups of up to 3 persons. The podcasts and recordings will be available to the class after a process of feedback from a peer group and the lecturer. In this way, it is possible to utilize the curriculum to co-create in groups, to share knowledge and to support critical thinking and critical reflection. There will be rules as to what the peer group is to comment on and the way they will offer their comments. As the course in question is an e-learning course in "Digital Work Forms in Organizations" at the Inland Norway University of Applied Sciences, the digitalization of the assignment is regarded as appropriate. The peer evaluation will support the teacher in the way that it will prepare the work for the teacher and thus contribute to reduce the workload, as well as the finished assignment is a shared product that will support and enhance the course content. The students will also benefit from this as they are provided with an opportunity of meta learning from the assignment and peer-reviewing. Another important aspect to support the teacher motivation is to have time to reflect and this will provide the teacher with a tool for continuous improvement of the curriculum. This will also represent an opportunity for the teacher to get different aspects and thus learn from the students. It will require establishing a culture for knowledge sharing amongst students and amongst students and teacher(s). Hence, the teacher's role will be to empower students to reflect and think critically, and to support continuous learning for the students and the teacher(s).

Keywords: content co-creation, motivation, e-learning, teacher motivation, critical reflection

1. Introduction

Students attending higher education is a diverse (heterogeneous) group. Some students are full time students, some are part time students with a job either full time or part time. At the Inland Norway University of Applied Sciences we offer study programs for both full time and part time students. However, if they are attending the same course they need to have the same requirements, the same mandatory assignments and the same exam. The "adjustment" is thus the lectures. The full time students have 3 hour lessons each week. The part time students have full day (6 hours) five times each semester.

We use a Learning Management System called Canvas where they need to be handing in their assignments and where they find articles and other relevant sources tied to the curriculum. This is also where they can communicate with each other and the lecturer.

In the past years we have implemented "Flipped Classroom" (Carbaugh, Doubet, & Tomlinson, 2016; Fezile & Gulsum, 2016; Nematollahi, St John, & Adamas-Rappaport, 2015; T Vold, 2014; T. Vold, Braun, & Lundesgaard, 2016) as a way of getting the students more engaged in the courses. The students have access to streaming video of most of the curriculum. In the classroom only "high lights" are presented. The rest of the "lecture time" we use on task solving, discussions and reflections. In this way it is possible to get feedback and viewpoints from the students, which provide an opportunity of learning for the lecturer as well.

Our campus have a course called "Digital Workforms in Organizations". In the spring semester of 2019 we tested out using a digital tool for communication for the mandatory assignment. The students were to communicate over a specific task using written digital communication. The reasoning behind this assignment was to make the students express themselves in writing as well as mimic a work like setting. They were to come to an agreement regarding an issue and they were "physically" "located" at three different locations in Norway. We hoped that this would spark the imagination and would challenge the lecturers regarding correcting the assignments, and thus support the teacher motivation.

This paper present the results from observations and group interviews made during and after the assignment in both the on campus courses and the online course. Even if we in the following discuss "teaching" we mean both "on campus" – and "online" - teaching. Our main focus have been to get feedback on how they perceived a practical approach to the mandatory assignment, how they perceived to write a reflection note, and a focus on how to develop assignments in the future. We thus also propose an alternative assignment type and the reasoning for this approach. The objective is to support student activity, spur motivation, and enhance reflection skills, all in order to enhance the learning outcome for the students. It also represents an opportunity of expanding the "flipped classroom" concept and provide the lecturer with a stronger tool for the teacher regarding support for the students to become reflective practitioners.

2. Theoretical backdrop

Teachers that feel that they master their job and manage to teach students their subject are also feeling motivated. Doing a search in Oria (our university chosen tool for academic searches) for "motivation" and "education" provide over 500 000 hits and by going through the approximately 100 first of these, they are all about motivating *students*, not teachers. When searching for "motivation" and "teacher" there are about 160 000 hits, still some of them about how teachers can motivate students. This is also confirmed by Butler (2012) who has focussed her research on developing the "achievement goal theory". This is mainly about looking at how to master the task and have goals for the mastery as well as goals for the performance. This is tied to goal orientations and avoidance states (Pintrich, 2000). It is not only about how to perform and master, but also about to avoid not to master.

Jang et al. (2015) also describe motivation. They describe six motivation factors; Attitude, Interest, Value, Self-Efficacy, Self Concept and Goal. Although the article is about students' motivation to read, the same may apply to teaching and teachers. This is about attitude towards the task of teaching, an interest in teaching, feeling that teaching is important, feeling that one master the "art" of teaching, the way the teacher sees himself/herself as a teacher tied to the individual identity.

Flipped Classroom is a concept that allows the students to be more active and take a more active part in the education (Colorado, 2012; Fezile & Gulsum, 2016; Lewis, Chen, & Relan, 2018; A. T. Vold et al., 2017; T Vold, 2014). The students are to prepare in beforehand for lectures by watching streaming video and/or other material available, like for example short articles or news-themes. That allows for more in depth discussions and the opportunity of exploring the subject in a different way. Making students contributing into the lectures with their own material, support adult learning theories. All of our students are 18 years old or older and quite a few of them have work experience. For many of our students, education is about understanding mechanisms at work, and to learn how and what to contribute with at work. This may be about organizational change, training programs, preparedness planning, etc. Adult learning is about including and involving students in their learning process (Knowles, 1970, 1984, 1990). Letting the students use their backgrounds to share their knowledge and utilize this knowledge to build new knowledge does not only allow the students to learn, but the lecturer also have an opportunity to learn from their students. The lecturer becomes a facilitator but will still need to be the one "in charge" and also provide advising. One goes from an asymmetrical to a more symmetrical relationship between the student and lecturer. This change in role perception may influence how the teacher sees him/her-self. Lecturers that has little experience in teaching would probably benefit from being together with a more experienced lecturer as this shift in role perception may be difficult to handle. It definitely require an in depth knowledge of the curriculum and be able to respond to different questions regarding the course content. Also, the student should perceive the teacher as an "authority" and not discard the teachers knowledge as "we can look this up in Google". Raelin (2012) describes this change in the roles of company managers. It is more about facilitating through dialogue rather than deciding for them what they are to do.

This way of doing education also support the students in becoming reflective practitioners (Schön, 1987, 1991). The lecturer need to facilitate for reflecting and establish a culture for reflection. It`s impossible to decide upon a culture for reflection. Hence, it requires a lot of work to develop a culture for reflection. Planning, concrete actions and systematic work is necessary. An important aspect in this work is establishing a psychological safety in order to prepare for the individual to be able to speak freely also on matters that are uncomfortable (Edmondson, 2019). It is also important to utilize the student input and backgrounds in the classroom. It is also possible to adapt the mandatory assignments to include reflection, much like reflective journals (Bassot, 2013; Moon, 2004, 2006).

Critical reflection (Askeland, 2006) also aids the process for the students to reflect as they are encouraged to explore backgrounds that they bring into their education. Critical in this sense is not about being negative or commenting, it is about finding cause-effect connections. E.g. can a student studying "digital work forms in organizations" present what they use of digital tools and how this is perceived in the organization. If they are not content with the tools, what can be the reason for this? Can it be the introduction of tools? Is there something concerning the decision making process? Critical reflection will help teacher to help the students to be more critically reflective.

This also resembles what Kaplan (2003) provide as a checklist of advocacy in the classroom, where she suggests In what ways have I defined the objectives and the pathway to attain these?

- How have I assessed the background knowledge of the individuals I want to "teach" to support this idea? What information in their background can I use to facilitate the acquisition of the new material I want them to learn?
- How can I help the individuals I want to support these ideas to reflect or monitor their own thinking and behaviour so they can be successful advocates on behalf of the gifted?
- How have I included in my presentation the need to transfer the information communicated to other situations and programs? (Kaplan, 2003)

To this, we would like to add that that to facilitate for a culture that accepts making mistakes, and promote learning from mistakes, would be beneficial for the learning outcome.

This sums up the facilitative role and addresses the adult learning principles as well as it prepares for reflection and social constructivist learning (Vygotsky, 1978).

3. Method of inquiry

We collected our data through observations and through semi-structured interviews with groups (Denzin & Lincoln, 2005; DiCicco-Bloom & Crabtree, 2006; Merriam, 2015). A total of 105 full time students, 105 part time students and 162 online students took part in the courses this spring. We have discussed the assignments during lectures in the different classes. This qualitative approach has been necessary to seek out the nuances and the feedback in order to proceed with developing new assignments. They were also to write a reflection note in their mandatory assignment, and we have categorized the statements from these into a few generic statements.

4. Results and discussion

4.1 Feedback from students

The general feedback in the beginning – when we handed out the assignment - the students were not at all happy with this "practical approach" to the assignments. They were frustrated and did not see the point of doing this "artificial exercise". They even asked their representative to address the matter with us lecturers.

As we had our backs clear regarding learning objectives with the task and could show how the assignment met the learning objectives of the course, they later dropped the complaint. This show also that it is important to be clear about expectancies. If they know what to expect, they are less likely to complain.

There were "endless" masses of emails and messages in Canvas asking how to go about this and which tool they should use, etc., even though specified in the assignment.

Despites the negative feedback and general negativity towards the task, the assignments way exceeded our expectations. They had really worked hard and followed our instructions. The part of the assignments where there were some different approaches, were the reflection notes. Many students had handed in very good and reflective responses. Statements like: "I was first hesitant towards having to reflect, but as it was a part of the assignment, I felt I had to do it. Looking back on this experience, it has contributed towards my learning outcome. We should be "forced" to reflect in all our courses" and "I was surprised over how much writing a reflection note gave me regarding understanding what I have learned", show that they may not have been accustomed to reflecting and be fully aware of the effect of reflection with regards to supporting the learning outcome.

Most of the students restrained themselves from putting their aversions in the assignment, and were quite reflective and showed a high academic level. This was quite surprising as they were not only very good, but also added comments about how important this particular part was for their learning and some even added that this should be a requirement in other courses. Comments from the assignments that support this observation are:

"At first we struggled with the assignment, but when we agreed on how to go about it, we understood the purpose of the assignment" and "It seemed difficult at first, but we decided on just doing it and then we realized that there are people actually working like this".

Several students also wanted to hand in the assignment on their own and not cooperate with other students. This was came up several times although the lecturers had explained the value of working and learning in teams (Joseph A. Raelin, 2006).

4.2 Lecturers reflection notes

Looking back at our own reflection notes as teachers, we notice a "bumpy ride". It starts out quite well and the students describe our first lectures positively. The students are active in all classes, both online and on campus. There are clear evidences of mastery and positive attitude. The notes from developing the mandatory assignment show a desire to be a bit "bold" and go "beyond" the ordinary assignments that are generally to either respond to a case or to answer questions from the textbook or other curriculum. We "wanted to make the students do something practical, something that they may experience in organizations that has branches in different parts of the country or even abroad" (excerpt from Vold's reflection notes). We also wanted to "make the students reflect upon their learning process" and the best way to do this was to make it as a part of the mandatory assignment. This may refer to the motivation factors self-efficacy and self-concept that Jang et al. (2015) point out. Self-efficacy refers here to the belief in the ability to develop an interesting task, and self-concept refers to our perception as teachers and that we were confident about being able teachers.

However, the students did not interpret the course description as having to do something practical. They were used to "ordinary" written assignments where they use the textbooks to answer the assignments. We needed to address this mismatch. This can to an extent be related to Habermas and his requirements for a discourse (Flyvbjerg, 2001). To be able to respect each other's roles in a relationship between student and teacher is important, as well as it is important to level the relationship and acknowledge the student as a customer and thus an equal partner. To show that neither the students nor the lecturer has a hidden agenda and that both parties are open and transparent towards each other prepares the ground for a best possible communication (Flyvbjerg, 2001).

The teachers' reflection notes also show a down period where the motivation is low. The lecturer had three different student groups to cater for. From all the different student groups came constant comments on the mandatory assignment. At one point, the motivation was so low that reading and commenting on the assignments were postponed with the result of new emails from students asking about the results. This did not – according to the reflection notes – contribute positively to the situation or motivation. However, the reflection notes also points out that it is "very relieving to be two lecturers tied to the course". Even if Vold is the responsible for the course, Ranglund was also a contributor/lecturer and it is expressed clearly that the value of not being alone has contributed positively towards picking up courage and motivation. This may relate to being a part of a Community of Practice (Lave & Wenger, 1991). We could have avoided this by presenting an "ordinary" assignment as described in Pintrich (2000).

In this work we have reflected in the light of Gadamer (2010). According to Gadamer, it is very important to both listen and ask questions. In his book "Truth and Method", Hans-Georg Gadamer claims that we need to deepen our understanding of the nature of the question. We make no experiences without actively asking. When we acknowledge that a case is different to what we first assumed, we must apparently have asked ourselves if it is like this or like that (Gadamer, 2010, p. 326). It is in other words via questions we can revise our understanding. It is the *question* that is the basis and lead to the recognition of that a case seems different than we first thought, and this gives the question precedence. It is through the answers to our questions that the preconditions for our preconceptions and our biases are tested. Through dialogue with questions and answers, one must articulate and take up ones theme again for reflecting about one's own preconceptions and prejudices, something that may revise our understanding (Gadamer, 2010). This thinking shows us that both lecturers and students horizons have changed. After the course we think differently than before. In many ways, we have determined the questions, and that is the road to knowing, according to Gadamer (2010).

The exam was a semester assignment and the students were allowed to forward suggestions towards what it should contain, and their comments should be based on what they found contributing towards learning from working on an exam. Some input were forwarded and in the development of the exam, we considered the suggestions. In the reflection notes, we find a comment about “we expected more input from students, but some is better than none”. This suggest that we were somewhat disappointed, which lowered the motivation somewhat. This can be explained by the sense of lack of ability to establish a dialogue that has a desired outcome (J. A. Raelin, 2012). This “exercise” of bottom up rather than top down with regards to the exams, did not succeed as hoped for. However, this may be due to a still perceived inequality in the roles (Flyvbjerg, 2001) and also that they have an expectancy of the teacher role to be the one who decides upon the exam, and also that this should be a “big secret” until the day of the exam. This is a paradox as students generally do literally anything to disclose how an exam will be.

The students had their exam and since this was a new course, an external sensor marked all of the exams. The results were exceptional and the sensor commented on the high standard. This is noted in the reflection notes, as this contributed very positively to the motivation. This meant that also in other lecturers’ standards we had done a decent job trying to learn our students something. This ties well in with what Pintrich (2000) points out with regards to motivation being linked to respect from other peers. It also gives a sense of filling Kaplan’s (2003) checklist for advocacy in the classroom (both online and on campus).

The total experience, although giving us a hard time motivational wise, has not been very devastating and we still have a certain sense of motivation for developing a new task that will support the students.

5. The new task

We bring our experiences from the previous task into the developing of the new task. The new assignment will be to produce a podcast on a chosen subject. They are to work in groups of three and choose one of 10-12 subjects from the curriculum. They can use their mobile phones to record. The podcast must have the form of a podcast and be between 3 to 5 minutes long. They need to present the subject, discuss the subject –preferably give examples – and sum up. They will also need to provide a report that they hand in. The report may be the manuscript for the podcast. The report should also include a reflection note. As we writes this paper, we still have not decided on whether or not the students are to comment on each other’s podcasts.

The reasoning for asking the students to prepare a podcast is that to prepare curriculum to present to others require a different approach than “just” reply to an assignment. To choose the subject support the idea of including the student in the learning process (Carbaugh et al., 2016; A. T. Vold et al., 2017; T. Vold et al., 2016), and the reflection journal support the students in becoming reflective practitioners (Schön, 1987). Allowing for student peer review of the podcast also mean sharing knowledge through the podcasts and will, in addition to working in groups, support social constructivist learning (Vygotsky, 1978).

6. Conclusion

We still have belief in our ability to teach and we identify ourselves as lecturers. We still also feel that the flipped classroom, although challenging, is the better way of educating students. Learning from experience, learning from and with each other, and learning from students are all motivating factors that contribute towards defining us as lecturers. We feel challenged by the “flipped classroom” concept but in a positive way. It makes us be clearer about who we are as lecturers, our pedagogical skills, and our knowledge.

6.1 Further research

We need to investigate further how the “flipped classroom” effect teachers and students. In this paper, we have used our own experiences, and we need to interview other lecturers using the “flipped classroom” as method in their courses. Also, we need to do in depth interviews with students as well as follow up with group interviews. We will continue writing reflective notes from the lecturing, and will encourage our colleagues to do the same in order to collect more data for a more extensive research project.

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Cross-Location and Cross-Disciplinary Collaborative Prototyping Using Virtual Reality in Higher Education

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Abstract: The integration of virtual reality (VR) in education, particularly for collaborative activities and feedback, is recently trending with the continuous development of technologies. So, this paper reports a pilot study as part of an ongoing E-learning project to address the questions: 1. how can tertiary education design courses adopt VR systems in student projects in collaboration with external organizations, and 2. what are the perceptions of the students and external organization regarding the use of VR systems for cross-discipline and cross-location collaborative prototyping? The process of VR use for the learning activities are grouped into four categories: 1) introduction of basic features of VR tools (two hours), 2) self-learning/experiencing the tools — HTC Vive headsets with Masterpiece VR, SculptrVR, Google Blocks, and Sketchbox (15-20 hours), 3) co-creating design objects by adopting the selected VR tools — ScuptrVR and Google Blocks (two to four hours), and 4) presentation and get feedback in live VR space — Sketchbox with import models (2X30 min). The students responded that, for the collaborated project with a company based in another city, the VR setup is a great tool for demonstrating 3D models of the designed objects. It shows the detailed view of a product or a concept, it creates useful space for creativity, and it saves time. On the contrary, the technology is still in the early phase for the modelling purpose, still too cartoonish, lacks functions for engineering design, and gives a dizzy feeling. This study involved collocated student teams of engineers and future study should include students of different study programs and campuses working for the same client as part their respective courses.

Keywords: virtual reality, blended learning, prototyping, collaborative learning, designs for movement

1. Introduction

Virtual Reality (VR) systems are one of the emerging technologies that significantly advanced the product and service design process and have gained attention in the fields of e-learning (Zhu, 2016) and interaction design (Razek et al., 2018; Wolf et al., 2017). The integration of VR in the design courses of higher education involves the following decision factors: selecting economically feasible hardware and software that enables desired activities, testing and selecting the software for collaborative design by a collocated team, and selecting and connecting non-collocated VR systems for interactive design or at least presentation and discussion with the clients and end-users for feedback on the design or prototype in the 3D space. Moreover, the adoption of the VR systems for *authentic learning* (Lombardi, 2007) experience requires working on a real-world problem situated in the context of a public or private entity, who is the client and the students' project group is the design team. The involvement of the client from a remote VR setup with the collocated design team at the university and coordination of the industry-academia collaboration for prototyping involves additional factors.

In higher education, the design and engineering education programs have integrated VR as a tool for their students' design and development projects. The health education and training programs have integrated VR and augmented reality (AR) as the environment for learning. The integration of VR in education is observed primarily in the developed countries because VR equipment is expensive, requires a high-configuration computer, dedicated space for reduced setup and troubleshooting time, and shorter obsolescence period due to the arrival of newer versions in the competitive market. The selection of hardware and software for the collaborative design activities in the project-oriented and problem-based learning (PoPBL) of design courses cannot be immediately answered based on academic literature and online discussion forum. So, this study raised two research questions with the goal of sharing the pedagogical design and experience of selecting and integrating VR systems as a prototyping tool for collaborative design and prototyping as part of an undergraduate engineering course.

- 1. How can tertiary education design courses integrate VR systems in student projects in collaboration with external organizations?
- 2. What are the perceptions of the students and external organization regarding the use of VR systems for cross-discipline and cross-location collaborative design and prototyping?

The answers to the first research question involves the following (as elaborated in section three of the paper):

- the selection and installation of VR systems at two locations,
- collaborating with external organization,
- facilitating the course activities for students to learn VR systems and to work on the problem and scope in collaboration with the external organization,
- and facilitating the VR-mediated collaborative prototyping and feedback activities with the stakeholders of the external organization.

The second research question is addressed by reporting (as presented in section four) the students' responses to an open-ended questionnaire survey and a narrative based on an interview with the course projects' stakeholder from the external organization.

2. State-of-the-art: Review of literature and virtual reality in education

VR has been used for remote education (Potkonjak et al., 2016). Potkonjak *et al.* (2016) reviewed virtual laboratories for education in science, technology, and engineering. The authors summarized the advantages and drawbacks of virtual laboratories. The advantages are benefit of savings, flexibility, multiple access, damage resistance, and making the "unseen" seen. The problems include the requirement of computer resources for dynamic modelling, the created side-effect attitudes such as lack of seriousness, responsibility, and carefulness, and the requirement of hands-on experience with real equipment in the final stage of training. Lau and Lee (2015) did an empirical study with eight students to investigate how virtual stimulation can motivate students exploring creative ideas. They found positive impacts of VR that a heuristic and highly interactive simulated virtual environment can enhance students' learning experiences. Häkkilä et al. (2018) introduced the VR tools to industrial design students at University of Lapland in Finland, presented three cases from the course, and concluded that "rather than each student being in their own individual virtual world, we believe solutions should aim towards a common virtual environment"(Häkkilä et al., 2018, p. 9). The software packages Blender and Google Tilt Brush were used for 3D modelling and visualizations, models were imported to Unity 3D software environment, and 3D printed the models. Freina and Ott (2015) conducted a review on VR in education focusing on Oculus Rift and head mounted displays. The subjects of computer and medical sciences are identified as fast movers in terms of integrating and adopting VR in education. The integration of VR applications and systems are integrated in education as a substitution projector to design architectural spatial experience or medical training in a virtual hospital. Geenwald *et al.* (2017) symposium at the CSCL conference discussed the technology and applications for collaborative learning in virtual reality, which covered various kinds of applications developed for collaborative learning in the virtual space.

Despite the great efforts in previous studies, there is no work showing how VR systems are adopted in students project in collaboration with external organizations. From the pedagogical perspective, the perception of students, teachers and project stakeholders of university design courses should be investigated. It is evident that there is room for investigating the integration of VR systems for collaborative prototyping and remote communication among students and project's stakeholders of design courses in higher education. Ample researches on VR in education have reported that the continuous development of the technology, price, space requirements, time for learning, and the need for further user-friendly features make the integration process far from easy. In this study, we are particularly interested in the use of VR systems as a space and communication tool for design and prototyping activities. We are interested in the opportunity to work collaboratively and receive feedback from the peers, external project partner and the teachers using the virtual 3D space for designing and prototyping. So, accepting the challenges, this study shows the selection and integration of VR systems for collaborative prototyping and communication using VR with the goal of remote co-design and feedback involving non-collocated team, project client, and course instructor.

VR can be broadly categorized (Greenwald, 2018) as standalone, tethered, and mobile (see Table 1). Only HTC Vive is designed and marketed by explicitly stating that it is ideal for multi-user environments and allows connecting external sensors.

Table 1: Summary of virtual reality headsets

Headset Type	Name of the Headset	Hardware Platform	Software Platform
Tethered	**Oculus Rift**	PC	Oculus
	Oculus Rift S	PC	Oculus
	Sony PlayStation VR	PlayStation 4	PlayStation 4
	HTC Vive	PC	SteamVR
	HTC Vive Pro Eye	PC	SteamVR
Standalone	**Oculus Quest**	Standalone	Oculus OS, a variation of Android
	Oculus Go	Standalone	Oculus OS
	VIVE Focus	Qualcomm® Snapdragon™ 835 processing.	HTC's VR Platform & Viveport Content Store.
	Lenovo Mirage Solo With Daydream Headset	Android - Standalone	Google Daydream
Mobile	**Samsung Gear VR** (Powered by Oculus)	Samsung Galaxy Smartphone	Android

3. The Integration of VR systems in students' projects of a design course

We adopt action research (Lewin, 1946) as the main method in this study to investigate how can tertiary education design courses adopt VR systems in student projects in collaboration with external organizations. We were actively involved in the whole process from initiating the industry-academia collaboration, defining the theme, implementing the project, to data collection and analysis. Our role, as researchers and university supervisors, is to facilitate the process and guide the students to develop strategies, implement in practices and gain knowledge from the projects. This section elaborates the context of the design course and VR integration activities.

3.1 The collaborative learning context

The pilot study is conducted as part of the 2nd semester project of a bachelor programme Innovation and Business engineering. The semester runs for 5 months from February to June 2019. The student projects are based on a collaboration between the university (Faculty of Engineering and Faculty of Health) and an outdoor playground manufacturing company. The authors' roles are researchers, teachers and supervisors. There are 14 students, divided into three groups, who have no experience in VR technology prior to the projects. A senior manager and a researcher from the company joined the project. They have the background on sports science and they also have no experience in VR technology regarding design and communication. The project objective, defined by the company, fits the company strategy and the course description. The students need to design and develop a monitoring system for an outdoor playground that can monitor user behaviour and environment conditions anonymously. VR technology is served both as a designing tool for creating prototypes (artefacts) in the early phase of the design process and as a communication tool for demonstration and feedback. Three milestone meetings are arranged with the company stakeholders. The first one is an introductory meeting that the company stakeholders present the project in the classroom. The second and third meetings are feedback meetings in a collaborative VR environment.

3.2 Virtual reality environment in two campuses

Since the company is in another city, we need to use a VR tool for communication that has the necessary features for multiple users and feedback. In campus B, students have access to a university VR lab, which contains three HTC Vive headsets. Two VR systems are installed at the university campus A near the company office. The senior manager and the researcher hold a part-time position at the university's department of sports science and clinical biomechanics and installed the systems with support from the engineers at the department.

3.3 The process of VR integration in the students' design projects

As indicated in Figure 1, the process of VR use for the learning activities are grouped into four categories:

- 1. Introduction of basic features in VR tools: The introduction lecture has two parts. At first, we briefly present the available tools in the VR lab including MasterpieceVR, SculptrVR, and Sketchbox. Then we introduced basic design features and communication features of MasterpieceVR. In the second part, the students are asked to do an in-class assignment, co-create a simple object in MasterpieceVR to get familiar with the features. We facilitate the process and help with questions.

- 2. Self-learning/experiencing the tools: The students spend time on self-learning and experiencing the different tools in the VR lab. We provide support when they have questions.
- 3. Co-creating design objects by adopting the selected VR tools: We give a project related assignment to the students, co-create surroundings for an outdoor playground. We do not assign any VR tools, i.e. the students have the freedom to choose one or several VR tools for co-create the design object. However, it is required that the surroundings must be created in a VR setting, and they have to present their design with the playground integrated to the company in Sketchbox, a selected VR tool by us for communication.
- 4. Presentation and feedback in live VR space — in Sketchbox with import design objects: According to the milestone meetings, the students present their surroundings and the playground in Sketchbox to the company stakeholders who enter the same VR space. They present their ideas of what to measure by marking the areas directly on the playground and surroundings. In the second VR presentation, the students import their designs of the sensor units, created in CAD software, into the VR space, mount them on the playground, and present the concept to the company stakeholders.

3.4 Summary of students' VR-Integrated prototyping projects

All three groups successfully created the surroundings in VR. Figure 2 shows their designs, a desert theme park with a small hill and a few plants (Figure 2.a), a beach area with volleyball ground and a café (Figure 2.b), and a forest with trees and paths (Figure 2.c).

None of the groups adopted MasterpieceVR for co-creating the surroundings due to its defective co-creation features with multiple users in the software, e.g. no import feature (only the user who imports the subject can see it), no redo feature, and cannot save the co-created object. Two groups used SculptrVR to draw the surroundings (Figure 2.b and 2.c). The third group chose Blocks (Figure 2.a), a VR tool provided by Google, even though it was not introduced in the lecture. The students argued that Block had a better user interface and better features for designing the object. After creating the objects, all groups exported the design as OBJ files and imported them to Sketchbox for presentation. The images in Figure 2. indicates the multi-user access feature in Sketchbox that a student was presenting their concepts to a company stakeholder while another student took photos by using the camera function in the Sketchbox VR environment.

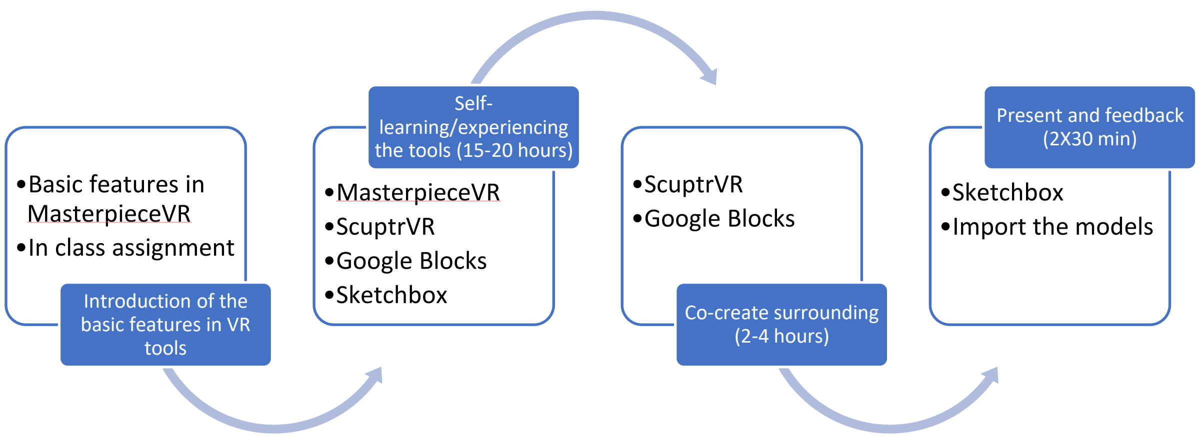

Figure 1: The learning activities as a process (excluding the first introduction to VR tools and features)

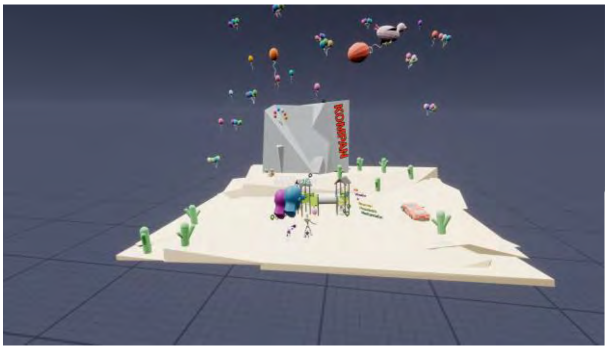

Figure 2a: Design object 1 – Created in Blocks, Image from Sketchbox during presentation

Figure 2b: Design object 2 – Created in SculptrVR, Image from Sketchbox during presentation

Figure 2c: Design object 3 – Created in SculptrVR, Image from Sketchbox during presentation

Figure 2d: A student is presenting the concept to a company stakeholder in Sketchbox

4. Students' and projects' clients perception on VR-integration for collaborative prototyping

4.1 Students' reflections on VR systems learning experience

We used questionnaires for data collection, which is designed to understand the whole process of the project and to get the students' feedback on the use of the technology. The main questions are listed below. The students answered these questions after the first VR presentation to the company.

- What are the VR tools used during the whole process?
- What are the features used to create the surroundings? Why?
- Describe the development process briefly.
- How long time did you spend on learning/experiencing the VR tools?
- How long time did you spend on creating the surroundings?
- Will you use VR for other projects? If yes, what will be the purpose? And Why?

According to the responses, the students spent 15 to 20 hours on self-learning of the VR tools, and then two to four hours for creating the surroundings. In all teams, the final design in VR was mostly done by one individual team member after they agreed on the theme and concept from group discussion. In addition to the two hours introduction lecture and one hour for presentations and feedback, they have spent 20 to 27 hours per group in VR.

The students are familiar with the creative process and creativity techniques. All groups start with ideation on what to draw as the surroundings. They ran two rounds of ideation in the divergent phase by adopting different techniques for idea collection and idea generation (Brem, 2019), and then they confirm the theme of the surrounding before putting on the VR headset. New ideas regarding the design details were triggered when they were drawing the design object in VR. One of the groups changed their themes for two times after creating the first drawings in VR. They used VR tools to validate their initial concepts.

We had a feedback meeting with the students after the last milestone meeting with the company. Most of the students were impressed when they experienced the VR tools for the first time. The immersive feeling in the virtual environment and the multi-user access feature open their eyes make them engaged in the design and learning process. More experience they gained, the better understanding of the technology they have. They pointed out both the advantages and drawbacks of the technology in the questionnaire and during the feedback meeting. In summary, the pros and cons are listed below.

Pros

- VR technology shows great potential in the early phase product design.
- It is easy to learn these VR sculpting and painting tools.
- It creates a design space with a realistic sensation, and unlimited space and materials for mockup, which is ideal for creativity.
- The multi-user access feature supports collaborative design and creation.
- It is useful for quick mock-up and prototyping.
- VR technology provides useful tools for demonstration and feedback.
- The design object can be presented intuitively.
- It can show both the overview of the concept or the detail of an object.
- It links people into the same shared virtual space.
- There is a benefit of saving on time and cost for e.g. travel and other running costs.

Cons

- The sculpting software is still in the early development phase.
- The drawings created by these VR tools are too cartoonish.
- The currently available VR tools are not designed for technical drawing and 3D modelling, i.e. missing engineering-oriented functions.
- The current VR headset is still not as comfortable as a wearable device. It is too big for head-wearing and it creates dizzy feelings.

Technical issues

- The VR system adopted for communication is not very reliable with multiple users.
- Sketchbox crashed a few times when the students present the design objects, mostly during the loading phase.
- The size of design object, being imported the virtual environment, is depends on the minimum computer power of all PCs' being connected.

The questionnaire results indicate that 13 out of 14 students decided to use VR in their future projects. The use of VR will be mainly for communication purpose, i.e. demonstrate the design object in VR to present the concept for feedback or stimulate new ideas or transfer knowledge. One student, who will not use VR in the near future projects, thinks that the technology is not ready for product design, and other modelling and prototyping methods are much easier.

4.2 Feedback from the company

After the first VR presentation, the company stakeholders asked for a step by step guideline on how to create a shared VR environment and how to import 3D models into it. This indicates their interests in VR technology for communication. In addition, we interview the senior manager after the second VR presentation for his feedback on the process and the technology.

The industry case's client representative for the students' projects, a senior manager of KOMPAN fitness institute in Odense stated the following during an interview and the authors verified with the respondent after writing in the form of a narrative.

The experience with non-collocated project members and the collaborative design and feedback process in the virtual reality environment shows potential for KOMPAN. We develop playgrounds and fitness equipment structures in Berlin and Brno. The designers at those places need to communicate and collaborate on the design and development of structures that are complicated. I see potential in working on similar scenarios in the company. In this project, the industry-academia collaboration would have benefited through the product development if we had involved a more complicated playground structure of an ongoing project. The VR-mediated collaborative design project with the students, we did not have much expectation in terms of the design outcome but exploring the potential of the design environment and technology selection process was the main contribution. Furthermore, the short time-span of the design project, as in the case for the students of the course, do not give impactful outcome. If this course could lead up to some student doing their bachelor or master thesis with the company then it would be valuable for us. One of the advantages on top of the collaboration among non-collocated stakeholders in the 3D design space is that it brings out a lot of elements of the product's elements and enables us to discuss. One of the challenges in implementing virtual reality mediated designing in multi-disciplinary teams is their differences in the level of experiences. Among the technology-caused challenges are: The avatars are impersonal, that is, compared to a video conferencing environment it is difficult to recognize person beside you in the virtual room and inhibits communication. In the case of making play and fitness products, the bodily and facial elements need to be improved to enable good collaborative design experience.

5. Conclusion and discussion

This pilot study explored the existing VR hardware and software for collaborative design and prototyping by non-collocated members of design teams and presenting the prototypes to the external organisation as the client for the product requirement. A senior manager of KOMPAN fitness institute played the role of a client and provided *authentic learning* (Lombardi, 2007) opportunity for the students' projects. This paper presents the procedure on how VR technology (PC-tethered HTC Vive) integrated into a design course to enhance the collaboration in the case of cross-discipline and cross-location prototyping with external organizations. At each of the two campuses of the university, multiple VR systems comprised of HTC Vive, accessories, and high-configuration PCs were installed. The client contact used the setup at campus A and the students worked at campus B. Different VR tools for collaborative design, prototyping, and collaboration have been tested, including Masterpiece VR, SculptrVR, Google Blocks, and Sketchbox. SculptrVR and Google Blocks were used to co-create the surroundings and Sketchbox was used to import the models and remote presentation.

According to the feedback from the students, we summarised the advantages and drawbacks of the adopted VR systems for cross-discipline and cross-location collaboration. The project creates value for educators and practitioners with the best practise of how to implement VR in teaching and/or collaboration projects. The company stakeholders also acknowledge and confirm the value of the pilot project and the trial with the VR technology. The avatars being non-identical to the appearance of a real user is identified as an additional cognitive load that hinders communication compared to real-world collocated design activities. In addition to the required VR software and hardware, it is highly important to have the project objective and expectation clear for all the stakeholders. This is the fundamental of collaboration, while VR technology provides tools to enhance it.

As Dede et al. (2017) expressed, VR interfaces provide sensory immersion focusing on visual and audio stimuli, that enhance students' motivation and learning. The use of an immersive device, such as a VR headset, brings the student into a virtual world with a panoramic egocentric view. This is in line with our findings. The students were engaged in the project. They voluntarily spent significantly more time, comparing to the lecturing time for introduction, on playing, experiencing and learning the technology individually and in teams. Comparing to the previous efforts experiencing VR in education, which have defined learning subjects in VR aiming at knowledge transfer, we provide a free space with tools in VR for the students to explore, design, and present their ideas.

Similar to the experiment by Lau and Lee, (2015), who investigated how virtual stimulation could motivate students exploring creative ideas, we provide a heuristic virtual environment and let the students play and create in it. Instead of focusing on ideation, our study explores the advantages and drawbacks of adopting VR for co-design, co-creation and communication. The result of the study shows the advantages and drawbacks of adopting VR technology for co-design in groups and communication cross-discipline. These complement the findings by Potkonjak et al. (2016), who reviewed the applications of software-based virtual laboratories and summarized the pros and cons of the physical ones. Since we use VR to provide virtual environments for creation and communication, we address the advantages and issues of the technology that has not been presented.

The design object in a virtual environment serves as a boundary object (Leigh Star, 2010) when the students presented to the company stakeholders. The shared virtual environment creates a meeting place for people at different geographic locations. The design object enhances the knowledge transfer across the boundary of two disciplines. The company stakeholders, who have sports science background and insights on domain knowledge, explained to students how the playground is designed, while the students, as novices of innovation and business engineers, expressed their ideas and exchanged the knowledge of the monitoring system from an engineering perspective. Although they have different disciplinary backgrounds, VR technology provides a good communication channel for explaining the concepts.

6. Scope of future work

This study involved collocated student teams of designers and future study should include students of two different study programs and campuses working for the same client as part of their respective courses. Future research should include students with heterogeneous backgrounds (i.e. not engineering only) to work collaboratively on the same project in anticipation of the need for greater lab/technological support and peer-group learning.

Industry-academia collaboration on projects involving multiple thesis students should be designed to contribute more value to the stakeholders and authentic learning experience to students.

From the health perspective, guidelines should be developed to inform the reasons behind experiencing dizzy feelings, protocols for troubleshooting and maximum duration of VR-based activities should be specified.

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PhD Research Papers

A Thematic and Grounded Theory Understanding of Faculty Adoption of Blended Learning in Higher Education

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Abstract: This paper assesses the teaching and learning experiences of faculty understanding of blending learning in a Higher Education Institutions (HEIs) in Ghana. The driving force for this paper is the transformational agenda of most HEIs to integrate technology with teaching and learning. The study posits that the adoption of blended learning for teaching and learning by faculty members in HEIs interplay with external and internal factors within and without the universities. Nonetheless, blended learning approaches in teaching boils down to motivation as the core concern around which these afore mentioned factors revolve. The experiences of fifteen faculty members using blended learning at the Ghana Technology University College was analysed using Thematic Analysis and Grounded Theory to develop a BL model. The paper describes the faculty blended learning adoption model and explains the model constructs and their relationships. The study indicated that staff motivation is at the core of the emergent theory of faculty adoption and presents institutional readiness, faculty technology affinity, student disposition to adopt blended learning and pedagogy fitness as constructs within and without the blended learning environment which positively influences faculty to adopt blended learning for teaching and learning.

Keywords: blended learning, thematic analysis, grounded theory, faculty adoption, higher education institutions

1. Introduction

Over the past two decades there has been a gradual shift from the traditional face-to-face to a more pronounced acceptance of integrating technology in what is termed 'Blended Learning' into teaching and learning in Higher Education Institutions (HEIs). Blended Learning (BL) has been defined as ''the thoughtful integration of classroom face-to-face learning experiences with online learning experiences" (Garrison and Kanuka, 2004). Scholarship shows that teaching in BL mode improves learning outcomes, increases student learning experiences, provides potential to reach diverse students demographics that cannot hitherto access traditional university education (Kuzmenko, 2017;Garrison and Kanuka, 2004; Okaz, 2015). Whereas these studies extol the benefits of BL, Moskal, Dziuban and Hartman, (2013) indicates that BL challenges the status quo and calls for the alignment of institutional, faculty, and student goals for successful implementation of BL programs.

Scholarship on BL view it as a 'dangerous idea' (Moskal, Dziuban and Hartman, 2013) whereas (Charbonneau-gowdy, Chavez and Bello, 2013) report that BL is having an impact on education, both at the *micro* level of the classroom, the *meso* level of program administration and at the *macro* level of higher education institutions. This author argues that nowhere is BL more pronounced than at the *micro level* where faculty engage students synchronously using learning management systems. Whiles this is so, studies on BL adoption has focused on understanding the critical success factors (Alhabeeb and Rowley, 2018) . Others have focused on understanding the impact of BL on students learning outcomes (Altameem, 2013), student adoption determinants (Teo *et al.*, 2019), barriers to student BL adoption (Narh, Afful-dadzie and Boateng, 2019) among others. Studies on faculty adoption have focused on issues relating to why faculty are not adopting (Ocak, 2011) , faculty use of specific learning management systems (Gowen *et al.*, 2017), Faculty perceptions of BL (Napier, Dekhane and Smith, no date), barriers to faculty BL adoption (Antwi-Boampong, 20118) and factors influencing faculty intentions to adopt BL (Teo, 2011).Very few studies exist on faulty adoption models developed from the experiences of faculty members (Algahtani, 2017)(Newton, 2007).

2. Literature review

Scholars have written extensively on educational technology, including the use of learning management systems (Gowen *et al.*, 2017), as well as distant learning and open educational technologies (Qayyum and Zawacki-Richter, 2018). Literature on BL adoption research indicate that teaching BL courses can be a highly complex issue due to its pervasiveness on institutional structure (Ocak,2011). However, much research on faculty BL adoption focuses on factors that impede or influence faculty to adopt BL. For example, Oh and Park (2009) surveyed 133 faculty members at Korean universities and identified barriers to BL adoption which included heavy workloads, lack of motivation and lack of financial support. Similar studies have examined factors associated with the use of BL approaches by higher education faculty in a UK university and concluded that the 114 faculty respondents identified structural constraints within the university and perceived usefulness of the tool as the main barriers to faculty adopting BL (Buchanan, Sainter and Saunders, 2013).

Also, in a survey of faculty members in a university in Iraq, Radif, Fan[1] and Mclaughln, no date, identified lack of or limited teachers' training; lack of commitment to constructivist pedagogy; lack of experience to use the technology; lack of technical support; lack of pedagogical training for teachers; and lack of appropriate educational software as the significant factors impacting on faculty BL adoption.

Additionally, Ocak (2011) interviewed 117 faculty members in a Turkish university with the objective of ascertaining why they were not adopting Bl learning. In his paper, Ocak (2011) found instructional process issues, technical issues and faculty community concerns emerging as the main inductive categories. furthermore, the complexity of the instruction, lack of planning and organisation, lack of effective communication, need for more time, lack of institutional support, changing roles and difficulty in adopting new technologies added to the faculty adoption complexities.

Other studies have explored what would facilitate faculty adoption and have found subjective norm, student characteristics, E-learning system, experience, ease of access, instructor characteristics, ease of use of eLearning support, support and training and engagement (Teo, 2011, Alhabeeba and Rowley, 2018). Isa, Amin and Ishak's (2018) study investigated the factors influencing faculty to adopt BL in Malaysia. Using a qualitative methodology, the study thematically analysed the data and found the following seven factors, namely: ease of use, university encouragement, flexibility, attractiveness, new technology usage, university policy and learning aids as factors that facilitate adoption of technology uses.

There is limited research on faculty BL adoption even though the outcome of such research will benefit HEIs to strategically implement BL (Porter *et al.*, 2016). Whilst previous studies looked at theoretical, pedagogical approaches, or specific aspects of faculty adoption research (e.g. faculty's perceptions, facilitators and barriers), fewer studies provide empirical evidence which details the lived experiences of faculty as they adopt BL in HEIs (Newton, 2007).

3. Methodology

The methodology adopted for this paper is the qualitative research design approach to solicit data from faculty members at a Public-Private Higher Education Institution (HEI) in Ghana (Ghana Technology University College, GTUC). Specifically, the research took keen interest to collect data from the three different faculties at the GTUC. Faculty members who participated in the research were from the Faculty of Computing and Information Systems, Faculty of Engineering and Faculty of IT Business who employs blended learning in their teaching experiences. The study sampled 15 lecturers from the entire faculty population of about 146 faculty members representing 10.27%. The data was collected using interviews and observations via an electronic recorder. The faculty members and the gate keepers consented and agreed to carry out this research. All ethical clearance approvals from the University was granted accordingly. The study employed thematic analysis as posit by Burnard (1991) to analyse the data using Atlas Ti. In view of that the responses received from the lecturers were transcribed to gather different meanings of their teaching experiences in the BL environment. The data was thematically coded to translate the transcript to themes, sub-themes and the number of occurrences.

The LMS adopted by the university is Moodle 3.4. Consequently, to fill existing gaps of effective usage of BL adoption in HEIs, a proposed Faculty Blended Adoption Model (FBALM) was developed and tested by colleagues and experts who are well vexed in BL in HEIs. The FBLAM contextualises faculty lived experiences by identifying the interplay of influences and barriers which faculty members relate to in making decisions to adopt or reject BL.

4. Findings and discussion

Profile of the Lectures

A total of 15 faculty members participated in the research, 12(80%) were identified as male lectures while 3(20%) were also recognised as female lecturers. The drastic difference in terms of male to female lecturers' ratio in the school is quite understandable at GTUC, since most female lecturers over the past decade are not seen to dominate in engineering and sciences disciplines (UNESCO, 2017). With respect to age, majority of the lecturers were above the ages of 30-35 (60%) while 20% were between the ages of 36-41 and 20% also above the ages of 42. It was seen that majority of the lecturers were vibrant and energetic. Also, it emerged that 3(20%) of faculty were from the engineering faculty, 4 (26.67%) of the lecturers were from the Faculty of IT Business while the greater participants 8 (53.33%) were from the Faculty of Computing and Information Systems. The whooping responses from the computing and information systems faculty is an indication of the strong information technology usage among the lecturers in that faculty and their perceived ease of use on IT systems to argument their teaching experiences in the BL environment. The lecturers predominately teach students from levels 100 – 300 while only 3 lecturers teach students at level 400.

Thematic Analysis of Faculty Experiences on Blended Learning

After the profile of the lecturers were captured and analysed, the researchers took keen interest to analyse the qualitative responses captured through the interviews and observations of the faculty usage and experiences of the blended learning platform used at GTUC. The data was then transcribed to explore different means from the lecturer's perspective on the BL usage. Thematic analysis as posit by Burnard (1991) was then employed to categorise the responses of the faculty experiences and understanding of the BL into themes and sub-themes. The occurrences of the responses according to the sub-themes was keenly analysed and recorded using Atlas Ti version 8 as indicated in Table 1. All the 15 lecturers shed lights on their various understanding and usage of the BL approach employed in their teaching and learning experiences.

Table 1: Thematic analysis of faculty experiences on blended learning

Classifications	Themes	Sub-themes	Occurrences
Faculty BL Experience	Ease of use of LMS by faculty	Easy to adapt	11
		Flexible	12
		Convenience	8
		Seamless access	8
		Social presence	5
		Interactive	7
		Prompt support	9
		Availability	10
	Pedagogic Enhancement	Supports lifelong learning	6
		Prompt feedback	9
		Social activity via forum discussions	11
		Cognitive activities	
		Teaching activities	5
		Online assessment	8
		Learner support	13
		Engagement of students in the classroom and	4
		beyond the classroom	7
	Students Acceptance	Response to assessment via the LMS	13
		Contribution to forum discussions	
		Social acceptance	12
		Students responds to faculty for support	
		Seamless access to learning resources (PDF,	5
		videos, docs, ppt, etc.)	3
		Submission and usage of Turnitin to submit	
		assessments	12
			7

Classifications	Themes	Sub-themes	Occurrences
	Management support and Policies	Provisioning of robust internet services Provisioning of conducive learning environment Student support services Faculty and students training Policy on the adoption and practice of blended learning	13 10 7 6 9
Challenges of Blended learning adoption by faculty.	Issues with Technology	Low internet speed and unavailability of internet service. Limited computer labs to support students without computer devices	12 6
	Students usage and perceptions	Disruptions and lack of focus Limited learner support Infrastructural challenges to support BL	4 3 9
	LMS challenges	Mobile compatibility issues Security issues Updates and notification issues Access and password re-set issues	3 6 3 4
	Motivational issues of faculty	Faculty unwilling to share their prepared notes online Lack of incentives to use the platform No policy to use the platform Inadequate Training and support	12 13 10 14

Largely, the thematic analysis of faculty experiences and understanding on BL was categorised into two main categories, i.e., the faculty BL experiences and their challenges. Nonetheless, The BL experiences of the faculty was further thematically grouped into four major themes. This includes the ease use of the LMS platform, the pedagogic enhancement, student's acceptance and management support and policies. On the other hand, the challenges faced by faculty for using BL includes issue with technology, student's usage and perceptions, challenges with the LMS, and motivational issues.

It was noted from the findings that a hooping number of the faculty who participated in the research responded in affirmative that the LMS platform used for their teaching experiences was flexible and easy to adapt with 12 and 11 faculty members responding respectively. Also, 10 faculty members also responded that the platform is always available for usage. Interestingly, 9 faculty members also affirmed that the Centre for Online Learning and Teaching (COLT) at the university always provide prompt response to them when the need arises. It was also noted that 8 of the faculty members responded that the platform provides them seamless access and convenience of use.

Correspondingly, another interesting theme the researchers discovered from the study was an accept of pedagogic enhancement via the use of the BL approach. A whopping 13 lecturers indicated that the BL approach support their assessment practices and thus, makes marking easier and faster. Also, 11 faculty indicated that the BL approach supported social activities via the use of forum discussions. This finding affirms the social presence of Garrison, Anderson & Archer (2010) model of community of inquiry of BL. In other words, this approach aids the students to construct their own knowledge (Asunka, Freeman & Sheeta, 2018). It was also explored that the BL approach supported faculty and students lifelong learning (6), student engagement (7) and prompt feedback to students in the classroom and beyond the classroom (6). Moreover, a greater number of the faculty (13) affirmed the platform was useful and thus students accepted the platform and showed keen interest to use it. Undoubtedly, 12 lecturers indicated that the students used the platform to access learning resources such as lecture notes, power point slides, video resources, etc. It was however noted that only few lecturers (3) indicated that they provide support to students to adapt the LMS platform. This is quite understandable since most of the students in the university have some level of computing and internet experiences.

Moreover, an interesting phenomenon that emerged from the findings were aspect of management support and policies to regulate the adoption and practice of BL in the HEI. Consequently, 13 lecturers affirmed that provisioning of robust internet services is keen to their teaching experiences and thus management should take conscious effort to establish a healthy internet infrastructure. Also, 10 lecturers responded in affirmative that the learning environment needs to beef up to augment the face-to-face aspect of the BL approach. The findings also emerged that management must enforce stringent policy to promote the BL agenda at the university with 9 faculty members reacting vehemently to that notch.

Despite the fantastic experience of the faculty on the BL approach in their teaching experience, it emerged from the interview sessions that the faculty members face serious challenges for employing BL in their teaching experience. Noted among the challenges are low internet speed and unavailability of internet at some part of the campus, a whooping 12 faculty responded in affirmative to this challenge. Also, some lecturers feel that the model the university use for students to bring their own devices (BYOD) hampers the free flow of delivery sometimes. Hence, 6 lecturers that there is the need to increase the number of computer labs to support students without computer devices.

It was noted also from the findings that the students perceived that university lacks infrastructural needs to enhance their classroom learning experiences. This implies that both the lecturers and supports perceive that the learning environment needs improvement to enhance teaching and learning. Also, 4 lecturers indicated that students are easily disrupted when using the online component of learning. It was likewise discovered that there was aspect of security issues (6) that needs attentions when using the online platform. This was discovered by lecturers because, some students sometimes use different students ID numbers to download and submit assignments on behalf of another student. This is noted to be a limitation on the Moodle platform used.

A critical aspect of the study that emerged from the findings of the study was an aspect motivation issues that faculty member face when using BL approach in teaching. Interesting, faculty members see the use of the online component of the BL approach is an additional responsibility to their traditional face-to-face experience and thus, request management to provide incentives. A whooping 13 faculty members responded to this claim. Interesting, 12 faculty members felt that they are not motivated enough to share their lecture notes since the university does not support the BL agenda. It was noted that since there were no policies, some faculty (10) felt that there is no need to do additional work apart from what they have been assigned to do in the classroom only. Virtually all the faculty felt the need to promote the BL approach however, they felt that there exist among themselves training and supporting needs from management.

Development of the Faculty Blended Learning Adoption Model

As a result of the findings discovered from the thematic analysis of the study, the researchers further thoroughly performed further analysis using grounded theory (Glaser, 2017) to develop faculty blended learning adoption model (FBLAM). Data for developing the model is derived from the findings of the thematic analysis (Burnad, 1991) and existing literature. The thematic analysis was conceptualised and theoretically abstracted into higher order themes through a vigorous constant comparative process (Charmaz, 2015) as described by Glaser, (1990). It was discovered from the combined thematic and constant comparative analysis (Charmaz, 2015) that motivational issues were prevalent to the abysmal usage of BL in the HEI. Hence, motivational considerations were determined to be the core influencing factors leading to adoption of the FBLAM as indicated in Figure 1.

The proposed model was derived from the constant comparative process which broke down the data into codes, concepts and categories until theoretical saturation. Axial coding of these categories yielded four key independent constructs as discovered also in the thematic analysis. Among these are Pedagogy fitness for BL, Faculty technology affinity, student positive disposition to BL (with two accompanying dependent sub constructs) and institutional readiness. Within the context of these constructs, in the mind of the author it is abstracted that these set of independent factors interact and interplay in ways that when influencing positively motivate faculty to adopt BL for teaching and learning. Thus, motivation is positively constructed as the emergent core category which leads faculty to adopt BL.

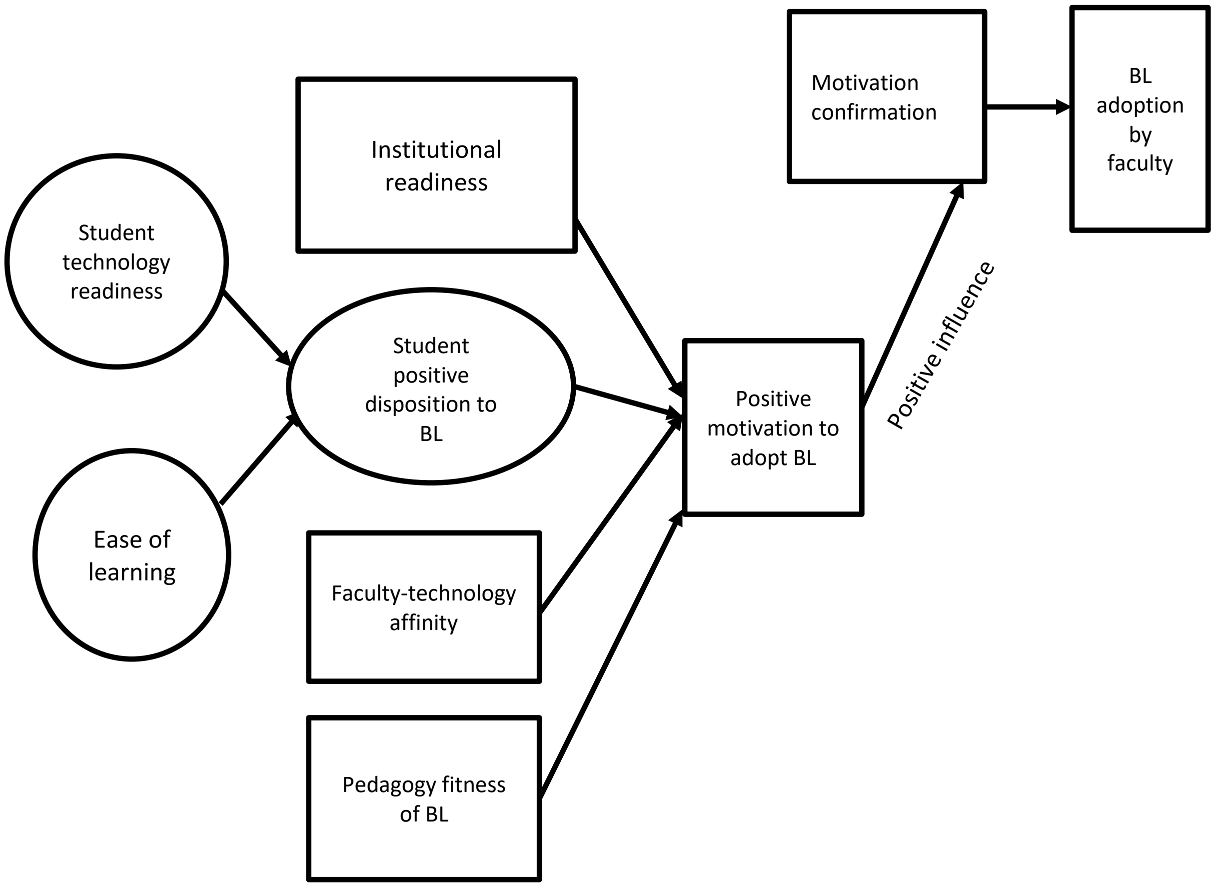

Figure 1: Faculty blended learning adoption model, Antwi-Boampong, (2019)

Institutional Readiness.

The pervasiveness of blended learning is documented in literature (Moskal, Dziuban and Hartman, 2013).It has the potential to disrupt institutional process and is cited to be a dangerous idea (Moskal, Dziuban and Hartman, 2013). Institutions intending on implementing blended learning should assess its technology readiness and avoid top down implementation strategies (Gautreau, 2016). A more consultative process that involves faculty to get their buy into the process is reported (Basak and Govender, 2016). Often, faculty have reported lack of consultations, the absence of institutional policy frameworks that outlines and guides BL implementation. Readiness of institutions intending on adopting and implementing BL should include factors such as policies that addresses faculty promotions, workload adjustments, technical support and intellectual property rights.

Pedagogy Fitness for BL

The use of technology requires changes in the mindset of pedagogy. However, studies report that there are still many faculty members who have pedagogical difficulties in adapting new instructional delivery method because they value the traditional way of knowledge sharing (Hollis & Madill, 2006). Since they are not certain about the value of technology, and their roles and abilities in the process of teaching (Kim & Baylor, 2008**),** they worry that delivering instruction online would decrease the quality of the instruction and students might feel hard to achieve their educational goals. Some faculty members even perceive that online instruction threatens their academic freedom by designating the way of teaching. Faculty see BL as a means of pedagogic flexibility and convenience (Antwi-Boampong, 2018).

Faculty Technology Affinity

Lack of formal understanding of how to integrate technology in teaching affects faculty ability to adopt BL. Faculty members lack the training to use instructional methods to teach in BL mode to achieve pedagogic goals (Awidi, 2008). As Klein et al. (2004) indicated, faculty dissatisfaction with technological tools affects BL adoption. Furthermore, (Ocak, 2011) indicates that direction of blended teaching, its adoption and the implementation largely depends on faculty members' adoption of new innovations (Rogers, 1995).

Student Positive Disposition to BL

Students disposition to adopt BL is affected positively by the student's technology readiness and the ease by which they perceive teaching and learning using BL. In the shared experiences of faculty members, the inclination to teach in BL mode is largely a function of how the predisposition of students are and how receptive they are to the method. Students technology readiness, their foundational understanding of how to use basis computer tools, and how to use LMS and its functionalities in a collaborative learning environments become a major consideration for faculty as they adopt BL. (Napier, Dekhane and Smith, no date) reports that major reason whey faculty do not adopt BL is the additional responsibility it comes with as faculty members in addition to teaching become technical experts and have to guide students through solving technical problems relating to learning platforms.

5. Conclusions

The study has shed light on faculty understanding of blended learning adoption in HEIs. The findings from the study which was thematically coded indicated that faculty members have positive attitudes towards BL. This because the BL approach provides flexible, seamless and convenient approaches to their teaching and learning experiences. Also, the lecturers perceived that most students are happy with the BL paradigm in their learning journey. However, the faculty members shed numerous challenges which lead to the development of a robust BL model (FBLAM).

The study revealed that the four-key constructs in the FBLAM is relevant elements if faculty adopt, design and execute blended learning solutions. The study suggests that for faculty to adopt blended learning for teaching and learning to be well, four key elements need to be considered: First, institutions of higher learning must evaluate their institutional readiness relative to policy frameworks, implementation strategies that align with and developed in consultation with faculty as key stakeholders driving the process. Secondly, faculty technology affinity needs to be accessed and where there are shortfalls it is recommended that faculty training programs are instituted to enable them to become fully familiar with the computer programs and technology instructional strategies needed to engage students in collaborative ways that enhances the students learning experiences and ultimately improve learning outcomes. This finds support with Graham's claims (2006) that there is a need to provide professional development for instructors that will be teaching online and face-to-face. Third, institutional support mechanisms that provide technical support to faculty needs to be provided, such as computer components, learning management systems and dedicated centres with instructional technologist who should be assist faculty align teaching content to achieve pedagogic fitness where possible. Fourth, lab sessions should be provided for students as a means of upgrading their technological readiness to and deliver teaching content targeting student's convenience and ease of use with the objective of stimulating positive disposition towards BL. The outcome of the model finds expression with theories related to motivation and identify similar factors like the motivation hygiene theory (Gawel, 1997). The results show that there are certain units of thought that faculty members consider as predisposing factors leading towards adoption. Analysed against the motivation hygiene theory (Martin, 2010) revealed that one factor, institutional readiness, faculty technology affinity, pedagogy fitness is reflecting in theory and it is consistent with the findings of this study. These factors can be construed as being either motivational (incentives) or Hygienic (disincentives). Similarly, (Oh and Park, no date) showed that the lack of faculty motivation to integrate technology into their courses is the biggest challenge to the implementation of blended teaching.

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Estimating Student Workload During the Learning Design of Online Courses: Creating a Student Workload Calculator

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Abstract: UK university students are expected to undertake 10 hours of work for each Credit Accumulation and Transfer Scheme (CATS) credit. With face-to-face learning, this is relatively easy to quantify as x hours of contact time and the remainder made up of independent study. For online and distance learning, this is more complex. Study materials are provided for students to work through independently, but unlike face-to-face where the class ends after an hour or two, online students could continue working indefinitely. Some students will inevitably take longer than others to complete tasks, and it is therefore more difficult to ensure student workload in online courses is proportionate to the credits awarded. This paper provides a means to calculate student workload in online courses via a workload calculator, derived from a review of the literature and available at http://bit.ly/postgradworkload. It uses Laurillard's (2009, 2013) conversational framework activity types to categorise online course materials into task types, and provides a means of estimating the time it would take an average student to complete each task, for use in informing the design of online courses. For those task types that cannot be accurately estimated it is recommended to provide guidance on how long a student should spend on the task within the learning materials.

Keywords: student workload, online learning, distance learning, learning design

1. Introduction

1.1 Background and context

Most higher education institutions in the UK use Credit Accumulation and Transfer Scheme (CATS) credits as a means of quantifying and recognizing learning. A specific credit value is awarded to a student upon completion of a unit of study, reflecting both the amount and depth of learning undertaken. Credits are accumulated by the learner towards the total credit required for a qualification (e.g. a Bachelor's or Master's degree). Whilst credit is awarded based on the successful achievement of learning outcomes, notional hours of learning are used as a guideline to estimate how long a student should be studying for each credit. In the UK, one credit represents ten notional hours of learning (QAA, 2018).

These notional study hours represent both directed learning and independent study. For courses delivered face-to-face, it is common for institutions to provide students with guidance on how they will be spending this time, with a set amount of contact hours (lectures, seminars, labs, study skills sessions, field work etc.) and the remainder spent on independent study (The University of Edinburgh, 2018; The University of Manchester, 2017; Warwick University, 2014). This provides students with a clearly structured workload. For online students it is more difficult to quantify their study time. Simultaneously, the ability to quantify study hours is of critical importance to these students who have most likely opted to study online for the promise of flexible part-time study (Park, 2017; Romero & Barberà, 2011). As workload issues are considered one of the highest causes for student dropouts on online courses (Bawa, 2016; Travers, 2016; Whitelock, Thorpe & Galley, 2015) try to prepare students; equipping them with information about required study time and helping them fit this in to their lives (Coventry University, 2018; Open University, 2018). Therefore, when designing online learning, a balance must be struck between ensuring the learning outcomes are met and providing an appropriate workload. What is therefore needed is an understanding of what students are actually doing when they study online, and how long it takes them.

1.2 Calculating student workload

It is possible to retrospectively model students' workload and how they spent their time on a course, either by asking them to record their actions or by using learning analytics.

Learning analytics tell us how students interact with their course. This can include when they access services, submit assignments or log on to university systems (Sclater, Peasgood, & Mullan, 2016). When applied to a course that is delivered wholly online, learning analytics can tell us how long students spend on their course or on specific pages, and whether they leave the page to search for external resources. This enables us to estimate how long students are spending on tasks, although you can never be certain of how long they are actually engaged whilst the course page is open on their device (Toetenel & Rienties, 2016).

Unfortunately, learning analytics can be time-consuming to utilize and are available during or after a course has run. If they demonstrate a need to adjust workload then a review cycle is required in order to make the necessary changes, requiring a significant time commitment from course creators. Using learning analytics as the sole measure of students' workload effectively makes the first students on a course the 'guinea pigs', impacting their learning experience.

Alternatively, workload can be assessed by asking students to record what they are doing and how long it takes (Nosair & Hamdy, 2017; Ruiz-Gallardo et al 2011). This can provide useful detail about timings, supplemented by qualitative feedback, and, as it is self- reported, the data should provide an accurate representation of how students are spending their time. These studies provide much smaller data sets than learning analytics, and they have their own limitations. Researchers note that students are not always reliable reporters of their own actions due to forgetfulness or perhaps a fear of disclosing how they are really spending their time (Garg et al., 1992; Ruiz-Gallardo et al., 2011). In common with learning analytics, this method is also retrospective.

Neither of these methods can be used during learning design. Of more practical use would be a method of calculating workload on a course whilst it is being produced.

Workload calculators do exist, but they are largely based on face-to-face teaching models (Barre & Esarey, 2016). They cover a limited range of tasks, leaving them unable to estimate times for completing problem-based tasks that online students undertake independently (Nosair & Hamdy, 2017). Where online workload tools have been developed, they are proprietary tools that are not in the public domain (Whitelock et al., 2015). This paper uses existing research to create a student workload estimation tool, addressing the following research questions:

2. Research questions

- What are the discrete task types that make up a programme of online learning materials?
- What is the estimated or average time for a student to complete each learning task, based on current research?

3. Method

This study is based on a literature review consisting of two parts:

- An examination of online learning design methodologies to identify a classification of task types carried out by online students.
- A review of the literature on student behaviour with a view to deducing an average 'time to complete' figure for each of the task types identified above.

The timings established in answer to RQ2 are used to create a workload estimation tool. This tool enables the user to estimate time required for each discrete activity or task on an online course.

4. Learning design and task types

4.1 Learning design

Learning design can be defined as the purposeful creation of learning materials, experiences or lessons, guided by pedagogical principles, in order to meet specific learning outcomes (Toetenel & Rienties, 2016). It is aimed at supporting the process of learning, rather than teaching, and therefore the learning outcomes are key for guiding an appropriate design, where the learning activities chosen suit the type of outcome desired (Gagné, 2005). Online learning design refers specifically to the design of those learning activities that are delivered online.

4.2 Activity types and tasks

If learning design is the process of planning what learners *do* to learn, then it is not surprising that practical support for learning design tends to focus on enabling designers to explore the use of a range of activities

(Conole & Fill, 2005; Manton, Balch, & Masterman, 2009; Sharples, 2018; UCL, 2018). Laurillard's conversational theory of learning (Laurillard, 2009, 2013) has been influential in informing a number of these learning design toolkits (Beetham & Sharpe, 2007). The conversational framework takes a holistic view of how students learn, interrogating key learning theories to provide a single framework. A practical application of the framework identifies six learning activity types that describe the ways in which students learn, which are frequently adopted as a means of planning a learning experience in which the student engages with a range of appropriate activities (Sharples, 2018; The Open University, 2018; UCL, 2018). The learning activity types are described in Table 1.

Table 1: Learning activity types (Laurillard & Kennedy, 2016)

Acquisition	Learner takes in information but is not required to do anything with it. Tasks include Reading Watching a video Listening to audio
Discussion	Learner asks questions of others, or answers them. They exchange ideas and arguments to construct knowledge.
Investigation	Learner carries out their own inquiry, requiring them to come up with their own question(s), search for information to answer it, and evaluate their findings. Tasks include: Conducting an experiment Searching for resources
Practice	Learner has a task goal requiring them to generate an action, respond to feedback on that action, and try again to get nearer to their goal. Tasks include: Writing Quizzes
Production	Learners produce something that the teacher evaluates. This could include: Writing Presentation Another artefact e.g. poster or video
Collaboration	Learners work together on a project to produce a shared output. This is different to discussion as the production of a shared output requires learners to negotiate their position until they agree. These outputs will be similar to those of Production activities.

5. Calculating time on task

Beetham & Sharpe (2007) distinguish between activities, which are engaged in *by* learners, and tasks, which are required *of* learners to scaffold their engagement in the activity. Learners complete a task or series of tasks that holistically contribute to their activity, and these are derived and quantified for each activity type in the following section.

5.1 Acquisition

5.1.1 Reading

Reading speed has been reasonably well researched and can be justifiably quantified. Rayner et al's (2016) systematic analysis concluded that for all people, reading rates are variable depending on the difficulty of the text and the purpose of reading. In creating their own workload tool, Barre & Esarey (2016) conducted a thorough review that identified three levels (Table 2) and three types (Table 3) of reading.

Table 2: Text difficulty

No new concepts	No new vocabulary, reader is able to quickly understand meaning using only their background knowledge.
Some new concepts	May be some new vocabulary, reader will need to check or infer meaning for some concepts.
Many new concepts	A lot of new vocabulary, reader is unable to immediately understand most of the ideas expressed.

Table 3: Reading purpose

Survey	To grasp main ideas
Understand	To understand the meaning of each sentence
Engage	To critically analyse

Studies of college students have shown that under normal conditions, reading a text with no new concepts with the purpose of understanding has a range of between 100-400 words per minute (wpm) (Carver, 1982; Chambers, 1992; Rayner et al., 2016). Where the material is more difficult, this falls to around 200 wpm (Barre & Esarey, 2016; Carver, 1982) and for engagement, rates fall to as low as 50 wpm (Barre & Esarey, 2016). Given more challenging reading material and purpose, the agreement across studies stabilizes (Rayner et al., 2016), suggesting that more accurate time estimates are possible for more complex reading tasks.

Barre & Esarey (2016) provided a breakdown of reading rates for all levels of text difficulty and purpose (Table 4).

Table 4: Reading rates

Reading purpose	Text difficulty	Words per minute
Survey	No new concepts	500
	Some new concepts	350
	Many new concepts	250
Understand	No new concepts	250
	Some new concepts	180
	Many new concepts	130
Engage	No new concepts	130
	Some new concepts	90
	Many new concepts	65

It should be noted that Barre and Esarey's rates are based on reading print, whereas online students will most likely be engaging with texts on a screen. Some studies demonstrate the impact of screen fatigue, screen position, and lack of tactile function leads to slower reading rates (Dillon, 1992; Kurniawan & Zaphiris, 2001). However, whilst a meta-analysis of comparative papers on reading on screen versus on paper (Kong, Seo, & Zhai, 2018) found that there was evidence for a slight variation, a 2016 review (Köpper, Mayr, & Buchner, 2016) found there was more evidence to show that reading times are equivalent for on-screen and paper. For the purposes of the workload tool, students have been allowed longer reading times (Table 5 Online reading rates). In order to maximize usability of the workload tool, and in line with other workload calculation methods (Chambers, 1992; The Open University, 2018) the number of categories has been reduced to just one difficulty level for each reading purpose.

Table 5: Online reading rates

Reading purpose	Words per minute
Survey	300
Understand	130
Engage	70

5.2 Watching and listening

Research on the use of media in education tells us the ideal length of videos to maximize student engagement (Brame, 2016; Giannakos, Chorianopoulos, & Chrisochoides, 2015; Kim et al., 2014), and examines students viewing patterns (Conglei Shi et al., 2015; Geri et al., 2015; Giannakos et al., 2015; O'Callaghan, Neumann, Jones, & Creed, 2017). However, there is a lack of research into the time students spend interacting with media and how that compares to the media duration.

A number of studies have identified successful viewing habits, finding that students who watched videos in full, repeated viewings, interacted with video (rewinding/skipping sections), and/or timed their viewings to occur during assessment periods achieved better results than those who didn't (Geri et al., 2015; Giannakos et al., 2015; Kim et al., 2014). None of these studies reported how long those successful students were spending on these tasks, but it is reasonable to assume that this kind of interaction is time-consuming and likely to take longer than the media duration. In deference to this, an initial figure of twice the media duration is suggested, accepting that it may need to be adjusted in response to testing.

5.3 Investigation

Investigative activities can be broadly categorized into two types of task (Laurillard, 2013; The Open University, 2018):

- Searching for and evaluating information
- Conducting experiments or collecting data

Research on how students search for and evaluate information tends to focus on how information seeking behavior manifests (Kelly & Sugimoto, 2013), i.e. what people do when they search (Vassilakaki & Johnson, 2015), how many search terms they try (Liu, Liu, Cole, Belkin, & Zhang, 2012), what they click on (Werner, Mandl, & Womser-Hacker, 2016), and how they feel about the process (Kelly & Sugimoto, 2013) rather than how long it takes them. Time is considered as an indicator of search success (Saastamoinen & Järvelin, 2018; Savolainen, 2006), and as a constraint (Crescenzi, 2014), yet time to search and what would be a 'good' time for a successful search is a current gap. Only one study (Borlund, Dreier, & Byström, 2012) was found that reported how long students spent on search tasks. The results can be found in Table 6, showing a marked difference in both the minimum and maximum times to complete tasks and a large disparity in time taken depending on the perceived difficulty of the task. At the 'quick' end of the scale is *verificative* tasks, which simply require the student to check a fact or find a named resource e.g. locating an article in the online library.

Taking almost twice as long are searches for *conscious* and *muddled topical* information needs. Conscious topical requires the student to search for information about a topic they know well. For example, a lawyer searching for relevant case law for an upcoming trial. With a muddled topical need, the user is looking for information about a topic they do not know well. For example, a student tasked with researching the topic of their first module.

Table 6: Time spent searching, measured in hours : minutes : seconds. (Adapted from Borlund et al)

Types of info needs	Min.	Median	Max.	Mean	Sd.
Verificative	00:01:25	00:03:52	00:15:37	00:05:36	00:04:07
Conscious topical	00:05:37	00:16:12	00:28:27	00:14:18	00:06:57
Muddled topical	00:05:02	00:16:38	00:28:30	00:17:17	00:06:02

The timings provided by Borlund et al. (2012) provide a useful indication of workload, however they do not tell us what an average student's experience will be. It is not possible in all cases to determine the type of search task and whether it will be the same for all students. We also know that searching is highly iterative (Kelly & Sugimoto, 2013) and there is high propensity for distractions (Greifeneder, 2016). Even within lab conditions, the difference between minimum and maximum search times is too great to provide a reasonable average. For these types of searches, the recommendation is that the learning designer suggests a reasonable time period, commensurate with the task and students' perceived pre-existing knowledge. This timing should be included in the learning materials to enable the student to plan their workload.

It is however possible to easily identify a verificative search task, and excepting the outlier at 15:37 (caused by one student not knowing how to access their university's library), the timings reported by Borlund et al. (2012) are within a reasonable deviation. The suggestion is to use the median figure, rounded to the nearest minute, providing a figure of four minutes for a verificative search task.

For tasks that require students to perform experiments or collect data the recommendation is again for the learning designer to make a reasonable suggestion as to the time that should be allocated and signpost this to the learner, in recognition of the wide variety of tasks that could be included here.

5.4 Practice

The two most common practice tasks in online learning are:

- Formative writing
- Quizzes

(Toetenel & Rienties, 2016)

Formative writing is discussed under 'Production'.

5.5 Quizzes

In calculating how much time to allocate students for quizzes, it is common for guides aimed at teachers to provide advice such as:
"To determine how much time the student will need to take the test use the following:

- 30 seconds per true-false item
- 60 seconds per multiple choice item
- 120 seconds per short answer item
- 10-15 minutes per essay question
- 5 to 10 minutes to review the work
- Or, allow triple the amount of time it takes you to complete the exam."

(Clay, 2001).

The suggested timings in such guides times vary from 30 secs per question (University of Central Florida, 2018) to 60-90secs per question (Salkind, 2006). These figures are not supported by sources and do not seem to take into account differences between recall and application questions.

Schneid et al's (2014) study of the use of multiple choice quizzes (MCQ) in medical schools suggest that the design of questions impacts the time required to answer them, with the number of distractors being a key indicator of time. They found it takes an average of 36 seconds to answer a three-option MCQ, and 41 seconds to answer a four-option MCQ. This is supported by Vegada et al. (2016), who suggest an extra 6 seconds is needed for each extra option on an MCQ question.

Allowing for MCQs with five-option questions and time for students to review their responses, 60 seconds per question provides an adequate estimation. This aligns with guidance provided to students at some institutions (Gareis & Grant, 2015; Nottingham Trent University, n.d.).

5.6 Production

5.6.1 Writing

Writing is one of the most difficult things to calculate a time for because there are so many different types of writing (Barre & Esarey, 2016). Nevertheless, Torrance et al.'s (2000) study attempted to quantify it by gathering information from 715 students about their writing habits. This data was expanded on by Barre & Esarey (2016) in their workload tool.

Further timings for writing have also been informally provided to the author by Coventry University's Centre for Academic Writing. These timings, recorded in Table 7, are based on experience rather than backed by formal research, yet they provide very similar estimates. Due to their ease of application to an online course, these are the preferred figures for the workload calculator.

Table 7: Time to write: from CAW

Writing	Opinion or thought (e.g. comment/discussion)	100 words = 20 minutes 200 words = 40 minutes
Writing	Formative	500 words =10 hours 1500 words =30 hours
Writing	Summative	500 words = 11 hrs 40 1500 words = 36 hours 2000 words = 48 hours

5.7 Discussion

Discussion is very difficult to quantify, largely because students behave very differently in discussion activities, depending on their knowledge of the topic and their personal preferences for engagement with online discussions (Curtis & Lawson, 2001).

In order to engage in discussion fully, a student needs to understand the topic being discussed, formulate and post an initial response, read their peers' writings and comments, and formulate responses to them (Macia & Garcia, 2016). Given the complexity of this task, it could borrow from both reading and writing in estimating timings. However, this somewhat formulaic approach doesn't allow for the complexities of dynamic online discussion. As with several of the complex tasks, a better approach is for the designer to suggest an appropriate amount of time for students to engage with the discussion, bearing in mind the topic at hand.

5.8 Collaboration

Collaboration is essentially production, with the added element of organisational and time management skills that go along with working in a team.

Group work generally takes longer as students need to negotiate their position and reach a consensus before producing their output and reassess and review each other's work before submission (Laurillard 2016).

Further research is required to understand the workload involved in collaborative tasks, so as a starting point it is recommended to use the figure for production and double it. This will need assessing for accuracy as the workload tool is tested.

5.9 Additional tasks

Given that some online courses may include some synchronous activity, a final task classification has been included to allow for a full calculation of study time. Synchronous activities such as online tutorials have a set time limit so there is no need to estimate their duration and they therefore have their own category in the calculator.

6. Discussion and conclusion

Having identified the amount of time students can be expected to spend on different tasks as they learn online, the data is compiled into a usable format for calculating student workload.

The basic workload calculator spreadsheet is supported by an information sheet detailing the time allowances by task type. Users will need to use the guidance sheet to calculate time for each task and add it to the spreadsheet which then calculates a total workload time for the course.

6.1 Application of the calculator

Although the calculation tool has been produced with the aim of estimating workload on UK postgraduate courses delivered online via the FutureLearn platform, its usability is far wider than this. The use of the conversational framework activity types to derive online tasks was explicitly selected for its applicability to any model of online course design and use of any platform. It could apply to any level of learning, including MOOCs, although educators may want to tweak the suggested figures based on their knowledge of their student cohort, for example if the course is not being delivered in students' first language. Additionally, the literature review into time on tasks revealed that there is no explicit difference between whether a task is completed online or face-to-face: the difference lies in the lack of facilitation and therefore explicit structure provided to online students. Accordingly, the workload estimation figures could equally be applied to a face-to-face situations, supporting educators in planning their teaching. On the other hand, for online students this tool provides an estimate of how long a task *should* take and is therefore accompanied by a strong recommendation that this is communicated to the student to allow them to plan their time.

6.2 Using the calculator to aid design

The calculator should be used to monitor workload during design, but also as a prompt to help manage student expectations. Knowing that "students spend too much time on almost all activities, leading to a general overload" (Ruiz-Gallardo et al., 2011) certain tasks (as indicated in the guidance) should be accompanied by a recommendation to students to spend roughly *x* amount of time on it, i.e. 'Spend up to one hour researching and provide a summary of your findings in the forum'.

6.3 Limitations and further research

As Bowyer (2012) identified:

> *"Designing a model of student workload is fraught with difficulty because there are so many factors to take into account. Some factors cannot easily be quantified and even with those that can, it is then difficult to assess the relationships between these factors and how much they influence workload."*

This tool is a pragmatic solution to a complex problem, accepting that it is possible only to cater for the 'average' student, and that this may be different from course to course (e.g. a course may not be in a student's first language). Even accounting for this, there were some notable gaps in the research, with student time on task being under-researched, for both face-to-face and online students. It would appear that there has been an over reliance in using the set time of classroom sessions to monitor workload, rather than assessing how long is actually needed in order for students to adequately engage with a task. Going forward, the calculator needs to be tested for accuracy and usability, which could be achieved using a combination of learning analytics and student-reported timings. Such a study could have the dual purpose of checking the reliability of the workload model and also filling in some of the gaps in research on how long students spend completing tasks. This could impact both online and traditional face-to face models of teaching.

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Experts' Insights About Blended Learning Implementation: What Teacher Attributes are Relevant?

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Abstract: Higher education already values blended learning as an alternative way of teaching and learning for various reasons. Nonetheless, the implementation of blended learning remains a challenging and difficult process. Many (f)actors play a role, ranging from policies and organizational culture (e.g. ICT policy plan, professionalization strategies, leadership style) to different personal teacher aspects such as ICT literacy, teaching style, openness to change or personal motivation. In any case, the teacher remains crucial in processes of educational change. This qualitative study therefore focuses on the teacher perspective by investigating and identifying teacher attributes that play an important role when implementing blended learning. Since experts have deep insights in aggregated and specific knowledge, a research approach of expert interviews was chosen. Twelve experts on blended learning in Flemish higher education were interviewed in order to identify what they perceive as relevant teacher attributes. Four attributes, rooted in intrinsic teacher motivation, emerge from the preliminary analyses: (1) a genuine concern with the quality of their teaching practice; (2) realizing a pedagogical need for change; (3) being able to critically reflect on their teaching practice; and (4) having a sense of pedagogical curiosity and creativity to explore technology in relation to learning processes. Additionally, the experts raised a number of cognitive teacher biases that hinder the uptake of blended learning. In particular a confirmation, vividness and omission bias towards the concept of blended learning were denominated by the experts. Insights from this study informs practitioners concerned with implementation and deliberate application of blended learning in higher education. Finally, recommendations for research and practice will be presented and discussed.

Keywords: blended learning, cognitive biases, expert interviews, teacher attributes, teacher change

1. Introduction and theoretical background

The implementation of blended learning (BL) in higher education comprises many factors ranging from organizational policies and strategies, over structural issues, to support for teachers (Graham, Woodfield and Harrison, 2013). Yet, in any process of educational change, the teacher lies at the heart of the process of change (Fullan, 2014; Sikes, 1992). Consequently, teacher professional development received profound research attention. Researchers such as Merchie et al (2016) addressed professional development and expanded the knowledgebase on effective teacher professional development. Philipsen et al (2019) bridged the gap between professional development and BL by aggregating six relevant findings from literature, including contextual and organizational recommendations as well as addressing teacher change. Although Philipsen et al (2019) acknowledge the importance of teacher reflection on BL on teacher professional identity and educational beliefs, the focus is less on relevant teacher attributes and interpersonal differences when adopting BL.

In the same way, much attention has been drawn to BL in empirical research. Many researchers focused on the design (e.g. Boelens, Voet and De Wever, 2018; Carbonell, Dailey-Hebert and Gijselaers, 2013; Vaughan, 2010), or on the student perspective and context (e.g. Moskal, Dziuban and Hartman, 2013; Vanslambrouck et al., 2018). The teacher perspective received attention from researchers such as Cheung and Hew (2010) who examined different teacher attributes in the specific context of facilitating asynchronous online discussions. They found that online facilitators showed the habits of awareness of own thinking, and open-mindedness. Likewise, Comas-Quinn (2011) and Lai et al (2018) emphasized the importance of teachers' individual dispositions and the strengths of internal and external motivators when engaging in BL. Yet, it remains unclear what teacher attributes play a significant role in the uptake or rejection of that teacher innovation. Thus, this study investigates the teacher perspective by identifying relevant teacher attributes when implementing BL. This paper will first highlight relevant literature and tap into the personal dimension of teacher change regardless of the context of BL. Next, the method section gives an overview of the main aim and research questions of the current study, and elaborates shortly on the chosen qualitative method. The findings section is organized around two perspectives: adaptive and maladaptive teacher attributes. A discussion of the results, limitations of the study and conclusion wrap up this paper.

1.1 Blended learning in higher education

In the last decade BL has increasingly been implemented for various reasons and the academic community has extensively explored BL in higher education (Garrison and Vaughan, 2013; Mestan, 2019; Moskal, Dziuban and Hartman, 2013; Porter et al., 2015). Although the definition is still ambiguous (Hrastinski, 2019), the pedagogical concept can be described as the deliberate combination of online and classroom-based instruction that activates and supports learning (Boelens et al., 2015). The open nature of the definition allows various applications of the concept. This pedagogical variety was not considered and investigated in this study. Educational institutions have adopted BL for various reasons such as providing more flexibility to meet students' learning needs and backgrounds (e.g. Boelens, Voet and De Wever, 2018; Jonker, März and Voogt, 2018), or as an attempt to reduce dropout rates (López-Pérez, Pérez-López and Rodríguez-Ariza, 2011). Much is known about the design (e.g. Boelens, De Wever and Voet, 2017) or implementation of BL (e.g. Carbonell, Dailey-Hebert and Gijselaers, 2013). According to Graham et al (2013) organizations face many contextual complexities when adopting BL, such as strategy (definition and purpose of BL, policies and degree of implementation), structure (technological and administrative systems, governance etc.) and support (technical and pedagogical support, faculty incentives). Yet, the role and position of the teacher within that process of implementation has received less attention. While Jonker et al (2018) researched the transition to BL through the lens of teacher educators' professional identity, there is still a lack of focus on core teacher competencies that lead to successful innovative teaching performances (Zhu et al., 2013). Although acknowledging contextual complexities during adoption of BL, this study focuses on the teacher perspective.

1.2 Teacher 'as a person' and teacher change

A lot of attention has been drawn to relevant teacher competences and the professional identity of teachers (e.g. Baran, Correia and Thompson, 2011; Beijaard, Meijer and Verloop, 2004; Kelentrić, Helland and Arstorp, 2018). From a competence perspective, Deakin Crick (2008) identified eight teacher competences for lifelong learning in the twenty-first century and defines competence as "a complex combination of knowledge, skills, understanding, values, attitudes and desire which lead to effective, embodied human action in the world, in a particular domain" (Deakin Crick, 2008, p.313). In addition, personal teacher qualities are listed as relevant such as critical thinking, creativity, taking initiative, problem solving and risk management (Deakin Crick, 2008, p.312). Likewise, Zhu et al (2013) investigated core competencies related to innovative teaching. Their research revealed four core competencies for innovative teaching: learning, educational, social and technological competencies.

Additionally, researchers have extensively explored more holistic and dynamic perspectives on teaching. For example Biesta (2015) argued that a single perspective on teacher 'competences' can be problematic. More specific, a competence perspective can lead to overemphasizing the technical dimension of the teaching profession; possibly resulting in long lists of 'tickable' competences. Biesta (2015) argued that this might even lead to undermining the agency of teachers. Similarly, other researchers such as Timperley (2008) acknowledged the dynamic and contextual character of the teaching profession. Beijaard et al (2004) pointed out that the teacher's active role in the forming of his professional identity is even threatened by striving for uniformity and conformity. This being said, the implementation of BL is a process which affects both teachers' competences and their dynamic and contextual professional identity.

Few researchers have investigated BL from a cognitive, neurological perspective. Our human cognitive architecture is actually 'built' to preserve existing beliefs and understandings instead of actively plunging unto new challenges (Katz and Dack, 2014). According to Katz and Dack (2014) there are a number of cognitive biases that prevent teachers from engaging in 'real' professional learning. These biases can be considered as mental shortcuts that teachers (unconsciously) activate when being confronted with change. Possible biases are (1) confirmation bias: people tend to select only the information that confirms their current knowledge and beliefs. (2) Vividness bias: people overemphasize the value of what is very noticeable. And (3) omission bias: people believe that taking no action is better than risking new actions. Hence, they maintain the status quo.

2. Research objective and research questions

Given the above, it is clear that many (f)actors influence the implementation of BL and that educational change must at least take into account the teacher as a person (Fullan, 2014). Empirical investigation in innovative core teacher competences is a "valuable way to understand the real situation and perspectives about innovative teaching and learning of teachers in schools" (Zhu et al., 2013, p.25).

This study aims at investigating and identifying relevant teacher attributes when implementing BL. The main research question that guided this study is: What teacher attributes contribute to or hinder the implementation of BL in higher education? To answer this research question, the following subquestions were formulated: What adaptive teacher attributes do experts describe as relevant for the uptake of BL? What maladaptive attributes do experts describe as hindering for the uptake of BL?

The insights from this study inform the process of BL implementation by taking into account relevant teacher attributes when addressing teacher change on blended learning or organizing teacher professional development initiatives.

3. Research method

3.1 Expert interviews

To investigate underlying interpretations and behaviors of practitioners, qualitative approaches and indirect measures are commonly used (Miles et al., 1994). Van Audenhove and Donders (2018) and Bogner, Littig and Menz (2009) suggest expert interviews as a valuable and legitimate empirical research method to reveal insider process knowledge on practical complex problems. Bogner et al (2009, p.221) define an expert as "someone who is responsible in some way or another for the development, implementation or monitoring of a problem or who has privileged access to information about people or decision processes." Since experts are better at selecting relevant details from large sets of information, spend more time analyzing problems qualitatively and are better at transferring knowledge to other domains (Bogner, Littig and Menz, 2009; Willingham, 2009), this method was chosen for investigating the challenge of implementing BL from the perspective of the teacher across contexts. Although the experts fairly addressed contextual complexities, this study focuses on the teacher perspective in order to identify relevant teachers' attributes across contexts. The experts' own contexts in their universities were not considered.

3.2 Participants and data collection

Purposive sampling, and in particular intensity sampling, allows the selection of a small number of representative cases that provide insider information and knowledge of a particular phenomenon (Patton, 2002; Teddlie and Yu, 2007). All Flemish universities were included in the selection process for the current study. In addition, experts from Flemish university colleges were included. Fifteen participants were invited through email. Twelve experts agreed to be interviewed. All participants were considered experts with BL based on their certification, experience in their organization, LinkedIn profiles and after discussion within our research group. An overview of the experts, their background and roles is presented in Table 1.

The experts were asked to prepare a relevant case from their institute and experience. All participants were interviewed by the first author. The duration of the interview varied between 39 and 86 minutes with an average of 62.75 minutes (SD=13). To ensure a safe climate, the first author communicated that experts could talk freely and that all data would be treated anonymously. All interviews were audio recorded with permission of the participants through a signed informed consent. A semi-structured topics list was used by the interviewer to guide the interview.

Table 1: Expert participants and their BL role.

Expert[a]	Background	Role
Marc	PhD Educational Sciences and Innovation	Educational advisor and designer, project leader
Luke	MSc Educational Sciences	Curriculum and instructional designer
Finn	MSc Communication Sciences	Advisor technology enhanced teaching and learning
Frasier	MSc Psychology and Educational Sciences	Director teacher training institute
William	MSc Educational Sciences, E-learning	Head of research on educational innovation

Expert[a]	Background	Role
Charlotte	PhD Educational Sciences	Professor in e-learning design and educational technology
Alice	PhD Educational Instructional Technology	Associate lecturer and researcher in educational technology
Ferguson	Higher professional education Technology enhanced learning	Project leader E-learning in higher education
Agatha	PhD Educational Sciences	Researcher in instructional psychology and technology
Travis	MSc Computer Engineering + certificate Educational Technology	Educational advisor blended learning
Grace	PhD Educational Sciences	Project leader educational technology
Harry	MSc Instructional and Educational Sciences	Instructional developer and researcher

[a]All names are pseudonyms

3.3 Data analyses and trustworthiness

Eight out of twelve interviews are currently transcribed and analyzed. The analysis started by reading the transcripts several times to allow first categories to emerge by means of open and inductive coding (Thomas, 2003) in NVivo 12. To improve trustworthiness, two consistency checks are currently performed. After an introduction to relevant literature underpinning this study, a second researcher coded three of eight interviews inductively and parallel to the first author (Thomas, 2006). As a result of this open parallel coding, there was insufficient reliability. In line with Armstrong et al (1997) there was agreement on general themes but both researchers packaged them differently. For instance, first author coded "a fascination to exploration technology" while the second coder tagged this as "a capacity for curiosity and exploration of technology". Informed by discussions, the first author explored the interviews again. After refinement and (re)grouping, the following categories and codes in Table 2 emerged.

Table 2: Final codebook

Main category	Subcategory	Code
Adaptive attributes		
	Intrinsic motivation	Teacher are intrinsically motivated
		Feeling awarded by a superior
	Skills	Being able to reflect on own teaching practice
		Being able to reflect on 'what means good education' for my students
		Capacity to connect technology to learning processes
	Attitude	Genuine concern with teaching quality
		Realizing a need for change
		Being curious to investigate technology
Maladaptive attributes	Teacher biases	Confirmation bias
		Vividness bias
		Omission bias

4. Preliminary results

4.1 Adaptive attributes

Experts perceive the following attributes as positively affecting the implementation of BL.

A genuine concern with the quality of teaching practice. (Attitude)

According to the experts (n=6) teachers who adopt BL show a general concern with the quality of their teaching practice. They have a general reflective attitude and show sincere willingness to think about their own practice. In Marc's words: "Involved teachers have the internal realization that simply giving your PowerPoint is not enough anymore." Or as Frasier formulates:

> *"Because yes, you feel and see that those teachers are very concerned by a particular problem in their teaching practice. The fact that they are concerned, is an absolute minimal requirement."*

Realizing a need for change. (Attitude)

The experts (n=8) mention a triggering event to activate the concern with teaching quality and a consideration to implement BL. Concerned teachers become aware of a particular pedagogical need or problem in their teaching practice that triggers the process of change. Being concerned is not enough according to Ferguson who states that the teacher in question needs to 'do' something with that concern:

> *"That particular teacher realized through student feedback that something needed to change. "I lost my students somehow and I wanted to change that". With that question, he came to our instructional design department."*

The experts ascertain the following pedagogical needs as triggers for teacher change: (1) student-oriented reasons (n=7) such as activating students in large groups; dealing with diversity in heterogenous student groups; using BL to meet the needs of international and working students. And (2) more pragmatic reasons such as gaining time, or problematic subjects that many students struggle with.

Exemplary for these pedagogical needs are Finn's words: "We have a lot of subjects with many variations in student population and big differences in students' prior cognitive abilities." Marc and William state, "teachers have to teach less when applying blended learning, so then they have more time for projects. University departments implement blended learning to cut costs."

Capacity to reflect on their teaching practice. (Skill)

The genuine concern and realizing the need for change congregate in a skill namely the 'capacity to reflect on the own teaching practice'. This is generally described as an important attribute by the experts (n=5). For instance, Alice stated, "Teachers are able to ask themselves 'why do I react this way, what is my pedagogical intention here?'. There is a kind of pedagogical reasoning aspect involved."

Finn used other words to identify that reflective skill: "That teacher took a student evaluation as a starting point where students said, 'we are not prepared well enough for the exam', and based on that he realized that his teaching style did not prepare the students enough." Marc even explicitly identifies "being able to self-criticize" as one of the most important teacher attributes. Charlotte confirms this capacity but extends it to a higher level: "What do those teachers think is good teaching? Those teachers have a good understanding of what is good education, what is good teaching, and what does that mean for students?"

Sense of curiosity and creativity to connect technology to learning processes. (Attitude and skill)

This critical attribute related to technology was identified by the experts (n=4). From an intrinsic curiosity and "love for learning" (Alice) teachers deliberately explore technologies and how technology can contribute to the learning process. In Alice's words:

> *"Those teachers have a fascination for learning and the affordances of technology, for the potential affordances of technology for learning. And the willingness and the curiosity to explore them. Teachers address the challenge of 'how can I use those shiny or non-shiny tools - because sometimes those tools can work on your nerves - to enhance the learning process?"*

Finn and Marc confirm the importance of a curious mind to explore technology for learning. As Marc stated, "the pedagogical creativity, the possibility to quickly switch to other options, to explore new ideas, yes, those are skills that are very necessary."

Rooted in intrinsic motivation

Intrinsic motivation was clearly present as an umbrella construct for these relevant teacher attributes. Although only two of eight experts mention "intrinsic motivation" literally, it is clear that the described adaptive attributes in Figure 1 originate from internal interests and personal motivation, rather than external factors. As Charlotte states:

> *"So, in a way, it also came from their own internal motivation because they wanted to have blended learning. … For some, it is simply about internal motivation, they like to integrate educational*

technology, there's a lot of technology available, online, and now recently [the new online learning environment] available. So, they are intrigued by using new methodologies."

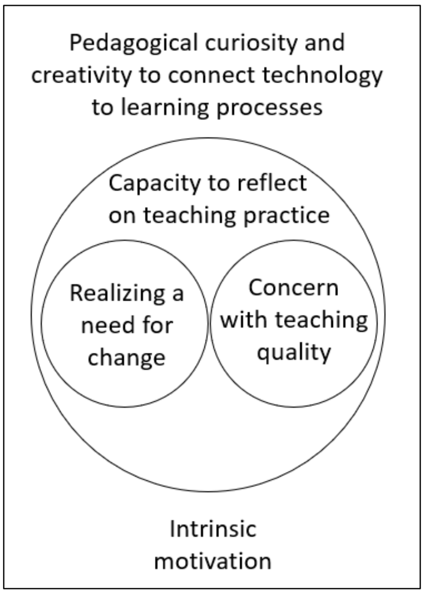

Figure 1: Overview adaptive attributes

4.2 Maladaptive attributes

All experts articulate at a certain point teacher attributes that hinder the uptake of BL. Alongside anxiety for new technologies and a lack of time, experts express particular excuses that teachers formulate. According to the experts (n=6) teachers prevent engaging with or misuse of the concept because they have a number of cognitive biases on the concept of BL.

Vividness bias

BL has a number of noticeable features such as the use of video clips or the reduction of face-to-face moments. Teachers tend to overemphasize these vivid features and therefore have a limited view on BL. According to Marc and William:

"Blended learning? Yes, okay, then you will come to record my lessons."

Teachers will try to explain that with a lot of screencasts and PowerPoints in the online learning environment.

Teachers say "Yes, okay, then we have to teach less and then we have more time to work on projects".

Confirmation bias

People tend to interpret new information in relation to their current assumptions and beliefs, and therefore disregard parts of the change which they perceive as contradicting.

For instance, in Luke's words, "Teachers who say 'yes, that's pretty interesting, but I don't have the time and that [making a blended course] is not currently in the project." Hence, they do not investigate possible added values of BL. Or as Ferguson stated, "people are naturally habitual, and they think "that's how it works now, for me, so I'm not going to change much about that" which is confirmed by Frasier and William.

Omission bias

This bias is related to the confirmation bias. People tend to have an indisposition to change based on their current assumptions and beliefs. Yet, in contrast to the confirmation bias, the status quo is maintained. According to Ferguson and William:

"I feel pretty comfortable now with my teaching as it is", or "I like teaching this way, and my student evaluations are well."

"If I put my time into it now, and within a few years it will all change again, something else will come up, then I will not make it all over again."

5. Discussion and limitations

The current study investigated relevant attributes that affect implementation of BL. Although the attribute "sense of curiosity and pedagogical creativity with technology" specifically addresses technology and learning, the experts touch upon psychological constructs such as awareness and intrinsic motivation. According to Ryan and Deci (2000, p.1) intrinsic motivation is "a type of motivation based in people's natural interest in various activities that provide novelty and change". Intrinsically motivated people engage in behavior because of internal interests, rather than external rewards. The attributes in this study are in line with previous research on motivation and education (Gorozidis and Papaioannou, 2014; Lai, Hsiao and Hsieh, 2018) by acknowledging intrinsic motivation as positive predictor to implement innovations. Yet, further investigation is needed on how these attributes relate to the psychological needs for competence, autonomy and relatedness. Zhu et al (2013) found four core competences for innovative teaching such as BL, namely: learning, social, educational and technological competences. The attributes in this study pertain to the learning, educational and technological educational competences from their study. By connecting competences to intrinsic motivation and awareness, the results of this study give nuance to three of the four core competences of Zhu et al (2013).

Teaching context and the culture of teaching impact teacher change (Fullan, 2014). Although the experts acknowledged context, these results were not included in this study. Future research could focus more on the relation between contextual and cultural complexities and the relevant attributes from this study. Another limitation of this study concerns the chosen method of expert interviews. Although expert interviews are a valuable method to investigate complex practical problems, the experts testify from their own perception “about others”. Triangulation with first-hand data would add validity to the results. Finally, reliability of the preliminary results can be improved by including stakeholder checks with relevant third parties and analysis of the final four interviews.

Organizations that face implementation of BL benefit from the results in this study since it provides insights into relevant teacher attributes. However, the practical implications of these attributes for the actual implementation could be explored in future research. Questions that would need further investigation are: “How can these results be translated into professional development initiatives so that practice benefits from it?” and “What approaches can turn biases into an openness or willingness to change?”.

6. Conclusion

The implementation of BL is not an easy endeavor. It impacts both organizational and personal aspects of the teaching practice. Yet, the teacher remains central in any process of educational change. This study investigated relevant teacher attributes that contribute positively to adoption of BL. Four attributes rooted in intrinsic motivation were denominated by experts in Flemish higher education. Additionally, experts provided insight into cognitive biases that hinder the uptake of the innovation. The results from this study inform practitioners concerned with implementation and deliberate application of BL in higher education. When addressing teachers that innovate their practice, this study suggests paying attention to (1) reflective activities on teaching practice, (2) deliberate connection between various technologies and how they contribute to the learning process, and (3) the challenge of overcoming bias towards the concept of BL.

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Work in Progress Papers

Incarcerated Students’ Support Services in Open Distance e-Learning: A Mixed Methods Protocol

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Abstract: Support for students is crucial for them to excel in their studies; even more so for those who are studying via distance education institutions because they do not have the on-campus support that students in traditional institutions have. As students of the University of South Africa (UNISA) who are isolated from the general population of distance education students and society, incarcerated students experience unique challenges which constitute a threat to their education. This ongoing study focuses on the experiences of institutional support by incarcerated UNISA students to understand their challenges and to offer recommendations on how to overcome them. It is hoped that this study will not only increase the throughput rate among the incarcerated distance learners under study, but also reduce their chances of recidivism upon re-entry into society as education has been shown to positively influence recidivism.

Keywords: open distance learning, student support, incarcerated students, distance education

1. Introduction

The high attrition rate of open distance learning (ODL) universities (UNISA, 2011:9) makes the provision of student support a priority. Support for students is crucial for them to excel in their studies (Ukpo, 2006:254; Ludwig-Hardman and Dunlap, 2003:1). This is even more true for students who are studying via ODL institutions (Ngubane-Mokiwa and Letseka, 2015:3; Dzakiria, 2008:103) because they do not have the on-campus support – physical buildings and designated staff with whom they can have face-to-face interactions regarding admissions, student records, financial aid, registration, library services, bookstore and counselling - that students in traditional institutions have. ODL students are often physically isolated from other distance education students and society, but incarcerated students even more so. This may not only constitute a threat to their education, but may also discourage other inmates from studying via ODL and open distance e-learning (ODeL) universities. Hence the need for research on institutional support for incarcerated students who study via distance education institutions so as to understand their challenges and also unearth ways of overcoming them. Institutional support to learners enrolled in ODL institutions can be in various forms, such as tutoring by correspondence or face-to-face; electronic or telephonic counselling; organisation of study centres; teaching via television or radio; library and administrative services (Ukpo, 2006:253; Kumar and Coe, 2017:136). This study will examine the institutional support available to the participants of this study from UNISA.

2. Aim and objective

This paper describes a research protocol for a study that will be conducted on student support for incarcerated distance education students enrolled with UNISA. This protocol is being used to plan research and reflect on the pre-data gathering phase of the study. The data collection phase of this research will commence in 2020.

3. Sanford’s theory of challenge and support

This study is informed by Sanford’s theory of challenge and support. Sanford and other scholars of this theory contend that student development is influenced by challenge and support. Inadequate challenge and support can hinder student development. A desired requirement for student development is a balance between the challenges and support that are experienced by students (Sanford, 2017; Ward, Trautvetter and Braskamp, 2005:2; Holcomb and Nonneman, 2014:102). The challenges of this study’s participants, as ODeL students, will be explored and corresponding support suggested.

4. Methods

4.1 Research design

A mixed methods research methodology (Schnoonenboom and Johnson, 2017; Gilbert and Stoneman, 2016:120), specifically, a multiphase mixed methods research design (Creswell and Plano-Clark, 2011:72), will be used for this study. This will involve, at different stages, the combination of quantitative and qualitative data collection methods with appropriate data analysis techniques. The use of a mixed methods research design will increase the validity of the findings of this study, assist in developing data gathering instruments, allow for elaboration and clarification of participants' responses, and also allow for generalisations based on a representative sample of participants that is expected to be generated from the quantitative data collection. In using multiphase mixed methods research design, a focus group discussion (FGD) among selected Department of Correctional Services (DCS) staff (who are involved in the inmates' education, such as the educational officers) will be the starting point for the data collection. This will be followed by questionnaire administration to the inmates and selected DCS staff, and concluded with in-depth interviews of the inmates. The design of data collection instruments and their administration will be interdependent to allow insights to be incorporated in the subsequent phases. The data gathered from the FGD will assist in developing the questionnaire. During the interviews, probing questions will be asked to better understand the answers that were provided in the questionnaire. It is expected that a combination of the various data collection methods will generate robust understanding of student support in distance education as experienced by incarcerated people.

4.2 Study population, participants and targeted sites

The study population for the quantitative leg of the research will include all UNISA students who are inmates of correctional centres in South Africa and all DCS staff who are involved in the formal education of inmates. Due to the expected large number of incarcerated UNISA students (projected figure based on 2019 enrolments is approximately 400), the quantitative data collection instrument will be a questionnaire. The qualitative data collection of this study will take place at Kgosi Mampuru II Correctional Centre, Pretoria, because it is one of the largest of its kind in South Africa, and male and female inmates are incarcerated there (Makatile, 2016; Mamosadi, 2010:44).

4.3 Sampling technique and sample size

Purposive and snowball sampling will be used for qualitative data collection (Bouma and Ling, 2006:117). Willing inmate participants who are UNISA students will be selected and invited to take part in this study. These prospective participants will be identified with the aid of lists (that will be obtained from UNISA and DCS) of UNISA students at the correctional centres. The selection criteria for the DCS staff who will be part of the FGD are premised on their jobs as educational officers of DCS which gives them knowledge of some of the inmate participants' experiences as ODeL students of UNISA. For the quantitative data collection, some DCS staff who are knowledgeable about some of the ODeL experiences of the inmates, as well as inmate respondents who are UNISA students registered in 2020 will be selected. The sample size of this study cannot be pre-determined because it will be dependent on the as-yet unknown number of inmates and willing participants.

4.4 In-depth interviews and FGD

The in-depth interviews (Marshall and Rossman, 2016:147) and FGD (Gilbert and Stoneman, 2016:302) will be used as complementary methods of data collection to the questionnaire. The interviews will be conducted individually with the inmates and some DCS staff in safe spaces within the correctional centres. Interview schedules for the individual interviews will be developed after analysis of the quantitative research. The participants in the FGD will be selected DCS staff only. Both the interviews and FGD will be guided by open-ended questions to allow participants to provide an array of responses which will give a rich and comprehensive understanding of the subject matter.

4.5 Questionnaire

The sole data collection instrument of the quantitative data phase will be questionnaire. The questionnaire for the inmate respondents and the selected DCS staff will be mailed or couriered to the correctional centres for onward distribution to prospective respondents (within the correctional centres) and the questionnaire will be returned through the same route. The questionnaire will contain closed-ended questions, which will provide a "shared frame of reference" and assist in generating reliable data (Gilbert and Stoneman, 2016:248). The questionnaire will have two sections – the first section will obtain the respondents' demographic information and the second section will contain questions that are germane to the subject matter of this study. Piloting of the questionnaire (Gilbert and Stoneman, 2016:252-255) will be done it is administered to all the respondents.

4.6 Data analysis

Each data collection phase will be analysed independently and interphase analysis will then be conducted. Consistent with Hsieh and Shannon's conventional qualitative data analysis (2005), categories will be allowed to emerge from the participants' responses regarding their experiences of support as incarcerated distance education students, rather than using preconceived categories. This type of qualitative data analysis is advantageous because it allows new information to be generated. Descriptive statistical analysis (Creswell, 2008) will be used for the quantitative data. The quantitative data will be analysed using SPSS software, frequencies, descriptive statistics and percentages. Possible relationships between variables based on statistical analysis can only be developed meaningfully after the initial phase of qualitative research has been completed.

5. Discussion

5.1 Protocol goal

Although literature abounds on student support in ODL and ODeL, most of it concentrates on non-incarcerated students. This is not surprising because the number of incarcerated people is far less than that of non-incarcerated people. This observation notwithstanding, there is a need to research the institutional support for incarcerated distance education students because their unique characteristic of being isolated from the population of distance education students presents unique studying challenges. These require specific student support solutions that may be different from those for the non-incarcerated distance education students. Hence, this research protocol seeks to determine the experience of support, in ODeL, as described by incarcerated distance education students and DCS staff who work with inmates studying via UNISA.

6. Implications and conclusion

This study will add to the sparse literature on student support for incarcerated distance education students in South Africa. It is hoped that the knowledge produced in this study will help shape UNISA's policy on student support for incarcerated individuals, thereby assist more incarcerated people to study via the institution and help to reduce recidivism after incarceration as a result of the formal education obtained. In line with the contention of Sanford's theory of challenge and support, it is expected that the recommended support discussed will bring about an equilibrium between the participants' challenges and their required support needs.

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Challenges in Designing e-Learning for Educators With Limited Time and Access

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Abstract: This project aims to develop three e-learning courses, each containing six modules concerning early childhood education and care (ECEC). Each of the modules is designed to be completed in small gaps of time by educators, who have limited access to computers in their daily practice. This is one of the challenges in designing materials for educators in this area. Another challenge that also needs to be addressed when developing a learning design framework and producing modules is the diversity of educational provision across countries. Preliminary findings have revealed challenges in the academic process of condensing and re-mediating theoretical work on Child-centeredness in ECEC settings into meaningful online modules for practitioners. Difficulties can also arise when attempting to ensure coherence and progression between online modules that have been created by different partners. This presentation will emphasize how the project is developing manageable online courses for ECEC educators, which can be, completed in short spaces of time in their daily practice. Based on the experiences of re-mediating theoretical texts in multimodal formats, this paper and poster seek to encourage interest in the design process of online courses.

Keywords: learning design, online learning, practice development, skills development, early childhood education

1. Introduction

Developing relevant and applicable online courses for educators working in early childhood education and care (ECEC) settings is not a straightforward process. When designing for educators in ECEC settings such as kindergartens and pre-schools across different European countries, it is important to be aware of the diversity between practices. Although there are common characteristics between daily structured and non-structured activities, differences are found in the prioritisation of early learning, learning objectives, academic subjects, activities and free-play. How might one design for this diversity? Furthermore, when designing online learning for educators to access in their professional environment, challenges like limited time and access to computers need careful consideration.

The Research Centre for Learning and Digital Technologies at VIA University College has participated in the Erasmus+ project “Interpreting Child-Centredness to support Quality and Diversity in Early Childhood Education and Care”. The project is in collaboration with partners from UK, Croatia, Ireland, Spain, and Italy. The project aims to support the development of the educators’ professional and technological competencies. This by designing and developing three online courses as illustrated in Figure 1.

Researchers from VIA have developed one of the courses, with Spain and Italy developing the other two courses and UK developing the general introduction to all three courses. Furthermore, VIA has also been responsible for designing and conducting workshops structuring the development of the three online courses. In the workshop participants were encouraged to consider ‘how might continuing education for ECEC educators be supported by the use of technology’? Inspired by Learning Design (LD) methods, an overall LD framework for online courses was developed to extend educators’ understanding of the competences required for Child-centred practice in ECEC settings.

The project also need to consider the educators’ mind-set, which was likely to be based on ‘traditional’ ways and understanding of participating in further education - traditional in the sense that educators enter a course at an educational institution located away from their professional environment. An online course will, however, move education into the educator’s professional environment, with the objective of bridging the gap between theory and the educational context

The intention is to bring new perspectives into play; the design should provide a variety of online resources to support educators’ reflections and interpretation of their ECEC setting. The learning objectives should therefore build on collaboration among professionals, promote self-reflection and accommodate further interest in trying out new perspectives. This tension between these two ways of being becomes relevant to the LD and makes it interesting to investigate.

Figure 1: The three courses and the modules within each course

2. Theory

Project team members from VIA conducted a workshop based on a LD methodological approach as part of a partner meeting. Present were the developers and the content providers. One of the LD approaches is based on Conole's definition of LD as a process when designing *for* learning (Conole, 2013, p. 7) and her LD taxonomy defining the distinction between a learning unit and LD (Conole, 2007). Mor and Craft (2013) define LD as a process: *"Learning Design is the act of devising new practices, plans of activity, resources and tools aimed at achieving particular educational aims in a given situation"* (Mor et al., 2013, p. 86).

The design-based approach inspired by Conole's 7Cs of LD supports participants in discussing and conceptualize the overall LD of the three courses. Furthermore the Collaborative e-Learning Design method (CoED) motivated a collaborative approach and three phases 1) a common foundation, 2) discussion of pedagogical values, and 3) making a LD (Georgsen and Nyvang, 2007). When adopting LD methods, collaborative aspects are especially important in the design process; these enable diverse perspectives on the LD by inviting negotiations of meaning (Wenger, 1998).

3. Method

Based on LD methodologies and the phases of the CoED method, the facilitated workshop initiated a design process involving e-learning designers and researchers. Through a collaborative and visual process, identification of learning outcomes and objectives for the courses took place. Different pedagogical approaches and values had to be managed in relation to concepts, words and translation, when designing for educators across a broad field of ECEC-settings. The workshop participants reflected and focused on general considerations in relation to subject matter, pedagogical theory and the overall design framework of the online course.

The workshop was divided into three phases:

First, the facilitator focused the LD process to support a common understanding of learning, together with an understanding of how the learning management system (LMS) can support learners.

Second, the overarching values and principles for the design were identified. Participants' expectations were addressed through pedagogical and didactics challenges. The LD should support a broad field of ECEC practitioners and enhance the learner's reflection on aspects of child-centered practice in their own ECEC-settings. The overall design therefore needed to frame and facilitate collaborative learning and reflection.

The third phase, the detailed design, is based on phase one and two. Subjects within each of the three courses were divided into six modules each (see Figure 1). The third phase also dealt with the overall design of the courses and modules storylines. In this phase, the participants were divided into three groups dealing with one course each.

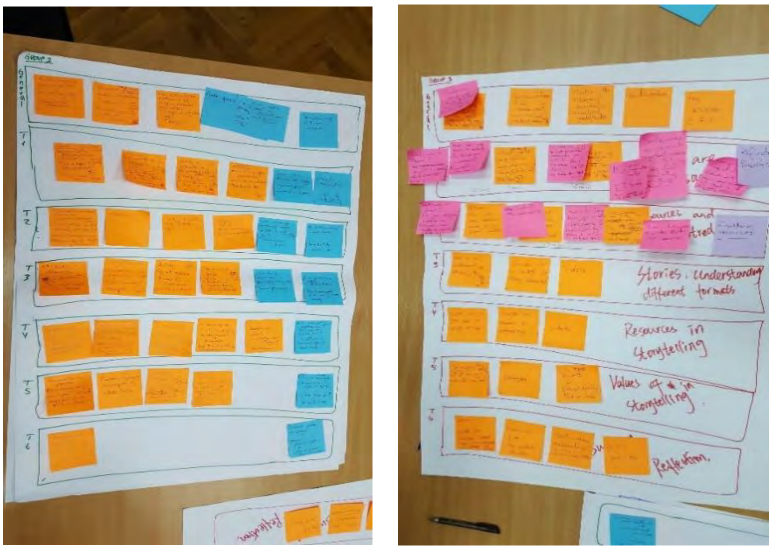

Figure 2: Illustration of the work in the design workshop

Each group came up with different learning activities in the LD for the whole course and the individual modules. Based on the groups' individual designs, a simple structural learning path was discussed and agreed upon. Each module should start with a few lines of introduction and clear objectives for the course in form of 1-3 Outcome / Learning goals. Next theoretical points had to be presented in videos with voiceovers, such as slide shows with narration, video presentations and footages from ECEC-settings. Short texts were created and pictures from ECEC-settings were selected. As part of the module, the learning content/objects should encourage participants to reflect on their own practices. Each module ends with some questions for further reflection and discussion in the local ECEC-setting.

4. The e-learning course design – challenges and possibilities

In the project, one challenge was to cooperate in developing three online courses across large geographical distances. Across European countries there are variants in patterns of professional development among ECEC staff (Jensen and Iannone, 2015). When using an online learning platform to overcome the challenges of distance and diversity, it becomes relevant to reflect on; how the online platform can do more than just serving as a digital storage of online resources, but offer future education that can be online accessed in the ECEC-settings. The importance of organizing an online course must be carefully considered (Conole, 2007; Salmon and Wright, 2014). Research points towards education of ECEC staff in ways that can benefit from focusing on the ability to use knowledge in practice, and not through training specific methods and programs (Jensen and Iannone, 2015).

Another challenge is time and online access. Each of the modules is therefore designed for educators to complete modules in small gaps of time and with only limited access to computers, which they experience in their daily practice. This is an important challenge to address, which was addressed by designing each module to take only 20 minutes to complete, and the whole course therefore taking only 2 hours to complete.

In the course 'child-centred practice from an embodied perspective' the 5 stage model (Salmon, 2003) is used to scaffold the transformation of the academics' theoretical work into delivery of the individual modules. The course is designed, as a collaborative learning resource, based on LD methods that endeavour to harness a reflective design and taxonomy for the learner (Conole, 2007; Georgsen and Nyvang, 2007; Salmon, 2003). In Child-centered pedagogy values like free-play, Children's opportunity to communicate and be included as individuals are prominent (Warming, 2011). The project is focusing on creating a LD that frames and facilitates an open learning process through which participants can discuss and reflect on how they can enhance their Child-centred practice from an embodied perspective. The design is aiming to facilitate a variety of communities of practice (Wenger, 1998) in integrating in local ECEC settings, and support the ongoing renewal of child-centered approaches and practice.

The project is working systematically with the development of the courses. Challenges have appeared continuously e.g.: How is learning handled in small gaps of time? How is traditional academic dissemination transformed into online elements? How can the details of theoretical perspectives remain when scientific articles are transformed into (for example) short videos? The development of the modules was undertaken in a close collaboration between researchers and online developers. Video productions were sharply framed, articles and text was edited. Conventional presentations in the classrooms were re-mediated and incorporated into quizzes, cases, and finally, tasks for reflections on practice were carefully described and framed by recommended time intervals. The individual modules take into account the insecure users' access and use of the online material.

5. Conclusion

Our preliminary findings reveal challenges in framing and condensing theoretical work into meaningful online modules, as the project involved experienced and non-experienced online designers. Facilitation from learning designers intended to accommodate a clear and manageable framework. Strict framework and considered constraints in relation to the content elements contributed to academics' focus on selecting and communicating content and creating consistency in online modules. The LD process ensured consistency through the process of developing the courses that accommodated limited time in the ECEC settings, as modules are to be completed in short time frames. Furthermore, the modules advise reflections and discussions among educators in their own professional environment. The process of transforming classroom education to online learning was accommodated with the use of a consistent learning design. The courses have been evaluated in a first iteration with educators, and this shows that the main difficulties lie in using the online platform, as it was in English; also, some participants insisted on certificates for the students to complete.

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Digital Literacy in a Sociomaterial Perspective

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Abstract: This paper is based on qualitative research in a Danish Year 6 classroom during a multimodal literacy workshop where I observed students working with paper, computer, scissors, pencils and printers. Situated in sociomaterial theory the aim is to rethink writing and writing research. Through the concepts of intra-activity, enacted agency, and writing as translingual assemblage, I put to work data on students making a fashion magazine to demonstrate how dominant perspectives in literacy education are not adequate when conceptualizing literacy as intra-active and translingual assemblage. I demonstrate analysis and discuss how a posthuman approach can capture and understand how bodies, languages, materials, technologies, ideas, time, and space are all intra-actively producing literacies.

Keywords: sociomateriality, intra-activity, literacy, assemblage, enacted agency, writer identity

1. Introduction

This paper focuses on enacted agencies of writers and on writing as intra-activity and translingual assemblages (Kuby & Crawford 2018, Zapata et al 2018). It is based on a pilot study that is part of my PhD research on writer identities and digital technologies. My research is focused on Danish teaching in a Year 6 class at a municipal primary/lower secondary school in Denmark. The purpose is to explore and to cultivate more inclusive orientations for writing research and teaching, integrating both literacy practices we know and are familiar with, as well as those practices that might yet be unknown. My study emerges from multimodality (Kress 2009) and New Literacy Studies (New London Group, 2000), but demonstrates the inadequateness of these perspectives when conceptualizing writing as intra-activity, as well as explanatory frameworks for how technology is involved in and influences social processes. Focusing on learners and on the various materials and modes they use to produce texts for future use, NLS is limited to the domain of human social practices and focuses on the meaning of interactions and how we come to know, with tools and materials. Within a sociomaterial perspective, the study focuses on the constitutive entanglement of the social and material (Fenwick 2015), asking how this may change our research practices and writing pedagogies. After a presentation of sociomaterial theory of literacy, I examine how sociomaterial methodology can be carried out in classroom. After discussing of my findings, I conclude that we must invent new literacy research practices.

2. A sociomaterial theory of literacy

While influenced by sociocultural theory and NLS, I found that when researching in writing assemblages these theories left me searching for ways to extend the thinking about how materials, time and space were actively working with students in literacy teaching and learning. NLS broadened the definition of literacy, understanding literacy as always multimodal and situated in local and institutional contexts (Gee 2001, New London Group 1996). Multimodal design focuses on the meaning of literacy practices and multimodal products, and the affordances of the materials. That is, the human doing something intentional to materials. Technologies tend to be relegated as tools subordinated to human intention and design (Fenwick 2015). Sociomaterial theory decenters the subject (Kuby 2019), undermining understandings of knowledge, learning and education as solely social or human processes, and insists upon attending to the material that is enmeshed with the social and human. Focus is not on what the human does to materials and with others, but on the entanglements of humans, materials, time, and space.

For the purpose of this paper, I focus on a few concepts that emerged in the process of analyzing data, or "thinking with theory" (Zapata et al 2018). The first, *intra-activity* (Barad 2007), is the entanglement of humans and nonhumans producing new literacies. Intra-activity signals the entangled intra-action of humans and nonhumans, unlike interaction which focuses on social human relationships. Intra-action with materials expands what counts as writing. Next, a posthuman stance forces me to rethink agency, not from a human-centric perspective but as a force being produced. The material world is entangled with/in producing agency, and *enacted agency* (Kuby 2019) is emerging between people and materials, not residing in individuals. The students' agency is therefore the effect of and enacted through the sociomaterial entanglements in the classroom (Fenwick 2015). Finally, writing emerged as a *translingual assemblage* (Zapata et al 2018). Translingualism

(Canagarajah 2017) is a more expansive semiotic landscape that considers linguistic encounters with the materiality of space, place, matter, and semiotics. Assemblage theory provides an ontological frame for understanding pedagogies. DeLanda (2006) suggests that assemblages are dynamic and fluid wholes whose properties emerge from the interactions between parts.

3. Sociomaterial methodology

Sociomaterial studies in education aim to decenter human reasoning and reflection as the single source for meaning making (Kuby 2019). Because we are always already interconnected with our environments, methodological thinking should respond in kind by cultivating similar interconnections. Doing this, it is no longer enough to produce knowledge through interviews, observations, and texts. Language insufficiently represents the sociomaterial intra-activity. As a consequence I focused on the in-the-moment realities of students, teachers, materials, cultures, languages, and other semiotic materials coming together.

Thus, during my research I looked for ways literacies unfold in the moment (Leander & Boldt 2013), how they are woven into material assemblages, and how and when affective intensities arise. I focused on three notions: departures from the expected, intra-activity with materials, and writing emerging as a translingual assemblage. I tested different ways to produce data, and my analytical questions emerged in the process of analysis. I used videos of students in writing assemblages, student-made artifacts, conversations with students, photographs, and field notes.

To demonstrate different research practices, I will use a writing assemblage that occurred over a period of a week when the students worked in small groups with magazines related to their interests and hobbies (gaming, horses, music, etc.). The outcome was a multimodal artifact that to some extent resembled a professional magazine. The students selected topics, chose how to angle them, gathered information and pictures on the internet, wrote texts on the computer, and discussed layout and modalities for the product, working with paper, glue, and scissors along with word, Google, Sketch, YouTube, and Photoshop. Two girls, Ann and Nina, got entangled in a fashion assemblage of paper-glue-scissors-Ann-Nina-computer-internet-photos-drawings-printer. Humanist-centered research questions would focus on what identities Ann and Nina were performing, what materials they used to create artifacts, in what ways the sociomaterial environment shaped them as writers, or how their experience of being a writer was. Asking within this interpretivist paradigm I would miss the intra-active becomings and the enacted agencies.

Shifting focus to the intra-actions of students and materials, my questions instead included what was being produced as students-materials all inter-act. In what ways did students-materials identities become, shift, and change? How did the enacted agencies of students-materials create literacy texts? What newness was created? My point is that what counts as data in the fashion assemblage is put to question, not privileging the voices of Ann and Nina, but locating data that allows me to analyze humans and non-humans intra-actively becoming. I located data in the discourses, movements, bodies, and so forth that were produced in the fashion assemblage of paper-glue-scissors-Ann-Nina-computer-internet-photos-drawings-printer. I studied how the fashion assemblage enacted agencies and new literacies, e.g. by placing bodies around a table, producing movements of the hands, allowing some ideas, not others. And I analyzed how the printer, frequently sending Ann and Nina back and forth to get photos and texts, enabled new literacies by expanding the semiotic landscape and forming the materiality of space.

4. Findings

Preliminary results indicate that the writing assemblage produced both writing practices we know and are familiar with as well as departures from the expected. Ann and Nina (re)produced components that stabilized the identity of the writing assemblage, that is, territorializing it (Deleuze & Guattari 1987). At the same time they activated components forcing it to change, the departures at work in the assemblage creating new innovative folds in the classroom discourse (de Freitas & Curinga 2015). Activities that suggested rule-governed student practices were in constant interaction with actions that were spontaneous and improvisational. What I found was affective intensities and their effects emerging in the intra-action of bodies, texts, and materials, especially the printer. When removed from the dynamics of its own unfolding, much of Ann and Nina's activity made no sense. One moment did not necessarily build on the next, and it was not fixed in purpose. They were continuously off-task. And still, they did not at any time disturb the classroom assemblage. In fact, their dynamic, shifting, and ambiguous intra-activity with ideas, materials, and texts produced new literacies and new agencies.

Researching literacy in a sociomaterial perspective, the important shift is what texts are understood as doing; while indeed aiming to produce texts that are recognized as artifacts of literacy practices, what seems to count most for Ann and Nina was to move with and through the texts, in the production of intensity. Agency was mainly enacted when students were concerned with the ongoing surface creation of affect and effect that indeed involved a more expansive semiotic landscape. Seeing them entangled in this translingual assemblage, I began to recognize that these students had a broader view than I did of what being a writer meant.

5. Conclusion

In response to a sociomaterial theory of literacies, this paper has suggested that we need to rethink writing and the research of writing. I have argued that sociomaterial perspectives have potential to offer theoretical, methodological, and pedagogical possibilities. Through the concepts of intra-activity, enacted agency and writing as translingual assemblage a vision of practice that avoids a domestication, subtracting movement, indeterminacy, and emergent potential from the picture, was suggested. A sociomaterial approach is never simply one or the other—traditional writing or nontraditional writing—but a multiplicity and convergence of many possibilities. How does language become in relation with other semiotic resources and ecological matter? How are literacies, identities, and agencies produced in the entanglement of the social and the material? Therefore, as researchers we must invent new research practices to better understand the being, knowing, and doing of students-materials, slowing down to analyze those possibilities and their multiple and varied potential outcomes. Classroom literacies are rich with potentials. Practices may materialize in ways that are in line with mandated curricula, as children produce texts that adhere to the specific criteria of standardized assessments. But they also emerge in ways that departs from the expected. Literacy is charged with multiple potentialities, and further research is required to establish parameters adequate to measure what knowledges are produced when humans and nonhuman intra-act.

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Meaningful Communication and Active Learning in Online Courses

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Abstract: Many educators in higher education today are moving from an in-person, face to face setting towards an online learning environment because of benefits and advantages that online instruction provides, for example, saving time and money on traveling to campus and allowing students to learn at their convenience and pace. In order to help students to be successful, instructors must be willing to allocate the time needed for the creation and facilitation of a Web-Based Learning Community. One major component of the Web-Based Learning Community is Computer Mediated Communication that traditionally takes place through a text-based discussion board. Modern technology like real time videoconferencing enhances communication by adding social cues transmitted via video and audio. Through a variety of media, students are expected to interact with the content, their peers, and their instructor. Such interaction and communication facilitate the students' understanding and learning. In this paper, the authors first present literature relevant to online communication and learning communities. Then the authors share instructional strategies employed in their online courses. Instructional strategies include, but are not limited to, ice-breaking, moderating strategies, peer critique, peer review, peer evaluation, and the use of the video conferencing system Zoom.

Keywords: web-based learning communities, active learning, computer mediated communication, online learning, e-learning

1. Introduction

One of the authors has taught online courses for more than a decade. Initially she was overwhelmed by heavy workload for her online courses. To reduce her workload and to enhance student active learning, she experimented with a variety of instructional strategies. Some instructional strategies have worked well while others have not. The instructional strategies that have worked well include, but are not limited to, ice-breaking, moderating strategies, peer critique, peer review, peer evaluation, and the use of the video conferencing system, Zoom. A strategy that has not worked well resides in the design of responsibilities students play in moderating.

2. Online (web-based) learning communities

Online Learning Communities are the basis for all online classes. As defined by Hill (2002) learning communities are defined as a "culture of learning in which everyone is involved in the collective and individual effort to understand" (pg. 69). A strong learning community teaches learners to participate in a way that allows them to become proactive about their learning and interactions (Dixon, 2014). Learners interact with each other, building their own social network and relationships, which then leads to stronger interaction with the content of the course (Chen 2004). Strong learning communities require planning and preparation by the instructor but are ultimately are grown through the interactions of the learners (Chen 2004).

Web-based learning communities are built around Learning Management Systems (LMS), which is the online site for learners to interact with the content, the instructor, and each other (Chadha 2017). Effective learning communities are based on the principle that for learning to happen, the content needs to be learner-centred, active, and require strong communication between the learners (Ku, Lohr, & Chen 2004; Parker 2012).

As stated previously, strong learning communities require the building blocks of planning preparation. A successful learning community requires the instructor to be deliberate in their selection of learning outcomes, activities, and the support that they will offer to their learners (Mandernach, Dailey-Hebert & Donnelli-Sallee 2007). Instructors need to recognize the expectations, needs, and different learning styles of their learners in order to create an online climate that allows learners to interact with the content and each other, and ultimately facilitates the learning process (Mupinga, Nora & Yaw 2006; Thompson, Vogler, & Xiu 2017). Learners rate course organization and planning as one of the highest predictors of success in online courses, so it is important that instructors focus on course designs that allow for learner-centred interactions (Liu 2012; Poole 2000). In order to create an environment that leads to strong learning experiences, instructors must consider the diverse needs, expectations, and learning styles of their learners, as well as the utilization of the online tools available to them (Mupinga, et al 2006). For learners to be successful in online courses, instructors need to focus on creating an environment rich in resources and questions that allow learners to integrate the new knowledge and interact with it and each other (Mupinga et al 2006; Dixon 2014). Teaching strategies such as collaboration, discussion boards, frequent questioning and required learner participation should all be part of a successful learning community (Chadha 2017; Hamann, Pollock, & Wilson 2009). It is important to note that each instance of a Learning Community will be slightly different due to differences of interactions between participants that lead to a difference in the online experience (Chadha 2017).

Online learners feel that the role of the instructor is one of the most important factors in a successful web-based learning community. Instructors need to create an environment where learners feel comfortable with the content and each other. Expectations of the learners, especially when it comes to communication and community building, need to be explicitly stated and modelled by the instructor (Dixon 2014; Hill 2002; Woods & Bliss 2016). Email communications, feedback, and the instructor's interactions allow learners to feel that they are partners in the instruction, and they are not "missing out" because they are online rather than face-to-face (Mandernach, et al 2007; Lee & Martin 2017; Parker 2012; Mupinga et al 2006; Rayens & Ellis 2018). Two specific recommendations for instructor communication involve the use of constructive feedback as well as the use of weekly emails to help learners determine what they should be focusing on for the week (Woods & Bliss 2016; Hill, Raven, & Han 2002).

When creating a strong Web-based learning community, instructors need to focus not only on content, but also on their expectations for learner interaction. It is important to not only design projects that allow learners to interact with the content as well as each other, but also to model the expectations associated with these projects (Chen 2004; Mupinga et al 2006; Thompson et al 2017). Without examples and guidance, learners tend to focus only on their own ideas and arguments, as well as show a decrease in participation (Kwon & Park 2017; Dennen 2005).

Being an online instructor for a Web-based learning community requires a shift in thinking. According to Mandernach et al (2007) "teaching online courses may not take any more time than teaching face-to-face courses, but the time investment is distributed differently throughout the week" (pg. 6). Traditional face-to-face instructors can rely on their work week taking place Monday through Friday, with minimal interaction on the weekends. Learners in an online environment do not tend to post in a traditional Monday through Friday setting, but instead may do the majority of their posts on the weekends. These same learners appreciate that the instructor recognizes that they are not only students but "citizen-students" that deal not only with school but have many other demands on their time (Mupinga et al 2006). Online instructors must shift their interactions to accommodate the specific needs of online learners.

3. Instructional strategies

To foster a meaningful learning community, the instructor uses the following instructional strategies:

3.1 Ice-breaking

During the first week of the class, the students need to post an introduction about themselves, including things that many people know about them and things that most people do not know about. The instructor first models it by posting a similar introduction about herself. The students then post theirs and respond to their peers' posts.

3.2 Moderating strategies

During the first week of the instructor's classes, the instructor explains what moderating strategies are in an online environment and models by example how to be an effective online moderator/support in her classes. Students then choose a week when s/he will be available to serve as the online moderator/support during the week. Points are issued once students complete this task.

3.3 Peer review/critique

Students submit all of their assignments to the Discussions Forum. Then they need to review their classmates' submissions and critique their work. Critique has two levels: Level I Critique and Level II Critique. Level I Critique refers to the critique provided by the reviewers to the assignment submitters. Level II Critique refers to the feedback of the assignment submitters to the reviewers. Points are assigned to not only assignments but also the two levels of peer critiques.

3.4 Peer evaluation

Students are required to complete a team project and are strongly encouraged to help their classmates throughout a quarter. Toward the end of the course, students conduct peer evaluation. They need to divide 17 points among the team members including him/herself; no decimal can be used. They also need to provide their rationale for assigning the points. In addition, students recommend students as being the course's best contributors (two or three depending upon class size). The best contributors receive bonus points.

3.5 Zoom

The instructor recently incorporates Zoom into her online courses and meets students via Zoom every week for about 30 minutes to an hour. This synchronous meeting is mandatory.

4. Discussions and conclusions

To evaluate the effectiveness of the use of aforementioned instructional strategies in the online courses, the instructor conducted evaluation replying on student survey, class observation, and instructor's journaling. The results indicated that the (1) ice-breaking prepared an open learning community for students to interact, (2) moderating strategies fostered students' active learning, (3) the peer review/critique promoted students' critical thinking, (4) peer evaluation augmented students' engagement, and (5) the use of Zoom enhanced the instructor's instruction and student learning. Although the instructor is in favour of the use of moderating strategies in her courses, she suggests that professionals should carefully design and state responsibilities of students and their workload when using moderating strategies in online courses.

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The Climb to the Blended Learning Peak

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Abstract: In response to the common but often overlooked challenges faced by many teaching professionals when having to move from a face-to-face model of teaching and learning to blended learning (BL), the purpose of this paper is to present a series of research-based and practical guidelines to support educators facing this transition. Some of the key issues discussed are the need for an openness-to-change mindset, the importance of a meaningful integration between face-to-face and online elements and the need for a conscious choice of technology.

Keywords: blended learning, curriculum design, constructive alignment, technology, SAMR model, teaching presence

An ample body of research has been produced about the benefits of blended learning (BL), the variety of technological tools and online educational resources is growing day by day and a new group of professionals such as instructional designers and educational consultants specialise in this area. Despite this, many educators still feel unsure about how to shift from face-to-face teaching to BL. Since they are ultimately the key executors of pedagogical changes, it seems paramount to provide teaching professionals with appropriate guidance and support in their journey to BL. The purpose of this paper is to provide a series of research-based recommendations to support teaching professionals when transforming their face-to-face courses into blended courses.

In general terms, BL refers to the combination of face-to-face and online teaching and learning. The possibility of combining the best features of its two composing models (face-to-face and online) is considered one of the main advantages of BL (Nortvig, Petersen and Hattesen, 2018). BL can combine the benefits of classroom teaching, e.g. social interaction with peers, with the advantages of online learning, e.g. learning anywhere and at the desired pace of the individual. A blended approach also widens the range of possibilities for some skills or tasks, such as collaboration outside the classroom, online peer assessment and more personalised support in the form of online quizzes available for those in need of extra support (Tucker, Wycoff and Green, 2017). However, the perception of BL as a delivery mode that is “useful, enjoyable, supportive, flexible and motivator for learners” (Güzer and Caner, 2014) cannot be interpreted as a guarantee that meaningful learning is taking place. Thus, it is important to consider how best to exploit the potential of BL to create engaging learning environments and to address the challenges that its implementation may present for teaching professionals.

The adoption of BL involves for many teachers the introduction of significant changes in the teaching methodology and delivery mode they normally use and have themselves experienced as learners. This explains why several studies have concluded that mindset competencies are critical for the implementation of blended teaching (Staker, 2018). The International Association for K-12 Online Learning includes mindsets as the number one domain in the Blended Learning Teacher Competency Framework, specifying that a BL teacher should have “new vision for teaching and learning” and an “orientation toward change and improvement” (Powell, Rabbitt and Kennedy, 2014). Being aware that the change from face-to-face to BL will involve rethinking pedagogical habits and experimenting with new approaches seems to be a good starting point for any professional moving from face-to-face to blended teaching. Negative perceptions of blended courses as incoherent are often caused by the lack of a “thought-through pedagogical relation between parts of the blend” (Sharma, 2010), which indicates that in order to realise the full potential of BL, it is essential to achieve a meaningful integration of its two components: face-to-face and online teaching. Garrison and Vaughan (2008) claim that “blended learning is distinguishable by way of the integration of face-to-face and online learning that is multiplicative, not additive”. This point is particularly relevant in the case of BL that is created from a face-to-face course (as opposed to courses that are designed as blended from the beginning), as the course will have to be carefully redesigned to avoid adding online resources and activities which simply replicate what is already taking place face-to-face. Establishing a clear connection between the teaching and learning done in the classroom and the teaching and learning done online is “the real test of blended learning” (Garrison and Kanuka, 2004) and requires careful planning.

The distribution of resources and activities between the face-to-face and online contexts and their connection to each other vary for each specific course. Vaughan, Cleveland-Innes and Garrison (2013) point out that "best practices that are applicable to all blended learning course designs are not available", which means that each course has to be designed individually. The constructive alignment (CA) framework for teaching design, developed by Professor John B. Biggs twenty years ago and based on the ideas first proposed by Ralph Tyler in *Basic Principles of Curriculum and Instruction* in 1949, can be useful to approach the design of blended courses in a systematic manner.

According to the CA model, curriculum development should begin by setting the learning objectives of the course, followed by the design of activities that create the necessary engagement to attain those objectives and the choice of suitable assessment methods to evaluate the level of attainment. The correlation or alignment of learning objectives, activities and assessment would create the necessary conditions for students to "construct" meaning through their interaction with the activities (Biggs, 2014). The design of activities that require interactivity and collaboration and promote autonomous learning has emerged as one of the key factors in the successful implementation of BL (Bower et al., 2015; Lai, Lam and Lim, 2016). The CA framework can help teachers to keep the focus on the learning objectives of the course when considering which of the two contexts, face-to-face or online, has more potential to create meaningful engagement with the activities.

Together with curriculum design, the choice and use of technology also deserves especial consideration in the implementation of BL. The visual appeal and supposedly motivational and entertaining nature of some technological tools can encourage their use for reasons other than pedagogical ones. Educators are frequently cautioned that the use of technology does not necessarily have a meaningful impact in learning and reminded that a thoughtful choice of technological tools is critical to avoid losing sight of the learning objectives and needs of the students (Tucker, Wycoff and Green, 2017). A careful evaluation of the technological tools can ensure that they are suited for the purposes of the activities. The SAMR (Substitution, Augmentation, Modification, Redefinition) model is a useful framework to assess whether using a new tool represents merely a substitution of one tool with other (substitution); involves the substitution of a tool but also an improvement in the activity (augmentation); allows a significant redefinition of the activity (modification) or creates an activity impossible to be created without the technology (redefinition) (Hamilton, Rosenberg and Akcaoglu, 2016). Although the use of technology would be perfectly justifiable even when it results only in a small improvement of the activity, the SAMR model can help teachers reflect on how much enhancement they are really achieving by the use of a particular tool and thus encourage thoughtful choices of technology (Tucker, 2019).

The sheer number of educational tools and software available can also make the choice of technology challenging, as it is time-consuming to experiment with several options before choosing the right one. A way of dealing with this situation is introducing new tools gradually, one at a time if possible. A gradual approach to the introduction of technology facilitates the integration of the tool in the course and allows students to become familiar with it. This is an important issue to bear in mind since the perceived ease of use of technology seems to be a key factor affecting students' satisfaction with the e-learning components of blended courses (Sun Chen and Yong Tat Yao, 2016). Although it is generally assumed that students do not need training in the use of technology, it is very often the case that they have a lower level of competency using tools than teachers assume (Tucker, Wycoff and Green, 2017). Despite using technology in their daily lives for communication and socialising, students are not necessarily familiar with the use of technology for learning.

In the delivery phase of a blended course, most educators will experience that their role changes from owner of information to facilitator of learning and may find that the way they interact with the content, activities and students is significantly different from what it used to be. Instruction in BL environments can be challenging for teachers, as they try to find the right balance between "providing maximum flexibility and autonomy for students on the one hand, and carefully taking into account the need for structure and guidance of (certain) students on the other hand" (Boelens, De Wever and Voet, 2017).

Among the various new instructional skills that teachers have to apply when implementing BL, their role and presence in the online context is a relevant one. Many studies indicate that teaching presence is a key factor in the successful implementation of blended courses and the facilitation of ongoing student interactions and engagement in the online environment is considered one of the most important tasks of the instructor (Benson and Kolsaker, 2015). Some specific tasks that a teacher might need to manage online include providing contribution guidelines for online discussions, considering the need for anonymity in certain online activities and anticipating difficulties encountered with the use of technology. The amount of time required to be present online concerns many teachers who experience that online teaching requires more time than face-to-face teaching, which indicates that teaching time online needs to be managed differently from teaching time in the classroom. Some of the practical recommendations to put boundaries to the time spent online are using shorter but more frequent blocks of time when working online and providing students with clear expectations about the teacher's participation and involvement in online activities. Even when based on careful teaching design, most blended courses will need improvements to enhance their efficiency. Sharpe and Oliver (2007) explain that "as many as three or four iterations of course design, development and implementation may be needed to complete transition from traditional to blended e-learning course". An evaluation of the course may include an assessment of how effective the activities have been to create engagement or how useful the technological tools were. In the case of courses delivered through a learning management system, this evaluation can use learning analytics to collect valuable information about the participation, engagement and interaction of learners in online activities (Arnold, 2018).

In conclusion, a careful planning of the integration of face-to-face and online environments, a conscious choice of technology and an openness to acquiring new skills as an instructor can address some of the challenges in the shift to BL. Some of the issues to be explored in the future development of this project are best practices for a meaningful integration of face-to-face and online components and the role of the teacher to create an online community.

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Developing an Implementation Framework for Adaptive Learning: A Case Study Approach

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Abstract: Although the interest in using adaptive learning in online teaching is steadily growing, its broad implementation remains low. This is despite positive attitudes of institutional leaders towards its adoption and learning promising results of early studies on its empirical impact, for example, on students' learning outcomes and course dropouts. Recent studies have identified and discussed the challenges that prevent higher education institutions from using adaptive learning for their teaching purposes. However, little empirical research has been done to clarify the interdependency or interplay of these challenges. Our work aims to close this gap by identifying the relationships between the different types of challenges of adaptive learning. From this, we then develop an implementation framework of adaptive learning to propose effective implementation strategies for adaptive concepts in higher education. A Delphi design was used to collect the data from two universities, the North West University of South Africa (NWU) and the Swiss Distance University of Applied Sciences (FFHS), as our two case studies. For the data analysis, the Grounded Theory Coding approach was applied. The proposed framework shows the five empirically identified dimensions, such as technology, teaching & learning, organization, law & regulations, and cultural & political conditions, and lays out a basic structure for challenges, prerequisites, and facilitators enabling the implementation of adaptive learning. Our findings suggest that multiple perspectives on the challenges of adaptive learning should be considered when implementing adaptive learning concepts in a higher education setting. The findings are valuable for institutions that seek to implement or already pilot adaptive learning in blended and online teaching.

Keywords: adaptive learning, implementation framework, challenges to adoption, Delphi technique

1. Introduction

Higher education faces many challenges today, including high costs, lifelong learning, equal access to education and a high diversity of students with different socio-economic backgrounds, needs and lifestyles. Some innovative teaching approaches are emerging to meet these challenges. One of them is adaptive learning, which enables a personalized leaning experience in blended and online learning environments. Adaptive learning refers to technologies that monitor learner progress and use data to continuously modify teaching content to the behavior and needs of individual learners (Alexander et al, 2019). Today, interest in adaptive learning concepts is growing rapidly, but their broad implementation remains low (Green, 2018). This is despite promising findings on student learning outcomes, course dropouts, and positive attitudes of board members towards their adoption (Daines, Troka and Santiago, 2016; Green, 2018; Holthaus, Pancar and Bergamin, 2019). Recent studies have identified barriers and challenges that prevent universities from using adaptive learning concepts (Tyton Partners, 2016; Johnson and Zone, 2018). Most of these studies provided insights and recommendations on how to overcome implementation barriers and facilitate the introduction of adaptive learning in education. However, to date little research has been conducted to clarify the relationships between the different challenges identified or to develop an implementation framework for adaptive learning. To address this issue, we report on the current progress in the development of an implementation framework for adaptive learning in educational institutions. Based on the data collected within a Delphi study spanning two universities, this paper aims to identify and interpret connections between the challenges of adaptive learning by specifying their context. From this, we propose a first draft of the implementation framework of adaptive learning that is grounded in the participants' data.

2. Methodology and instruments

In this paper, we further analyse the data collected in the Delphi study on the challenges of adaptive learning (Mirata et al, in preparation). Delphi is a research method used to collect anonymous judgements of experts usually on a poorly defined topic or complex problem without face-to-face interaction using a series of questionnaires with interspersed controlled feedbacks (Skulmoski, Hartman and Krahn, 2007). Delphi can be designed to generate new ideas, predict future developments, reach consensus or obtain experts' opinions (Linstone and Turoff, 1975; Häder, 2014). We used Delphi as a research method, because it allowed a group of participants, as a whole, to deal with the evolving concept of adaptive learning in a flexible but still structured way. Our Delphi study was designed to obtain experts' opinions on the challenges of adaptive learning. According to Häder (2014), this type of Delphi is well suited for deriving interventions to respond to a problem identified in the study. Two simultaneous Delphi surveys were conducted at two universities with different socioeconomic, organizational backgrounds and implementation stages of adaptive learning: The North West University of South Africa (NWU) and the Swiss Distance University of Applied Sciences (FFHS). These universities were selected as our case studies to include different perspectives on adaptive learning. A purposive sampling strategy was used to identify participants with necessary expertise based on predetermined criteria, for example, years of working experience in a technology-based learning area (Elo et al, 2014). 27 experts from NWU and 24 experts from FFHS including lecturers, researchers, technology advisors, and administration staff participated in the Delphi study. The data was collected via online surveys with open-ended questions. The experts were asked to identify, describe and prioritize challenges related to adaptive learning.

In the present study, all participants' responses were analysed applying the Grounded Theory Coding approach (Charmaz, 2006) and a constant comparative method, which involves making comparisons during each stage of the data analysis (Glaser and Strauss, 1967). This coding approach was chosen, because it provides useful techniques (e.g., focus, axial, selective coding) for looking at the relationships between emerging concepts and categories, and developing hypotheses that interrelate the categories in the model. (Charmaz, 2006). The data was managed, coded, and visualized using the MAXQDA software Analytics Pro12.

3. Results

Due to the limited space, we present the preliminary results directly in the form of illustrations to show the emerged challenges and their interrelationships. Figure 1 shows the individual challenges and their classification into three dimensions and eight categories which were identified.

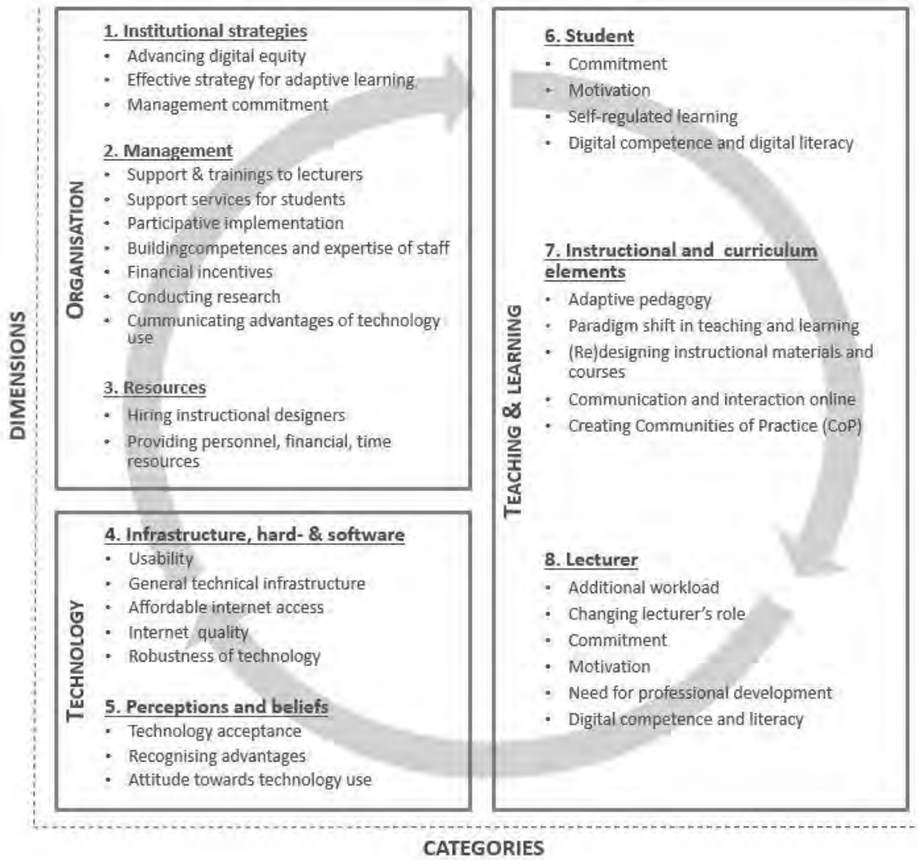

Figure 1: Challenges of adaptive learning, dimensions and categories

Figure 2 depicts exemplarily only the challenges of the technology dimension and their relationships with other challenges including examples of supportive quotations.

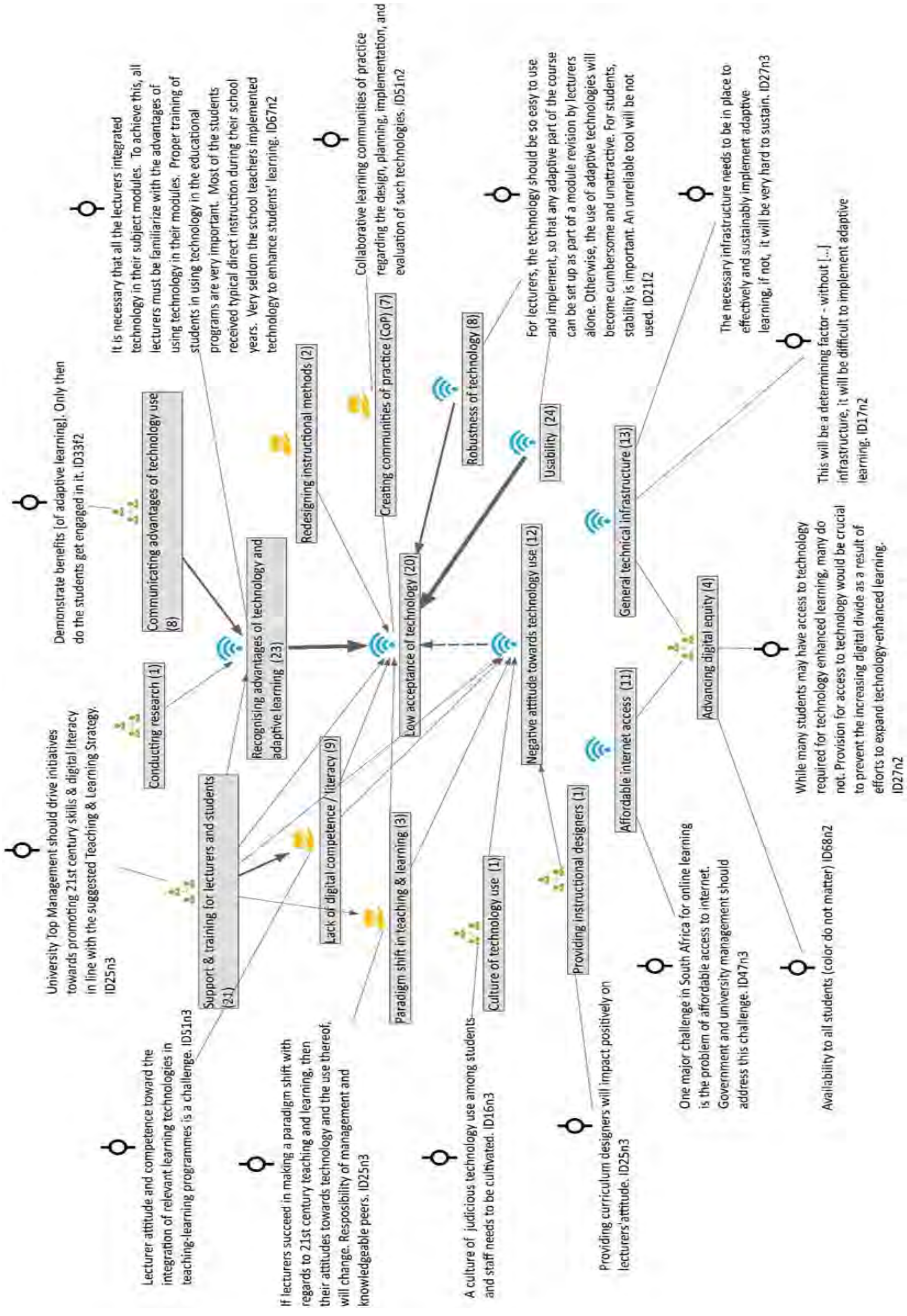

Figure 2: Dimensions: – technology, – teaching & learning, - organization; ϕ- quotations. The number of participants' statements related to a corresponding code are shown in brackets. The frequencies of identified relations between codes are shown through the line width: 1-2 connections, 3-5 connections, 6-14 connections. Dashed lines show hypothetical connections not supported by the data

4. Discussion and conclusions

To develop the implementation framework for adaptive learning, we analyzed different challenges (Figure 1) and their interrelationships (Figure2) by searching for causes and conditions of the observed phenomena. Due to the limited space and the current state of this research, in Figure 2 and the discussion, we focus mainly on the perceptions and beliefs category. We are aware of the limitations of this kind of presentation. However, we present a preliminary prototype of the implementation framework of adaptive learning and discuss briefly the next steps of its further development.

One of the challenges found at both universities is the low acceptance of current technology (e.g., adaptive learning systems). A relevant prerequisite condition for it was that most lecturers and students have not realized the advantages of using technology in teaching practices and learning yet. To support the recognition of the benefits of adaptive learning, the participants suggested improving the communication process between all stakeholders and empirically researching the impact of adaptive learning systems on learning outcomes. This finding is similar to one of the key findings by Brooks (2015), who found that faculty would adopt technology in their teaching practices more, if they had evidence that students benefit from it.

Another finding was that the low acceptance of technology is also a result of insufficient digital competence and digital literacy of lecturers and students. Indeed, improving digital literacy was recognised as one of the significant challenges impending technology adoption in higher education (Alexander et al, 2019). The participants stated that top management should provide institutional support to improve digital literacy, for example, in the form of training for lecturers and tutorials for students. Similar strategies to improve digital literacy were proposed by Adams Becker et al (2018). Overall, through the data analysis, institutional support and trainings were identified as relevant facilitators to improve digital literacy and acceptance of technology.

Although there is a significant amount of empirical evidence that attitude towards technology impacts its acceptance (Ertmer, 1999), our study could not confirm this connection. It remains thus a hypothetical relation waiting for its empirical confirmation.

Challenges related to the affordable internet access and technical infrastructure were identified as such solely at the NWU. A large number of participant statements indicate the importance of these challenges (Figure 2). Some participants referred to the infrastructural challenge as a “determining factor” when implementing adaptive learning. However, only few relations were found with the other challenges. This finding indicates thus that infrastructural and internet challenges can be fundamental prerequisites for the successful implementation of adaptive learning. Addressing these types of challenges in the South African context, some participants referred to the concept of "digital equity" - a difficult challenge for which solutions remain elusive to date (Adams Becker et al, 2018). Our data revealed however that its key solutions might lie outside of an institution, but rather in other social and global dimensions (Saba & Shearer, 2018), that address cultural, political, and regulatory frameworks of a particular county.

Based on the preliminary results of this study, we propose a first draft of an implementation framework of adaptive learning that comprises five dimensions with challenges, prerequisites, and facilitators enabling the implementation of adaptive learning (Figure 3). Whereas the identified dimensions remain for every implementing institution stable, challenges, prerequisites, and facilitators might very dependent on its specific context (e.g., socioeconomic background). An institution may start with identifying prerequisites (e.g., affordable internet access) and continue with determining their specific challenges (e.g., acceptance of adaptive learning systems). Then, it may look for possible facilitators (e.g., conducting research) along the proposed dimensions. Depending on a specific context (e.g., for NWU), some online learning challenges may appear relevant for the implementation of adaptive learning.

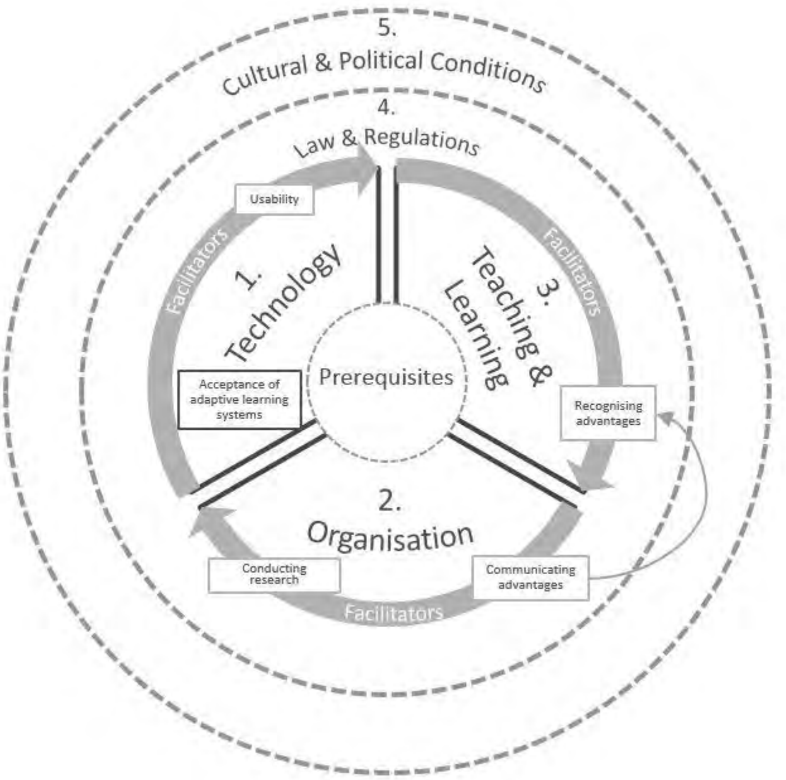

Figure 3: Adaptive learning implementation framework

So far, only few implementation models have been developed specifically for adaptive learning. For example, Johnson and Zone (2018) proposed an adoption model with five functional components (faculty, chairs/senior faculty, academic/administrative consultants, support staff, administrators) involved in the implementation process. This model focuses mainly on questions of the stakeholders, but hardly explains the relationships with other aspects in the implementation process.

One advantage of our framework is that it is grounded in data and can therefore be continually reevaluated and improved with additional data (e.g., through research at other universities). It also lays out a basic structure, in which new challenges, prerequisites, and facilitators can be included based on a specific institutional context (e.g., socioeconomic background, organizational structure, implementation stage). The framework helps institutions to prepare the implementation of adaptive learning by identifying context-dependent prerequisites first and then considering their specific challenges and facilitators along the five identified dimensions.

At this point, we point to limitations of the current model. Some relationships must still be saturated with additional data, and students were not included in the initial sampling strategy. Considering these limitations, investigating other universities with different socioeconomic and structural characteristics forms our next research step to improve the validity of the framework.

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Breaking Sequentiality: An Interactive MOOC

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Abstract: One of the common weaknesses of Massive Online Open Courses (MOOCs) is their lack of interactivity with the learning materials. Where MOOCs do offer learning materials with a degree interactivity, this is usually limited to single content items. In any case, even interactive learning materials are generally constricted within a sequential order that is often subject to a strict schedule. Sequentiality and scheduling restrict the autonomy of the learner in choosing how and when to consult the learning materials and engage in the learning activities. Changing the sequential and scheduled approach of traditional MOOCs poses educational, methodological and technological challenges for designers, instructors and learners. This contribution proposes an Interactive MOOC (I-MOOC) prototype, based on hypervideo and learning activities that are not bound to a precise timing or a specific sequentiality. The purpose of the I-MOOC is to offer participants autonomy in deciding their schedules and customizing their own learning paths. The I-MOOC provides various levels of interactivity: with the learning materials through hypermedia; between peers; and with the instructors. This paper illustrates the e-learning model underpinning the design of the I-MOOC, its multi-platform architecture, and the reactions of the users who participated in an initial pilot evaluation.

Keywords: interactive MOOC, hypervideo, mixed e-learning

1. Breaking sequentiality: The interactive MOOC

There has been a tendency to group MOOCs into two categories: eXtended MOOCs (xMOOCs), based on video-lessons followed by learning activities presented in a linear order, and connectivist MOOCs (cMOOCs), where learners set their learning objectives and regulate the intensity of their commitment (Alexiou et al, 2016). What is observed is that almost all MOOCs are based on sequentially organized content, delivered over a specific period of time. Often, sequential fruition is conditioned, i.e. completion of a module is a prerequisite for accessing the following one. This imposed sequencing prevents learners from self-regulating their own learning process.

In A Taxonomy of Massive Open Online Courses (Pili & Admiraal, 2016) different types of MOOCs are illustrated. The "iMOOC" (interactive MOOC) category is defined by "its learner-centered approach, the flexibility of study, and interaction between students, which are uncommon features in other MOOC formats" (Pili & Admiraal, 2016). Other types of interactive MOOCs that can be found in the literature concern the interactivity offered by virtual environments (Zhang et al, 2018) and the semantic reorganization of video content (Zhao et al, 2018). In such cases, however, even if there is greater *student-learning materials* interactivity, the organization of the contents remains sequential.

2. Research background

The TRIS project (Benigno et al, 2018) proposes an educational model for the creation of the Inclusive Hybrid Class (IHC), a learning environment that blends the physical and the virtual. The IHC is capable of generating active and collaborative participation in school lessons for children who are unable to physically attend school due to serious debilitating conditions. The Interactive MOOC (I-MOOC) presented in this contribution reports the transfer phase of the TRIS Project, a massive e-learning action designed to train school teachers on how to create and run an IHC from the methodological-didactic, organizational and technological points of view.

The development of the I-MOOC takes into account three requirements:

- To set up an online training course for a large number of users (Italian school teachers);
- To create a platform with a high level of interactivity, both with the learning materials and between peers;
- To offer a MOOC without a specific timeframe or sequential organization of the learning materials.

The I-MOOC design differs from standard MOOCs design and implementation, since: (a) it seeks to offer different ways of exploiting the contents; (b) didactic activities are not subject to rigorous scheduling and (c) the workload of the tutor must be light. The design challenge is both didactic-methodological and technological: (i) how to increase the interactivity of learning materials; (ii) how to design interactive learning activities that do not impose precise timing and that lighten the tutoring load.

3. The e-learning design

The e-learning model adopted in the implementation of the I-MOOC is the result of an integration of several e-learning approaches modulated between interactive learning and content-driven learning. Fig. 1 schematically illustrates the components of the model in relation (a) to the learning processes it intends to implement, (b) to the types of interaction functional to their implementation.

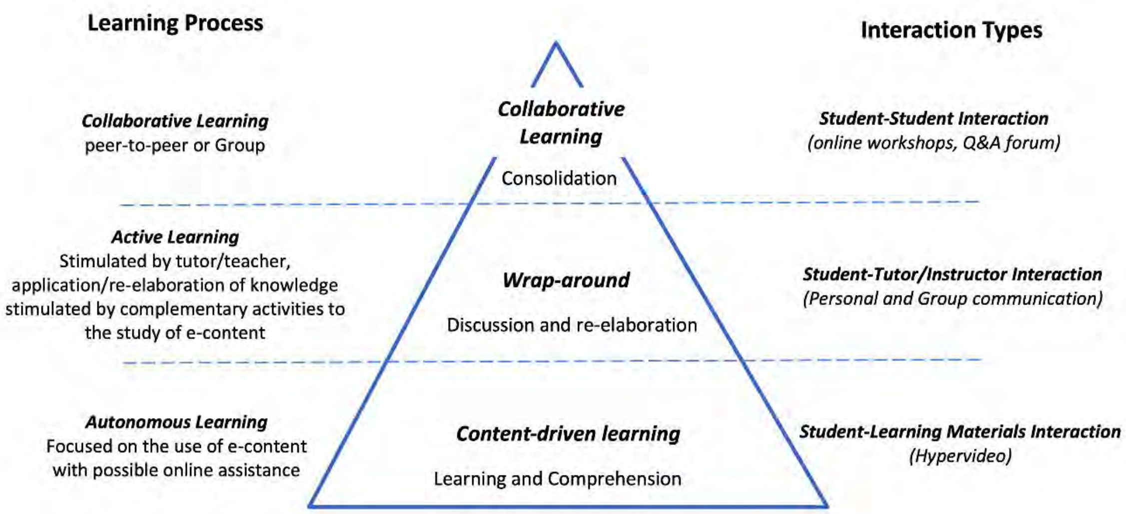

Figure 1: The relationship between the learning process and the type of e-learning interaction (Trentin, 2016)

In accordance with the model, the following three levels of interaction were implemented.

3.1 Interactivity with the Learning Materials

The I-MOOC is formed by a hypervideo environment in which students can browse the video contents in different ways, in order to increase their engagement.

This hypervideo comprises around 50 video clips with an average duration of 4-5 minutes each. These were produced as multi-purpose 'bricks' that reconfigure according to each navigation modality that learners take through the course contents: by macro-arguments (the main axes of the TRIS model); following the TRIS model modulation protocol over time; or exploring the application context of the model. More details are provided in Section 4.1.

3.2 Interactivity with the instructors (teacher and tutor) and student scaffolding

Interactivity with tutors is achieved through the Virtual Classroom environment, using a direct channel ("ask the tutor") and the thematic forums available to the participants. A further communication channel for student-instructor interaction is reserved for the delivery of the final report, which is evaluated by the instructor and determines the formative credit.

The function of the tutor is predominantly "pull" (on request answers) and moderately "push" (proactive); the latter is limited to a few circumstances, such as reminding learners of the only deadline scheduled in the I-MOOC, the launch of the two online Moodle Workshops of the course.

As a massive course, diversified solutions ease the pressure on the tutoring staff. Strategies included:

- the creation of a contextual didactic guide;
- the preparation of detailed scripts to support learners in carrying out activities (contributions to the Forums; papers and exercises to be peer-reviewed in the online Workshops; final papers for the awarding of formal credit certification);

- the use of a status bar indicating learners' progression through the course (completed and upcoming activities, results, etc.).

3.3 Interactivity among learners

Within the Virtual Classroom environment, the interaction between the participants unfolds in: the Community Forum; in specific forums for discussions and collaborative work; in the Q&A forums; and in the Workshops devoted to the peer-review of learner assignments.

In order to lighten the burden on tutors, many of the learning activities that stimulate interaction between the participants involve automatic functions provided by Moodle, such the Workshops and Q&A Forums.

Collaborative interaction in Workshops and Forums for learning consolidation are restricted to learners who are adequately prepared and not by "occasional" participants. To access these collaborative interaction spaces, learners need to complete preliminary activities, namely the vision of the Hypervideo or the study of some chapters of the reference book. Verification of learner readiness for those activities is conducted using assessment tests.

4. The architecture of the I-MOOC

The TRIS I-MOOC was developed by integrating two digital environments (Fig. 2): The Hypervideo environment, where the student can freely navigate and study the video contents using a dedicated player developed with Klynt software and embedded in a Wordpress webpage; the Virtual Classroom environment developed using the Moodle platform, where the learner carries out activities in order to achieve the formal credit certification. Both environments can be accessed from PC or mobile devices.

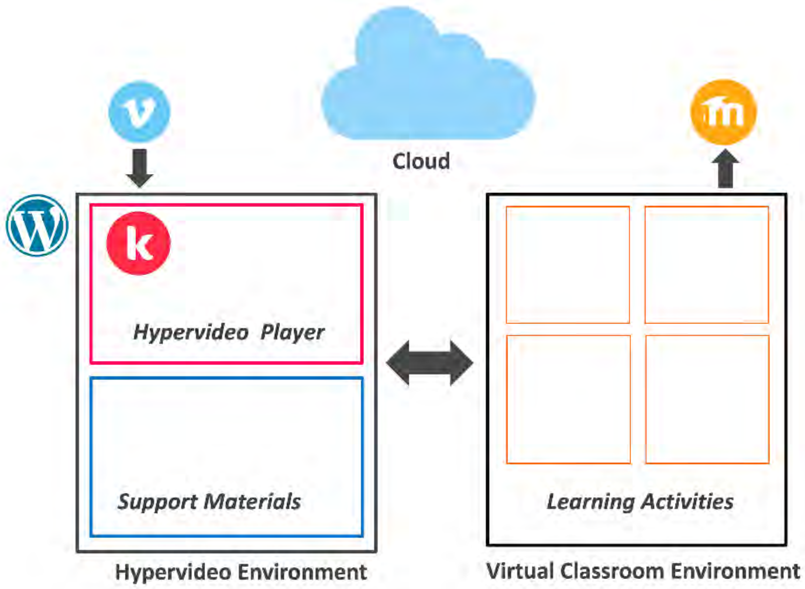

Figure 2: The architecture of the TRIS I-MOOC.

4.1 Hypervideo environment

Interaction with the learning materials is based on interactive video or hypervideo (Hammoud, 2016). The I-MOOC's hypervideo is of a database type, it incorporates different videos, whether interactive or not, with two levels of interactivity: (a) with each single video and (b) with the entire set of videos. The video clips have been produced in different formats: live-action, animation and 360° video (Fig. 3). Interactions with single video clips comprise:

- Bookmarking of key moments
- Prompts to consult given chapters of the course textbook
- Immersive 360° navigation of certain videos.

Figure 3: Examples of video format in the Hypervideo environment.

The second level of interactivity concerns the different ways of browsing the contents. The video-lessons are divided into four thematic macro-categories which corresponding to the four macro-areas of the TRIS model: the psycho-social context, the methodological-didactic axis, the organizational axis, and the technological axis. The video-lessons are linked together (Fig. 4), which highlights the hypertextual nature of the I-MOOC.

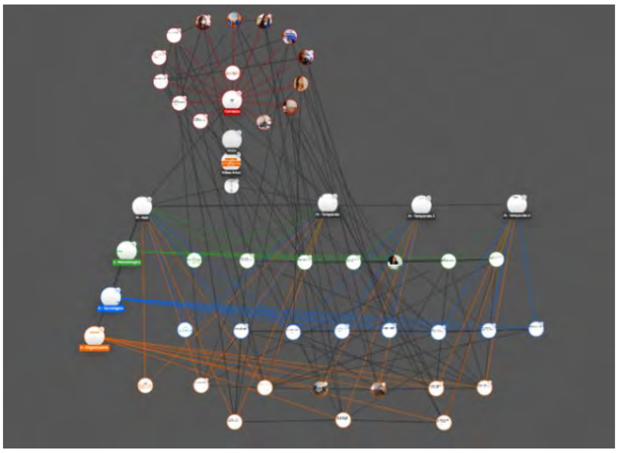

Figure 4: The Hypermedia structure of the Hypervideo.

Fig. 5 illustrates the three navigation modes of the hypervideo: (i) according to the axes of the TRIS model; (ii) according to the temporal modulation protocol of the model; (iii) according to exploration of the psycho-social context of the model. Fig. 5 also shows (bottom right) the screen displaying the three navigation modes.

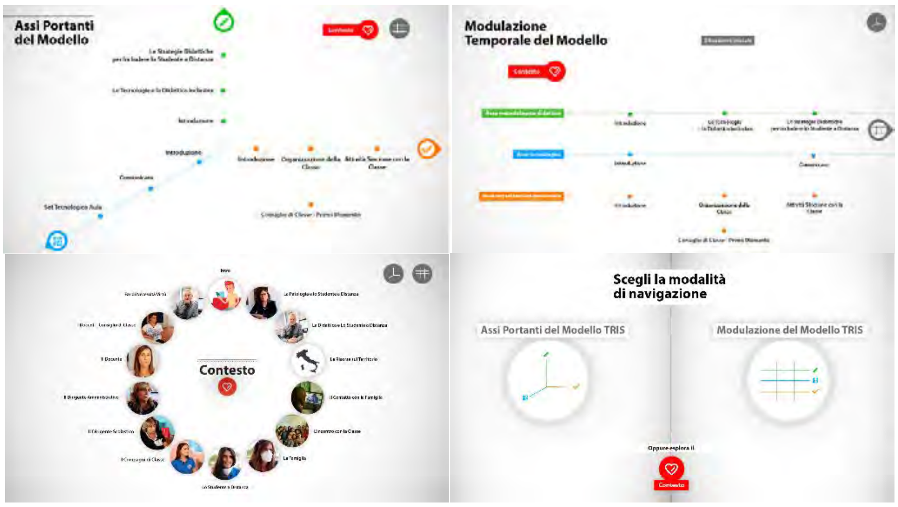

Figure 5: Navigation modes of the TRIS I-MOOC

In addition to the Hypervideo, the leaning materials include the course reference book, video-lessons in audiobook format, and the voice-over scripts.

4.2 Virtual Classroom environment

Fig. 6 shows the main section of the Virtual Classroom, which hosts the I-MOOC learning activities. The course modules are organized in four independent quadrants. The modules share the same structure, which follows the progression indicated in Fig. 1.

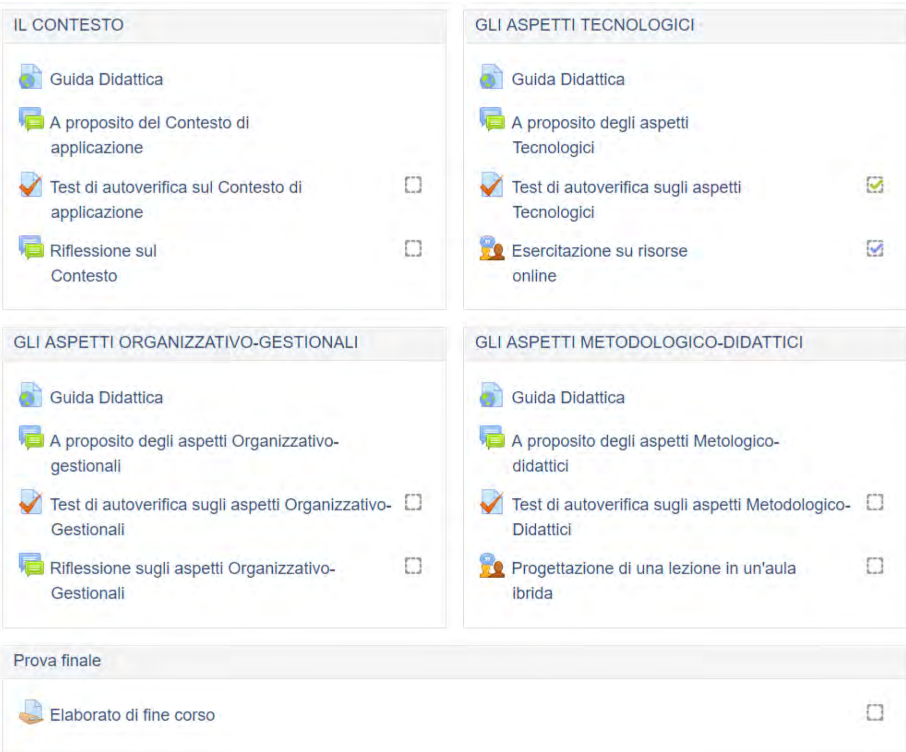

Figure 6: The main section of the Virtual Classroom environment

5. Conclusions and future work

Currently, the I-MOOC is being validated by a sample of about 100 teachers, varying in gender, geographical area, school level, subject area, previous experience of socio-educational inclusion, skills in the educational use of technologies.

Future research will involve in-depth analysis of the data collected during the pilot phase. Some considerations can already be drawn based on the initial reactions during the first run of the TRIS I-MOOC. The first impact with the I-MOOC prototype was very positive. Almost none the participants reported any significant problems either in using the system, orienting themselves in the multi-platform environment, choosing a navigation path in the Hypervideo environment, or in understanding the learning activities to carry out. Factors possibly contributing to these impressions were: the clear interface of the Hypervideo; the contextual didactic guide; the detailed description of assignments and ways to complete them.

In future, in addition to introducing improvements to the Hypervideo environment, the TRIS I-MOOC will involve the development of *Hey Tutor!,* a conversational application (chatbot) with push/pull tutoring functions. This app will help to lighten the workload of human tutors: in "pull" mode, through the management of FAQs; and in "push" mode through reminders, notifications, proactive interventions addressing participants in danger of dropping out, etc. The alpha version of this chatbot is currently being tested at ITD-CNR in the field of language learning (Ravicchio et al, 2019).

Acknowledgements

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Choose Your own Adventure: Self-Directed Adult Learning and Assessment

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Abstract: Initiatives such as blended learning, experiential learning, and learning styles models have been applied in the face to face classroom and online classroom for decades. Not all of these strategies have been successful in identification of student motivation or showing student learning because the courses are predicative, and static. The courses become less desirable for both adults and young adults as they can learn topics in micro-learning platform, bite sized content from YouTube or other open learning platforms. Universities that utilize online learning as their primary mode of delivery need to explore opportunities for flexibly of content and student engagement. In 2018, a Walden University Doctor of Philosophy (PhD) program began a program update to address the issue of student flexibility and ways of improving assessment of learning. Taking a self-directed learning approach to complex topics within the program content courses allows the students to explore the content in a personal meaningful way, allows students to take control of their learning and find ways to improve their intrinsic learning capacity. By allowing flexibility in student learning, this can cause difficulties in assessing the student learning outcomes for the course and program. Students using a self-directed learning approach should be assessed utilizing controlled variables that are embedded with the curriculum, implementation of feedback received, and reflection of the student learning process. This paper and poster will outline a case study that provides context to why andragogy is critical at graduate level learning and inspiring student creativity and building skills that serve students as their work environments demand independence and critical thinking capacity. This work unique, innovative, and has the potential to support student development at all levels of learning. Given the generational differences and the desire for micro-learning, this case study encourages self-directed learning, intrinsic motivation, and new methods of assessment.

Keyword: self directed learning, assessment, andragogy, online learning, instructional model, peer feedback

1. Background of study

1.1 Online instruction

Online and blended modalities have released education to the most adaptive, accessible, and customizable periods in education. With the shift of traditional institutions to the online learning environment, institutions struggle with creating online experiences that engage students in the learning process and validate student learning outcomes. In some cases the application of blended e-learning is often used to blend collaborative learning, problem based learning and some independent learning (Hoic-Bozic, Mornar, & Boticki, 2009) and not just lecture and using an e-learning environment to facilitate grading and course administration. In most cases those educational institutions that attempt to blend or shift to on-line learning platforms only recreate what is most familiar (Whelan, 2018). A main reason that the shift to online fails is that faculty and most students are not prepared for the new skills required in an online environment.

Educational institutions may take the blended approach using both face-to-face and online methods in one course. Research points to the fact that mixed or blended situations in some cases are not optimal to improve student outcomes (Adams, Randall, & Traustadóttir, 2015). Institutions continue to struggle with building content to motivate and engage students. Students desire the flexibility of online learning but they underestimate the time and skills needed to succeed in the online environment.

1.2 Learning theory

Adult students are motivated different than children. Adult students are motivated, extrinsically, and intrinsically. To improve intrinsic motivation in adults, the learning content and platform need to promote flexibility and respect for the student's experiences and interests (Al-Aulamie et al., 2012). Learning pedagogy generally remains traditional similar to operant conditioning popularized by B.F. Skinner (1953).

Application of Kolb's Experiential Learning Theory (1984) has attempted to be used in an online environment, yet the results can be varied due to the student may not experience a "hands-on" exercise within the course or in personal experience. Honey-Mumford, Grasha-Riechman, and Myers-Briggs model may be too complex to apply to the online curriculum development. Students have identified that they prefer to use microlearning which allows mastery in small bit sized lessons.

Knowles and Merriam et al. (2007) argued that adult learners are mostly self-directed, have motivations to learn, and impact learning with their life experiences. Eduard Lindeman noted that adults need to be self-directed. When applying Malcolm Knowles reasons for self-learning, it was a framework to create self-directed curriculum with the emphasis on the learner driving the knowledge base. The curriculum was written, allowing the student to become a learning resource for their peers and faculty in the course.

1.3 Supporting independent study and playful learning

The program has shifted from curriculum-based learning to a co-creative and collaborative environment (Kangas, 2010). While not child's play, the paradigm opens students up to exploration and moves away from the discussion, assignment, and specific readings model. This hybrid model encourages comradery and creativity. This model bolsters flexibility and cohesive independence where students select and design their learnings within specific course context giving adult learners more flexibility to explore topics that are meaningful to the student. The PhD students are focused on refining research methods, and work collaboratively by researching classmates projects broadening and expanding the student's exposure and knowledge development.

The model has a curriculum prepared list of topics and delivery methods that the student can choose to create a unique learning experience. Students and faculty are required to complete self-reflective assessment which are mapped to program and course outcomes. The model is identified in Figure 1.

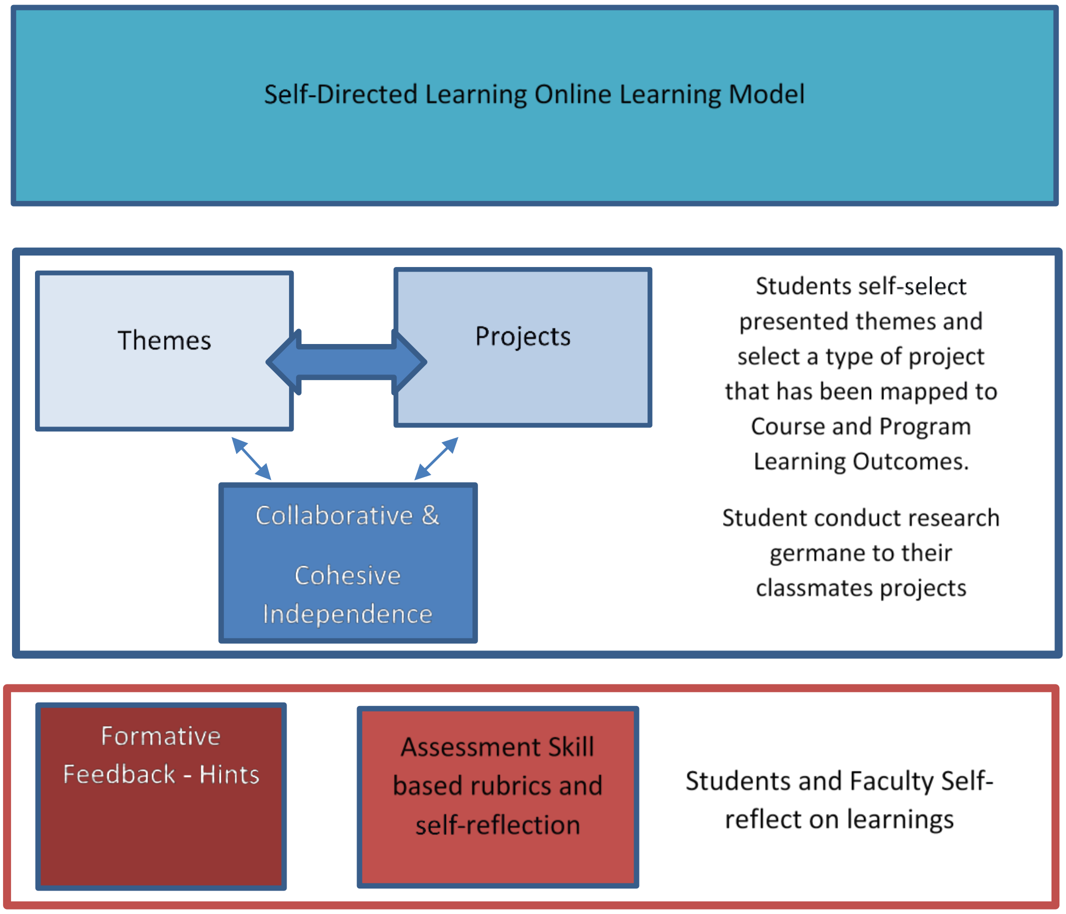

Figure 1: Self-Directed learning online learning model

1.4 Assessment

One of the most challenging experiences for students to overcome is their perception of taking a class and forgetting what they had learned. "It's only for the grade" can be an attitude students take. This attitude can impede the dissertation process, where independent and being self-directed is a critical skill. Collected student data, formative assessments, and summative assessments from the previous program identified that students would come to their online class with the expectation of completing an initial discussion and post two responses to a minimum of two peers each week.

The updated curriculum implemented a student directed class experience and updated assessment. The decision was made to use a quality formative assessment. Weldmeskel and Michael (2016) identified "qualitative formative assessment denotes the delivery of formative feedback by educators, peer-assessment, and self-assessment, which contribute to the improvement and the self-regulation on learning."

2. Methodology

Within the process of developing online learning the faculty facilitate the learning, but they are not the focal point of the learning process. The demographic for Walden University PhD programs is primarily adult learners over the age of 40. They are professionals, individuals that may consider a career change, or want to further their research pursuits. Given the age and focus of the students, it was essential to retain a level of intrinsic motivation into the course development (Merriam, Caffarella, Baumgartner, 2007). The program goal was to update the curriculum using andragogy, where the instructor is more of a coach and participates in the learning process.

In the updated curriculum, the student is required to work on three different themes. Each course has a list of potential research topics the student can choose. The specialization courses exemplify the open framework structure that students must fill with their research. Beginning in our foundation courses students are given freedom to develop projects that relate to their specialization. The students practice how to create knowledge. Kangas (2010) argued that even with young learners the ability to create knowledge is not the focus of learning. Students consume knowledge but lack the ability to construct new knowledge or develop their ideas. The ability to construct knowledge is a key distinction in this andragogical model. Typically, students are taught that the content they are being fed is complete and static. This model limits static knowledge. It is similar to gameplay: students must combine concepts, topics, and ideas to construct knowledge independently.

3. Analysis and discussion

The adult learner has a specific motivation for undertaking a PhD program. The prior programmatic assessment of the old program identified from the student and faculty feedback that many of the skills-based assessments, content, and reflection had been removed from the curriculum, but were necessary for the workplace and in understanding the role of the scholar-practitioner.

Each course was pilot tested before curriculum was finalized. The faculty member identified to build the curriculum taught the old version, taught a modified version, and taught the final version making modifications as needed. Each course added elements of self-directed learning assignments and skills development. The results of the pilot testing were analyzed and used to build the current curriculum. According to Kaye and Rumble (as cited in Moore & Kearsley, 2005) most students in e-learning programs are adult learners (Baby Boomers, Gen X) who lack time because of work or an inclination to attend a traditional brick and mortar program and e-learning enables more to achieve their educational goals.

4. Conclusion

The Walden University PhD in Management program has been developed to introduce independent learning and andragogical learning early so students are prepared for the dissertation process. Once the required coursework is complete, and students enter the dissertation phase of their program, students have a clear understanding of what is expected of them as a self-directed independent researcher.

Intrinsic motivation and self-directed flexible learning options within the curriculum have improved retention and have created skills to become an independent researcher. While there are other aspects of adult learning to consider when creating a self-directed curriculum, Jones (2013) identified goal orientation, relevance, perceptual arousal, motive matching is often highlighted as keys to successful learning for adult learners. These areas will be monitored and assessed.

Preliminary results of the new curriculum model have been positive. Students noted they enjoy being able to explore their topics in depth yet have exposure to alternative topics by discussing and researching other student topics. The faculty noted the conversations with students are robust and content coverage seems to be greater than traditional prescriptive online curriculum. There is limited data to analyze programmatic or course outcomes.

Course and program assessment can be improved. While traditional formative and summative methods of assessment are currently being implemented with this current model of learning, we will be exploring the use of formative peer assessment. Diegmayr (2018) stated "formative peer assessment is an instructional method that offers many opportunities to foster students' learning, both with regard to the core task (e.g., academic writing) and with regard to their assessment and feedback skills" (p. 194).

An area of opportunity in this curricular model would be to allow graduate or doctoral students to be able to allow the students to identify a topic, have the faculty/administration approve the topic, and use that topic for the course projects. This option will be explored as assessment data is available.

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YouTube as an Instrument of Learning in Higher Education: Opportunities and Challenges

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Abstract: Fashion for using video resources of the Internet and especially YouTube in the educational process is becoming more and more noticeable in universities and colleges around the world. Perhaps, there is nothing strange in this trend. Contemporary students are used to spending a lot of time on the Internet every day. Besides, it is true, that YouTube contains a significant amount of useful information for learning. This information is presented on various popular science and educational channels. So, using YouTube allows students to get through the learning process in a familiar and comfortable form. Therefore, the trend for using YouTube resources in the educational process is hardly surprising. But an understanding of the true opportunities of using YouTube in this area still needs clarification. Is there a real need to use YouTube in the education process? What are the specific opportunities of it's use in education? And what are the challenges of it's use in education? This paper is devoted to the description of the research, which was started by the authors for clarification of these complicated questions. The initial goal of the research is to clarify the specific opportunities and risks of using of YouTube as an instrument of learning in higher education. The authors focus their interest on the analysis of a particular case of using YouTube resources in the educational process at the Ural Federal University (Ekaterinburg, Russia) during one educational cycle in the 2019 academic year. The authors rely on several research methods: sociological survey, discourse-analysis and content-analysis. The authors not only describe specific examples of using video content from YouTube for solving educational tasks, but also to analyze in detail the students' reaction to the use of such content. The key hypothesis of the research is that the potential benefits of using YouTube resources in the educational process are significantly overvalued. YouTube is useful as an auxiliary and illustrative source, but its excessive use in the educational process does not match with the needs of students and leads to a decrease in the quality of education.

Keywords: YouTube, higher education, social media, sociological survey, Russia

1. Introduction

High popularity of new information technologies in modern society raises many challenges for educational institutions. The percentage of active Internet users in different countries is variable, but almost everywhere it is used by most people every day. Moreover, recent studies show that schoolchildren and students use the Internet even more often than other social groups: almost 100% of them do it every day (Ivanova *et al.,* 2018). Of course, educational institutions and organizations cannot ignore this important social trend. Refusing to use Internet resources in the educational process creates risks of degradation of educational programs and deterioration of quality of education. But at the same time, using Internet resources can make the process of learning more flexible and relevant to the students' habits. So, the notable interest of schools, colleges and universities to using Internet resources in the learning process doesn't look strange. An important and very complex research question is related to the problem of optimal mechanisms and extent of the use of Internet resources in the process of learning. How does the use of Internet resources in the process of learning correspond to the real needs of students and how do they see it? What specific problems of learning can be solved through the use of Internet resources? How can we organize the inclusion of Internet resources into the learning process? Aiming to understand such issues, we decided to implement our own research project on the basis of the Ural Federal University in Russia.

2. Purpose and assumptions

In our project we focused on a certain case of using Internet resources in the process of learning. Our focus was on analyzing the use of YouTube in higher education. YouTube's case is indicative and informative for clarification of the issues that were mentioned above. On the one hand, YouTube is one of the most popular Internet resources and it is actively used by schoolchildren and students around the world. On the other hand, the YouTube content is very diverse: it includes not only entertaining videos, but also educational ones. Moreover, recent research describes specific cases of using YouTube specifically as a useful resource of learning. (Moghavvemi *et al*., 2018; Jackman, 2019). So, the analysis of YouTube provides an opportunity to explore a private, but very informative and illustrative case of using Internet resources for learning.

The initial goal of our project is clarification of specific opportunities and risks, related to using of YouTube in the process of learning. Opinions about these opportunities and risks can be different. Some researchers like the idea of using of YouTube in the process of learning and describe many potential effects of its realization: the use of visual video material, the availability of the learning data, the simplicity of organizing interaction between learning participants, etc. (Perrett and Minhas, 2016; Shoufan, 2019). Other authors, on the contrary, are quite skeptical about YouTube and mention important problems: the risk of losing emotional contact between the teacher and students, potential possibility of spreading of incorrect learning data, the loss of professionalism in the learning process, etc. (Jung and Lee, 2013; Reynoso and Aguirre, 2016). That is why our initial hypothesis was the assumption that YouTube can be used in the process of learning as an effective auxiliary and illustrative tool, but its careless use can cause significant risks or problems. Active use of YouTube in the process of learning can cause discomfort for students and teachers, because it will significantly change the format of learning. But there may be more global problems. The introduction of YouTube in the learning process can lead to the formation of a specific culture and skills of professionals, who get through the process of learning in colleges and universities. So, the long-term effects of use of YouTube in the process of learning will be felt by society in general.

3. Project design

We started the project in April 2019 and plan to complete the work by early 2020. We expect to perform several tasks during the project. Figure 1 illustrates the stages of the project.

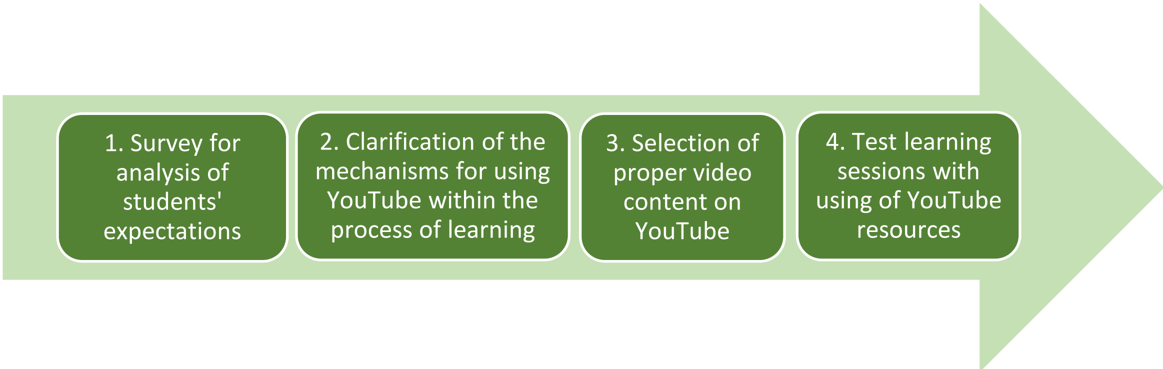

Figure 1: Stages of the project

The first stage has been completed already. We conducted a sociological survey among students of two academic groups who will later become participants in the project in a period between September and December 2019. The purpose of this survey was to understand the opinion and expectations of students about the use of YouTube in the process of learning. The next step of the project will start in July 2019 and will be performed as an analysis of university educational programs, intended to identify the best mechanisms for using YouTube within the process of learning. The third step of the project will be the selection of proper video content on YouTube: based on the techniques of discourse-analysis and content-analysis, we intend to find videos that are appropriate to the objectives of the educational process and adequate to students' needs. The fourth (and the most important) phase of the project will start in September and will be performed as a series of test learning sessions, which will be built on the intensive use of YouTube resources. By conducting these test sessions and gradually measuring students' feedback, we plan to get a detailed description of the specific opportunities and risks related to using of YouTube in the process of learning.

4. Current results and prospects

At the time of preparation of this paper we are only at the beginning of the journey and have completed only the first stage of the project. So, now we must be very careful about the conclusions about the project in general. We can only afford preliminary conclusions, but at the same time, available data allows us to describe students' expectations about the directions of using YouTube in the process of learning. The responses received from students thus far indicate that the use of YouTube this area needs to be deliberate and careful. In total, 98 people from two academic groups were interviewed during the survey. Their answers show that the basic idea of using YouTube in the process of learning looks really promising. 83.3% of respondents use YouTube almost daily. 85.7% of them have already watched an educational video on YouTube that helps them to master the skills useful for their future profession. 64.7% of respondents confirm that they would like to use YouTube more actively during their studies at the university. Most of them even see clear opportunities of using YouTube. 85.7% of them think that using YouTube resources could make a process of learning simpler. 76.3% of them suppose that YouTube can make process of learning more modern and actual. So, probably we can conclude, that students have a strong request for the use of YouTube in the process of learning. However, there is also another important trend in the data. Most of the interviewed students are not ready to consider YouTube as an alternative to more traditional formats of learning. As can be seen in Figure 2, most of them clearly do not like the idea of using of YouTube as a replacement for lectures and seminars. They are ready to consider YouTube only as an additional tool for learning.

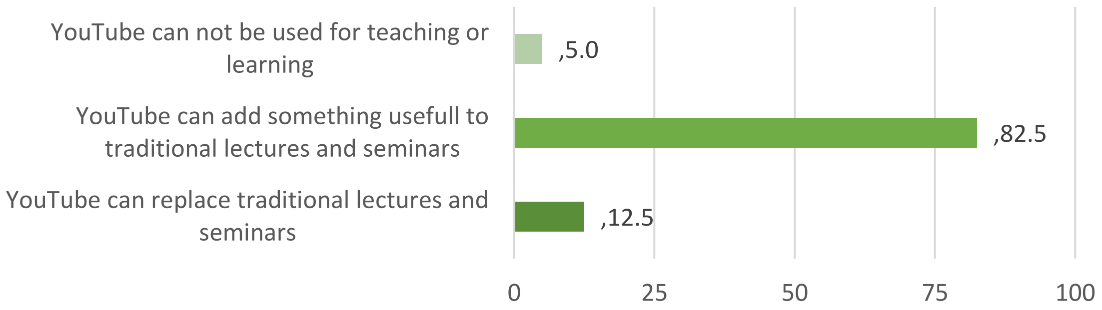

Figure 2: Opinion of students about using of YouTube in the educational process (% of total number)

More than half of them are convinced that excessively intensive introduction of YouTube into educational work will lead to negative results: decline in interest of learning process (70.6%), disappearance of emotional contact with teachers (56.7%) and raising of risk of getting incorrect educational information. In other words, students are interested in using YouTube more actively in the process of learning, but they want this tool to complement the traditional forms of learning, not to replace them. However, we emphasize again that now we are only at the beginning of the project and we can rely only on the opinion of the students. Real opportunities and risks, related to using YouTube in the process of learning, have to be identified and described during the next stages of the project.

5. Conclusions

The initial goal of our project is to evaluate the opportunities and risks, related to the use of YouTube in the process of learning. Now, we are only at the beginning of this complex project and this forces us to be extremely careful in our conclusions. Available data shows that using YouTube as a learning tool requires caution and deliberation. YouTube can be a promising tool that can make the learning process more interesting and visual. However, excessive intensive use of this tool could generate significant risks: breakdowns in students' contact with the teacher, facilitation of transmission of too low-quality information, etc. During the further stages of the project, we are going to deepen and specify this preliminary conclusion.

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Students From Central Asia in Russian Universities: Social Media as a Tool for Adjustment

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Abstract: Globalization is internationalizing the educational environment. The number of international students is increasing in Russia and many other countries. Students from Central Asia now constitute a majority of the foreign students studying in Russian state universities. International students need to adjust not only to the educational process but also the culture of the country in which they are studying. We hypothesis that since the social media are often the main communication channel for contemporary youth, they constitute a tool of adjustment that helps foreign students learn to live in a new country. Our research is based on a case-study of students from Central Asia who are studying in Yekaterinburg. The aim of our research is to analyse how the universities of Yekaterinburg utilise the social media to help students from Central Asia to adjust. The study is based on (1) a set of interviews with the universities staff members who deal with students from Central Asia, and (2) content-analyses of students' accounts on Vkontakte – the most popular social network among Russian youth, where students can exchange textual and visual messages. In our study we found that the universities do not distinguish between students from Central Asia and other countries in social media communication. The content which the staff members develop for the social media is focused on announcements about extra-curricular activities while experts stress the need of students from Central Asia to be adjusted to the process of education, but not to life in Russia in general. Our findings point out that communication with students from Central Asia through the social media can be boosted in two ways: (1) by regular feedback, and (2) by posting more links on resources which could help students improve their level of competence in subjects necessary for successful studying at the universities.

Keywords: social media, international students, students from Central Asia, higher education in Russia

1. Introduction

Globalization is internationalizing the educational environment, bringing a growing number of international students in Russia and many other countries. These students need to adjust to the educational process and culture of the country in which they are studying, and the social media are often their main communication channel. Through the social media students can get information they need to adjust to a new place of study and living; share impressions and exchange opinions about their new residence; establish new contacts and friendships at the university. In this way the social media provide a tool of adjustment that international students can use to adapt to living in a new country. Our research is based on a study of students from Central Asia who are currently studying in Yekaterinburg. Nowadays students from Central Asia are the majority of foreign students studying in Russia. Data from the Russian Federal Office of National Statistics indicate that in 2017, students from Central Asian countries comprised 56 percent of the total number of international students studying in the state universities. Yekaterinburg, a city with a population of over one million inhabitants, is an educational center situated on a border between Europe and Asia. This geographical position makes the city attractive for students from Central Asia.

2. Literature review

Ever since the Internet came into existence, scholars have been investigating how social networks are developing and how they influence our life. Theories by Castells (1996), Rheingold (2002), Chesebro (2014), Danet (2007), Mansell (2012) have become classics in this field. They focused on the specificity of different aspect of network communication and analyse the role social media play in contemporary societies. The role of social networks in the context of Internet communication and their major characteristics are studied by Boltz (2007), Hong (2013), Nations (2019), Brusse and Hekman (2009). In the field of education the role of digital technologies is analysed by Roblyera, McDanie, Webb, Hermand and Wittye (2010), Garner and O'Sullivan (2010). They all evaluate the advantages and disadvantages of various communication channels in the educational process. Negative consequences that the use of the social media can cause are studied by Moran, Seaman and Tinti-Kane (2011). In Russia, communications on the Internet have been studied by Morozova (2010), and Lutovinova (2008), who mainly investigate the interactional dynamics in the social media. Taking the above mentioned concepts into account, our understanding of the social media as a tool of adjustment is based on (1) the idea suggested by Rheingold (2002) that in contemporary world social networks are arranged in a definitely new way; (2) the phenomenon of 'self-communication' described by Castells (1996); (3) the interpretation of the social media as the message developed by Boltz (2007) where the content is considered as a secondary element of the message, whereas communication per se is becoming its most salient element. To summarize, most of researchers see the social media as a tool which helps to optimize and upgrade the process of education. But few studies focus on how contemporary universities can utilize the social media to help international students to adjust to their new settings. In our research we try to fill this gap by focusing on how the social media can be employed to boost the educational process for international students.

3. Methodology and sample

To investigate how universities utilise the facilities of the social media as a tool of adjustment of foreign students to a new educational and cultural environment we chose three universities in Yekaterinburg: Ural Federal University (UrFU, the largest university in Yekaterinburg and Ural region), Ural State Pedagogical University (USPU), and Ural State University of Economics (USUE). At the first step of our research we conducted a set of interviews with the staff members and heads of students communities related to national cultures who interact with international students (N=9). The sample consisted of (1) one for each university executives (N=3) (head of the International Student Support Center in UrFU: male, age 40, 15 years of working experience; head of the International Education Project Center in USPU: female, age 42, 11 years of working experience; and senior supervisor of the International Relation Center in USUE: male, age 26, 4 years of working experience); (2) heads of student communities related to national cultures (Kazakhstan, Kirghizstan, Tajikistan) in UrFU (N=3): all males, age 22-23, with working experience from 2 to 5 years; (3) representatives of the student organizations deal with international students (Buddy System and Erasmus Student Network) in UrFU (N=2): all females, age 20 with working experience from 1 to 2 years; (4) head of the Association of Ethnic and Cultural Communities of the Youth of Sverdlovsk Region (N=1): male, age 29, 14 years of working experience. Then we ran content-analyses of the accounts that students form Central Asia have in the social network Vkontakte (N=300). Vkontakte is the most popular social network among Russian youths. We sampled the open Vkontakte accounts of Central Asian students in these three universities on Vkontakte (these accounts are not confidential).

4. Results

The experts whom we interviewed generally agree that students form Central Asia adjust to living in Russia more readily than foreign students from other countries for the following reasons: (1) the common historical past of Russia and Central Asian countries (when they all were parts of the Soviet Union); (2) students from Central Asia who come to study in Russian universities are well informed about life in Russia; (3) the Russian language continues to be widely studied in the countries of Central Asia; (4) the presence of Russian-speaking diasporas in these countries:

> *"Common Soviet past does matter: the knowledge of the Russian language is not a problem because of that. Geographical proximity and strong diplomatic ties between Russia and Central Asia countries promote for the increasing number of students from this region in Russia" (senior supervisor of the International Relation Center, male, age 26);*
>
> *''They [students] easier adjust to life conditions [than to educational process] because they all are from countries which are former republics of the Soviet Union. In general, the lifestyle has been the same and most of the students can speak Russian" (head of Kazakhstan student community, male, age 23).*

Two major difficulties which students from Central Asia have are related to (1) their inadequate competence in mathematics and natural sciences (for those studying technical sciences) and (2) imperfect knowledge of the Russian language.

For the most part, the social media are used only to inform students: Firstly, the staff members who work with international students post announcements about extra-curricular activities (such as excursions, sports events, voluntary work, etc.). Secondary, they post instructions on how to settle in the dormitory or how to get a temporary registration on the territory of Russian Federation, etc. Only one university disseminates links on educational resources which help students to adjust to studying at university through learning the Russian language:

"We have released an application 'Lapta' [the name of Russian ball game] which helps learn the Russian language in a game manner. We regularly update our website 'Russia in Russian' and put lessons online" (head of the International Education Project Center, female, age 42).

The majority of Central Asian students who have accounts on Vkontakte are men (62%) and only 38 % of them are women. A majority come from Kazakhstan (58%), followed by Tajikistan (17%) and Kirgizstan (10%). Relatively few students come from Turkmenistan (8%) and Uzbekistan (7%). They have a substantial number of followers: almost half have 100 to 200 followers (40%); approximately a quarter (23%) has fewer than 100 followers while 15% have from 200 to 300 followers. One third of these followers are from Russia (30%). The most popular topics discussed by students are the following: leisure (63% of all posts); university life (26% of all posts); events in the city of Yekaterinburg (16% of all posts), national holidays (12% of all posts) and, finally, Russia in general (8% of all posts) (Figure 1).

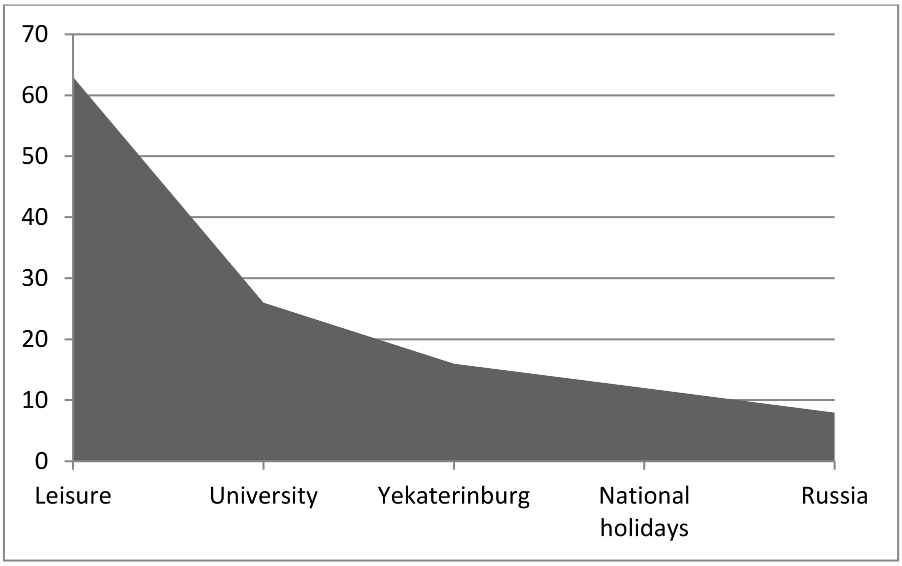

Figure 1: Topics discussed by students (%)

However, a subtopic 'university life' has only 6% of posts related to the process of studying. The students predominantly discuss extra-curricular activities. Thus, the issues related to the universities' educational process at university are rarely discussed by students in their on-line conversation.

5. Conclusion

Although there is a substantial body of research on how the new media influence our life, in the field of higher education scholars predominantly have focused on how social networks help to upgrade the process of studying. In our research we tried to understand how the social media can be utilized to help international students to adjust to the educational process in their new settings. We found that the universities do not distinguish between students from Central Asia and other countries in social media communication. In general, students from Central Asia are members of the universities Russian-language' publics in the social media and get information from there. The content which the staff members develop for the social media is focused on announcements about extra-curricular activities while experts stress the need of students from Central Asia to be adjusted to the process of education, but not to life in Russia in general. At the same time, the representatives of this target group (students from Central Asia) are active participants of the universities' publics on the Internet and have regular followers. This can be considered as a form of a network structure where information about the educational process and universities is generated and disseminated. Our results show that communication with students from Central Asia through the social media can be boosted in two ways: firstly, by regular feedback, and secondly, by posting more links on resources which could help students improve their level of competence in mathematics, the Russian language, and other subjects necessary for successful studying at the universities.

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Utilisation of Open and Distance eLearning Students Support Services by Postgraduate Students in an Open and Distance eLearning Institution

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Abstract: *Background*: The purpose of student support services in Open and Distance eLearning Institutions is to cater for students' cognitive, emotional, social needs and to help them with their learning. These services serve as the interface between the institutions and the students because they compensate for the isolated "individual" by making the necessary basic facilities available, in the absence of "live support" from the teacher. *Objectives*: This study aims at investigating the Utilisation of Open and Distance eLearning students support services by Postgraduate students in an Open and Distance eLearning Institution. *Methods*: A quantitative, explorative, descriptive cross sectional and contextual design in a form of survey (online SurveyMonkey) research design will be used to investigate the Utilisation of Open and Distance eLearning students support services among 479 currently registered Postgraduate students in an Open and Distance eLearning Institution. The sample will be selected by means of convenience sampling technique and data will be analysed using SPSS 26.00. *Contribution*: The expected results of the study will be utilised to recommend the development of strategies to reinforce student support services as a vital component of Open and Distance eLearning; for further development and improvement of these services; to suggest some ways and innovative strategies to stimulate and encourage postgraduate students in the specific Department to utilise these services effectively and efficiently and deal with or address any challenges they may or might be experiencing due to ineffective and inefficient utilisation of these services. The results of the study may also inform policies and practice regarding Open and Distance eLearning students support services in the selected Institution.

Keywords: open and distance eLearning, student support services and postgraduate students

1. Introduction

1.1 Open and Distance Learning (ODL) and Open and Distance eLearning (ODeL)

ODL is a learning model that endeavours to bridge the time, geographical, economic, social, educational and communication distance between the institutions and the students, the academics and the students, the learning materials and the students and amongst the students themselves (UNISA, 2008).

By their very nature ODL institutions provide educational opportunities to mature non-traditional, working students who are often unable to access higher education in full-time, contact, and campus-based institutions (Ngubane-Mokiwa & Letseka, 2015).

In the year 2013, UNISA shifted from ODL to ODeL. This shift presumes the existence of an established culture, use of, and reliance on modern electronic technologies (Ngubane-Mokiwa & Letseka, 2015).

Maboe (2019), argues, there is no value if a distance student knows technology, but there is no online interaction occurring. ODeL institutions must commit themselves to support distance students in all aspects (academically, cognitively, administratively, institutionally and affectively).

To deal with the deficit many DOL Institutions need to have some form of provision or back-up apart from a text which is generally called "student support" (Simpson, 2015), and making it an integral part of the provision of ODL to address the diverse needs and expectations of students (Mowes, 2005).

1.2 Student support services

The purpose of student support services in ODL Institutions is to cater for students' cognitive, emotional, social needs and to help them with their learning. These services serve as the interface between the institutions and the students because they compensate for the isolated "individual" by making the necessary basic facilities available, in the absence of "live support" from the teacher (Nsamba & Makoe, 2017). These services which are an important issue associated with the planning and delivery of Distance Education programs, should be a major component of the Distance Education system whose success depends largely on the effectiveness of its student support services because in Distance Education student support services are very important due to a higher than average drop-out rate (Farajollahi & Moenika, 2010).

For Kelly-Hall (2010), these services are designed to give students the academic skills and confidence that are necessary for academic success and encourage them to get involved and integrated into the system. These services contribute to the quality of students' learning experience and their academic success considering that the most important factors in education quality assurance are: quality of teaching / learning and service systems and support for students. The role of these services is influenced by the relation with higher education institution and students (Ciobanu, 2013).

Herman, Puspitasari and Padamo (2015) argue that, to ensure that students who are studying in an ODl Institutions have an enduring learning experience, these Institutions have a duty to reinforce student support as a vital component of the Institution because the success of these institutions is reflected in how satisfied the students are with the support services and if they are benefitting from them. Thus, it is crucial for these Institutions to maintain the quality of student support services available and to be easily accessible by all students. These services are as important as providing students with an excellent academic content to guarantee their educational achievement (Secreto & Pamulaklakin, 2015). Without effective student support services, students will not have any academic, emotional and social connection with the institution and they are more likely to drop out and give up their studies (Ciobanu, 2013).

For Letseka and Pitsoe (2014), ODeL institutions need to organise and reorganise their systems and resources to support teaching and learning, without necessarily requiring teachers and students to be in the same space at the same time because ODeL students are supposed to have access to, and to be able to make optimal use of modern electronic technologies to access their study material and to interact with their lecturers without necessarily being required to make physical contact. Segoe (2012) as cited in Rangar (2015) states that, well-organised student support systems are essential for Distance Education (DE) students to engage in the process of learning.

In compliance with its 2030 Strategic Plan and be a leading provider of higher education opportunities through ODeL nationally, regionally and internationally; to provide guidelines on ODeL processes, practices and systems; to provide a shared understanding of ODeL and direct its implementation within a blended model of learning and teaching and to commit itself to an ongoing, responsive interaction with current and emerging national and international imperatives and developments with relevance to quality ODeL provision, the University of South Africa has established the following ODeL student support services: 1) Connect online (this includes myUnisa. This is an online student portal and the most important study tool). It consists of face book, twitter, LinkedIn and YouTube; 2) Connect with your lecturer and E-tutor; 3) Academic literacy services; 4) Counselling services (support is online and by email, person or by letter) and 5) Acalit Digital and Acalit@Unisa Hotline.

2. Methods

A quantitative, explorative, descriptive cross sectional and contextual design in a form of survey (online SurveyMonkey) research design will be used to investigate the utilisation of Open and Distance eLearning student support services by Postgraduate students in a specific academic Department at a the selected Open and Distance eLearning Institution. This design was found to be appropriate for this study because it is a process that is systematic and objective in its ways of using numerical data from only a selected subgroup of a population at a particular point in time (Creswell, Ebersohn, Eloff, Ferreira, Ivankova, Jansen, Nieuwenhuis, Pietersen, Plano Clark & Westhuizen 2012:5). Quantitative research design is often identified with the traditional scientific method that gathers data objectively in an organized, systematic, controlled manner so that the findings can be generalized to other situations or populations (Boswell & Cannon 2017:112). A survey design was also found to be appropriate because for this study because it provides a quantitative or numeric description of trends, attitudes, or opinions of a population by studying a sample of that population and from the sample results, the researcher generalizes or draws inferences to the population (Creswell 2014:200). Exploration is the attempt to develop an initial, rough understanding of some phenomenon. Much of the social research is conducted to explore a problem, that is, to start to familiarise a researcher with that topic. This approach typically occurs when a researcher examines a new interest or when the subject of study itself is relatively new. According to Babbie (2007:88, 115), exploratory studies are most typically done for three purposes namely to: Satisfy the researcher' curiosity and desire for better understanding, test the feasibility of undertaking a more extensive study and develop the methods to be employed in any subsequent study. In this study an intention is to explore the utilisation of Open and Distance eLearning student support services by Postgraduate students in a specific Department at the selected Institution. Description is the precise measurement and reporting of the characteristics of some population or phenomenon under study. The major purpose of many social scientific studies is to describe situations and events. This means that the researcher observes and then describes what was observed (Babbie 2007:89, 115). In this particular study, the researcher will describe the sample as well as the level of satisfaction with the utilisation of the existing student support services. This study will be cross-sectional because data will be collected at specific particular time. This study will be contextual in nature. A context is the circumstances that form the setting for an event, statement, or idea, and in terms of which it can be fully understood and assessed. A context is also the situation in which something happens and that helps you to understand it. In this study, the context is being currently registered student in a specific Department at the selected Open and Distance eLearning Institution.

The population of the study consists 479 currently registered postgraduate students in a specific Department at the selected Institution. The sample will be selected by means of convenience sampling technique. A convenience sampling is a type of nonprobability sampling in which people are sampled simply because they are "convenient" sources of data for researchers (Battaglia, 2011). It is also a type of sampling where members of the target population that meet the certain particular criteria such as easy accessibility, geographical proximity, availability at a given time or willing to take part in the study (Etikan, Musa, & Alkassim 2016:2). This type of sampling technique was adopted for this study because of the uncertainty that all the 479 students will participate in the study considering that, data will be collected using an online SurveyMonkey. This therefore means that the sample size will only be determined by the response rate at the end of data collection.

Data will be collected using an Online SurveyMonkey utilising self-developed and self-completion questionnaire written in English, and consisting of closed and open ended questions. The questions will be formulated with the aim to provide meaningful answers to the aim, objectives and research questions. Online SurveyMonkey was chosen as the appropriate method of data collection because it is low cost; fast and efficient; has contingency questions effective, has direct data entry and has a wide geographic reach. All questionnaires will be returned to the researcher electronically using the provided channel. The contact details of the respondents will be obtained through UNISA and the Department of Health Studies student data-bases.

The recruitment of respondents, the informed consent and the administration of the questionnaires will be done simultaneously. All ethical constraints pertaining to the conduct of the study will be adhered to. An e-mail invitation/recruitment will be sent to the accessible respondents requesting their participation in the study. The email letter will contain the title of the study, the aim and objectives of the study, a summarised version of the ethical considerations pertaining to the study as well as the duration of completion of the questionnaire as well as a link for the respondents to click or select to indicate their willingness and acceptance to participate in the study. Upon clicking on the link the first page of the questionnaire will immediately show up. At the end of the questionnaire, there will be a “submit questionnaire” box that the respondents will click on to send back the questionnaire to the researcher. Data will be analysed utilising the SPSS 26.00. Descriptive statistics will be used to summarize raw data in an understandable and meaningful way in order to describe the sample as well as all other variables and draw conclusions thereof.

3. Implication for practice

The consideration and effective as well as efficient implementation of the strategies to be developed based on the recommendations of the study may stimulate and encourage postgraduate students in the specific Department to utilise these services effectively and efficiently and deal with or address any challenges they may or might be experiencing due to ineffective and inefficient utilisation of these services thereby minimising failure and dropout rates and increasing success rate as well as encouraging them to carry on with their studies.

The results of the study may also be utilised by the selected Institution as well as the specific Department to reinforce student support as a vital component of Open and Distance eLearning Institution for further development and improvement of these services. These results of the study may also be utilised to review the framework for the selected South African University's policy and practice regarding Open and Distance eLearning student support services. The improved Open and Distance eLearning student support services may contribute to the university attracting and retaining more students as well as producing more knowledgeable and skilled graduates into the job market and changing people's life for the better. This way the selected Institution may increase and improve its significant contribution to the South African, African and the world's economy and integral development thereby reaching the Sustainable Development Goal (SDG), specifically goal number 4: ensuring inclusive and equitable quality education and promoting life- long learning for all.

4. Conclusion

The expected results of the study will be utilised by the selected Institution as well as the specific Department to reinforce student support as a vital component of Open and Distance eLearning; for further development and improvement of these services; and to recommend the development strategies to stimulate and encourage these students to utilise these services effectively and efficiently and deal with any challenges they may or might be experiencing due to ineffective and inefficient utilisation of these services. The expected results of the study may provide a framework for the University of South Africa's policy and practice regarding ODeL students support services.

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Future Challenges for Academic-Industry Value Co-Creation Through Lifelong Learning

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Abstract: The presented research aims to explore future context of e-learning, needs of professionals, and how higher education can respond to those needs. This is an empirical study with a qualitative approach. We interviewed teachers and students about their perceptions of e-learning. The interviews were semi-structured and allowed for reflections. All students interviewed were currently employed in industry and active e-learners. A web-based horizon scanning was made to identify trends in order to understand future context. The study is part of an academic development project with the intention of strengthening academic capacity and company knowledge to stay competitive in an international setting. In this paper, we present several cornerstones for creating courses that are suitable for professionals. Administrative routines and procedures need to be adjusted in order to meet challenges from other actors and the needs of stakeholders. A seamless experience would be preferred from a consumer-oriented perspective, where flexibility is a key factor. This flexibility is manifested by the need to control their own workload to adjust the work-education balance. Locus of learning needs to be problematized. Students do not identify themselves as co-creators. This is a challenge to overcome in order to design for the work-study situation. Previous studies on distance learning have mostly focused on full time students in today's context. This study involves foresight and the situation for students in employment. The findings will be relevant for teachers in the design phase of a course intended for any type of student who is not a traditional full-time student, and for university management building a strategy for the future of e-learning.

Keywords: foresight, e-learning, lifelong learning, professional education

1. Introduction

Demographic development and the need for industry to transform and be responsive to trends and tendencies that comes with globalization, digitalization, lifelong learning, sharing economy and a growing market for a new generation of educational institutions. Pucciarelli and Kaplan (2016) present three core challenges for institutions in higher education to address in the near future. They involve competition and market share, mindset changes towards entrepreneurship and involvement of stakeholders in co-creation. Web-based education gives universities an opportunity to offer its courses to new target groups, both nationally and internationally. It allows for widening recruitment and increased inclusion. In addition to course development, universities also need to work on developing support functions that are particularly relevant for web-based courses, for example in building up competence and administrative support around admission, validation, ICT support, internationalization and marketing.

Universities have extensive cooperation with business in the form of a large number of research projects. Recently the demands that the universities need to contribute to the professional's skill development have increased. The strategy meets two sides of the business sector's competence needs; partly increased business-relevant knowledge among young students and partly corporate need for skills development for employees. This new landscape involves challenges for universities and a need to learn more about different stakeholders' perspectives.

2. Theoretical background

A number of trends affect the future of higher education and this means that universities need to handle change, complexity, challenges and uncertainties (Pucciarelli and Kaplan, 2016). Among the opportunities are millennials seeking augmented educational experience, and also a growing and changing student population. Globalization involves a broadening competitive challenge (Pucciarelli and Kaplan, 2016). For Pucciarelli and Kaplan (2016) one strategic recommendation is to increase connections, interactions and co-creation of value with an increased number of stakeholders. This may involve a more dialogue-based communication and a new design of learning processes and structures. Scholars (Pucciarelli and Kaplan, 2016) also suggest another strategic focus: evolving requirements of the job market and employability.

The discussion about students being viewed as customers in higher education or not needs to end (Guilbault, 2018). The important issue is whether universities are market oriented and able to understand user needs. Guilbault (2018) suggests that it would be beneficial to talk about students as co-creators instead, according to a service dominant logic. Vargo and Lusch (2004) claimed that customers or users are always co-creators of value. Value-in-use is a central theme for the service-dominant logic, which makes user context important to understand. Higher education requires engagement from stakeholders and needs to be recognized as a service (Guilbault, 2018).

There are people-related barriers in higher educational institutions, and they involve resistance to change, teachers' disengagement, and student's attitudes (Lašáková, Bajzíková and Dedze, 2017). Among their suggestions to deal with innovation in higher educational institutions are efforts to strengthen collaboration with external stakeholders.

3. Method

This study was made with a qualitative approach based on empirical data. Two different methods have been used to generate data. By using web-based horizon scanning, we looked for emergent trends and tendencies. Both established trends and weak signals were identified.

As our second method, we performed a series of semi-structured interviews aiming to better understand the context and needs among students in existing distance courses who also work full time, and teachers[1] teaching those courses. For student interviews, an open invitation was presented in a course setting. Semi structured deep interviews with teachers involved in designing and executing eight distance courses on an advanced level specially focusing on students in company settings with at least one year of work experience. Analysis was made through thematic coding.

4. Preliminary results

The findings are still tentative as the research project is in the final stage regarding the analysis of empirical data. Political trends include a focus on lifelong and adult learning and the need for industry to transform in order to stay competitive. European Commission outlined these challenges as a significant part of the 2030 Agenda for Sustainable Development (Goals 4 and 9) (UN General Assembly, 2015). Other challenges include cooperation between universities and business and also development of skills and learning mobility (European Commission, 2018). Open access is only one example of how the sharing economy will affect higher education. Students express a need to share both course material and assignments with co-workers. Today this is a grey zone for students since access is limited.

Group assignments can cause difficulties and students often describe them as a source for frustration and conflicts. Student-student interactions are not described as important as student-teacher interactions. Students are interested in a community within the subject studied, but it needs to be uncoupled from the course.

A seamless experience would be preferred from a student as a consumer-oriented perspective, where flexibility is a key factor. This flexibility is manifested by the need to control their own workload to adjust the work-education balance

We have identified a number of challenges specific to lifelong learning and distance courses compared to the traditional educational setting. The first barrier towards successful lifelong education for the students is that often their place of work is not in agreement regarding their need for further education. This can effectively remove the students' ability to partake in education during their work-hours. When there is such an agreement and an identified need; companies tend to push students towards corporate education or commercial educational providers rather than public universities. Reasons for this vary, but timing and planning matter.

Second barrier is that even with strong intrinsic (and/or extrinsic) learning motivations, a group of students, fully employed in traditional work environments, cannot allocate the same hours to collaborate on the projects required to complete many traditional courses. This leads to low student engagement, difficulty in meeting deadlines, and low course completion rate.

[1] We would like to thank the teachers from Mälardalen University's lifelong learning programs (https://www.mdh.se/utbildning/livslangtlarande?l=en_UK) for the time invested in the interviews.

Third barrier resulting from fulltime employment is that student's access to the digital educational systems is often limited in their workplace. This is especially visible with distance courses that provide lecture recordings or supplementary materials using popular digital entertainment platforms.

Fourth, by losing the structure of the course, the students lose one incentive guiding them towards course completion.

5. Discussion

For students, successful participation in a lifelong learning course can increase their future employability and thus reduce the total spending of the social support system. In our findings, the main facilitator of the increased participation in lifelong learning on advanced level would be if their employers make it a welcome activity for employees. However, the employers often lack the incentive to make their employees qualified for jobs that they are currently not assigned.

In this context, it is necessary to look for solutions where the courses can be adapted for students with sporadic participation. To achieve this, the courses should not rely on rigid schedules. Deadlines can be either removed, made optional, or made relative to the start of work on the assignment. Teachers should also be aware of the restrictions when creating collaborative moments in the course. A structure for asynchronous work on assignment is almost always well utilized by students when it is present and collaborative work is required. Additional incentive towards finishing of the course should be built into the courses to increase completion rates closer to those of otherwise unemployed students. Co-creation in higher education according to a service logic can be a useful strategy as well as method in order to respond to these challenges. This is not a new idea. Eraut (1985) recognized the need for universities to re-consider their role and to move from being a creator and provider of generalizable knowledge to institutions with the role of enhancing the knowledge creation capacities of others, both individuals and professional communities. Students do not yet identify themselves as co-creators. This is a challenge to overcome in order to design for the work-study situation. Locus of learning is partly shifting and takes place in contexts outside of universities. This need for flexibility in time is a challenge for universities. It challenges the way teachers are organized and scheduled. This is a consequence of a user-centric perspective.

6. Conclusions

From a university perspective there is a need to reconsider the identity as an educator for youth. With the advancement of technologies many jobs are automated and higher skilled workers are required to monitor, control, and maintain the automation. This presents us with a future where lifelong learning is necessary to preserve industrialized society. However, at the moment, there are almost no incentives for employers to enable this type of learning, thus courses have to be adapted to students who are learning outside of the standard working hours and traditional structures. This can be achieved by introducing more flexibility into the courses as well as augmenting courses with systems that would incentivize completion outside of the traditional certificates and grades. These kinds of courses need to be designed for increased openness and to communicate through platforms enabling a relational approach for all stakeholders to enable co-creation of value in higher education.

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Blended Learning Sessions to Improve job Interview Skills

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Abstract: This paper describes part of an ongoing study of pedagogies to help undergraduates improve their global and cultural competencies. With the need for students to find a job abroad, part-time or full-time, blended learning sessions to improve undergraduates' job interview skills in English were designed and developed. The sessions were implemented in four classes of an English as a foreign language course. Each session consisted of teacher-led face-to-face instruction, individual work, pair work using audioconferencing, and online training through videoconferencing. Participants were business and management majors, and they engaged in the training for six weeks.

Keywords: blended learning, videoconferencing, job interview skills, synchronous technologies, English as a foreign language

1. Blended learning

The now widely adopted term "blended learning" refers to all combinations of different learning environments and methods (King, 2016). Blended learning is no longer viewed as an alternative approach but rather as mainstream in higher education because it increases learning flexibility in a demand-driven educational environment (Norberg, Dziuban, and Moskal, 2011). Various technologies have been blended in learning, such as email, blogs, text chat, and audioconferencing. Videoconferencing is one such technology. This technology offers immense advantages to education since it allows people in remote locations to not only talk with each other, but also to see each other in real time. Therefore, there has been increasing interest in the use of videoconferencing in educational settings. However, much uncertainty still exists about the development and implementation of blended learning sessions using videoconferencing to create informative and interactive learning environments.

2. Purpose of the study

This paper describes part of an ongoing study of pedagogies to help undergraduates improve their global and cultural competencies. One purpose of this study is to describe blended learning sessions that were designed and developed to improve Japanese undergraduates' job interview skills in English and evaluate their effectiveness. This paper focuses on the design and implementation of videoconferencing within the blended learning sessions.

3. Design and implementation

The sessions were conducted over six weeks, and each session was structured to consist of four steps: (1) teacher-led instruction, (2) individual work, (3) pair work using audioconferencing, and (4) online training through videoconferencing. Figure 1 shows how different media are blended in this study.

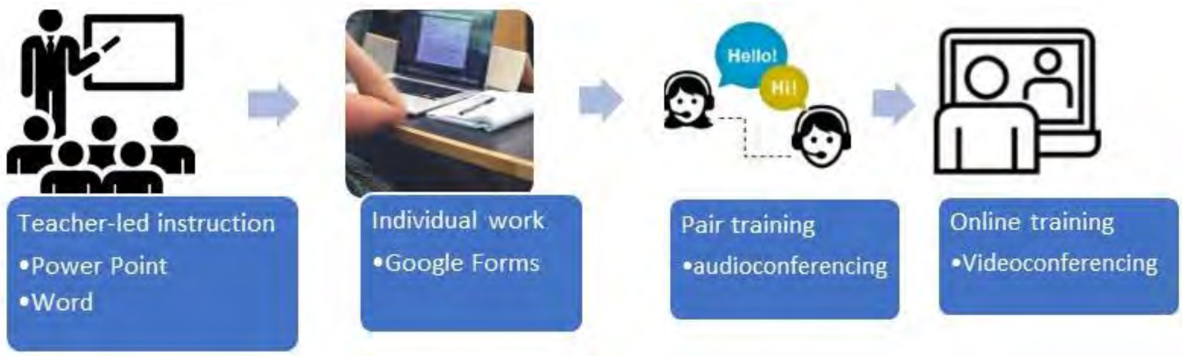

Figure 1: Rotation model – blended learning for developing job interview skills

According to the 3-C model (Kerres and De Witt, 2003), any learning environment consists of three components: a content component, a communication component, and a constructive component. These components can be delivered in various media formats, and it is important to combine elements from different components to support learners to have richer and more meaningful experiences and reach their learning objectives. This section describes the three components of our blended learning sessions.

3.1 The content component

Common interview questions were presented, classified into four groups: self-introduction, personal view, motivations, and plans. The questions were embedded in Microsoft PowerPoint files for class use. The purpose of the questions, possible answers, tips, and useful expressions for responses were also included. The information was presented during teacher-led, face-to-face instruction.

3.2 The communication component

Participants engaged in audioconferencing with their classmates using the information presented in the teacher-led instruction. As they practiced asking and answering the interview questions, they could exchange further information to enrich their knowledge and understanding of the ways to express and discuss their personal views.

3.3 The construction component

Participants engaged in videoconferencing. They were connected to an overseas instructor online so that they could each apply their knowledge to simulate an interview in English. A typical student's PC screen is shown in Figure 2. Many students split their screens as their tasks get complicated. In the figure, the right window displays the software that enables video chat and learning material presentation; the left top, a Microsoft Word file with the information given in the teacher-led instruction; and the left bottom, an online dictionary. Note that the software for video chat was developed by Sankei Human Learning Co., Ltd.

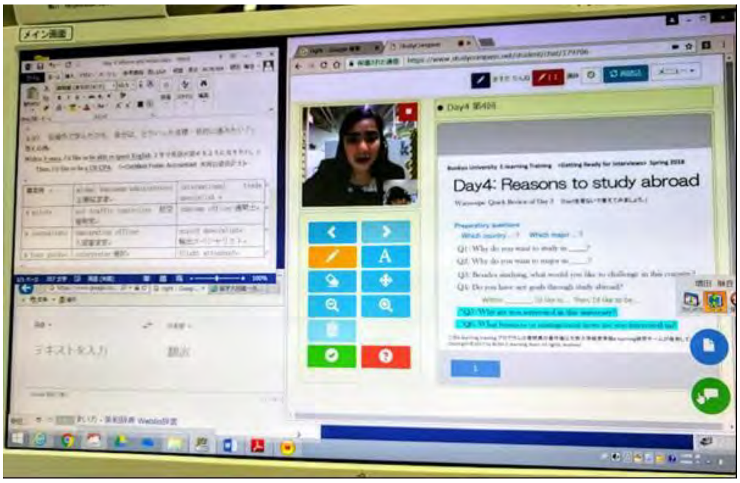

Figure 2: A typical student's PC screen, split into three windows

4. Discussion

The interactionist approach that began in the 1970s in the field of second language acquisition posits that interactional work that occurs when a learner and his/her interlocutor encounter some kind of communication breakdown is beneficial for second language development (Mackey, Abbuhl, and Gass, 2013). Previous studies also showed that we acquire language when we understand what we hear (Krashen, 2017) and when we are pushed to produce speech to make ourselves understood (Mackey et al., 2013). During videoconferencing, the participants often experienced difficulty understanding their overseas instructor or making themselves understood. In the face of such difficulties, the learners were taught to use expressions such as *Excuse me?* to politely ask for more "comprehensible input" from the instructors, whereas the instructors provided them with feedback such as *What do you mean by that?* or *For example?* to ask for clarification. Considering this evidence, it is assumed that participants of this study can develop their job interview skills through better understanding of interview questions and through practicing to automate some English phrases and structures.

The current blended learning environment may also improve affective factors such as confidence in foreign language learning and use. A number of studies suggest that verbal feedback and mastery experience can enhance self-efficacy (Hendricks, 2016; Phan and Locke, 2015). The learners of English in this study were provided with abundant positive verbal feedback from the overseas instructors and the teacher in the classroom. They were also given many opportunities to answer the interview questions and be successful during audio- and videoconferencing. Thus, it is likely that the learners benefited from the feedback and the mastery experience to enhance their self-efficacy for oral interactions in English.

5. Future research work

To examine the effectiveness of the current blended learning sessions, we will first analyze the learners' scores on listening and speaking tasks in English. Then, we will analyze their self-efficacy for listening, speaking, and interviewing skills. Further research is needed to fully understand the development and implementation of blended learning sessions using videoconferencing to create informative and interactive learning environments.

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