Enthusiastic Academic and Support Service Staff as an Agent for Change: A Case Study Based on a Project in African Higher Education Institutes

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Abstract: The aim of this case study was to evaluate whether there had been educational changes and if so, in which phases of implementation and institutionalization in three African higher education institutions. The changes were evaluated from the point-of-view of trainees in the field of e-learning and library services during the project conducted in 2013-2015. Written texts and visual material were analysed using qualitative content analysis. The enthusiasm and mutual pedagogical understanding of the academic and support service staff were the key factors promoting the changes in the integration of e-learning and modern library services into everyday practices in these higher education institutions. The provision of suitable training and pedagogic skills to the academics and the support service staff made it possible to detail these concepts to suit their home institution and provide them with a common language and value base that supported student learning.

Keywords: case study, development, educational change, e-learning, higher education, library, pedagogy

1. Introduction

1.1 Globalization of higher education

Higher education has changed in all parts of the world during the past decades. Globalization has increased our interconnectedness; this is evident in marketing, communication, cross-border mobility and information sharing. All of these changes have had a major impact on institutes providing higher education. At the same time, higher education is a notable participant in the global knowledge-based economy. (Marginson and van der Wende, 2007; Adams and de Wit, 2011). Today’s communication technologies have made it possible to exploit e-learning and electronic access to the scientific documents and information, increasing their availability for teaching and learning in universities and colleges in even remote locations (Altbach, Reisberg and Rumbley, 2009). However, according to Courtney (2013), adapting to this change is still proving to be a challenge for higher education institutions: how can they handle the growth of new technologies, the explosion of information and global competitiveness and integrate these concepts appropriately into their curricula.

In Africa, higher education has expanded rapidly in recent years and there is a clear willingness to revitalize and harmonize higher education throughout the continent. The African Union (AU) views education as a crucial tool for Africa’s development both from the perspective of quality and magnitude. Thus, the AU has strived to mobilize and support educational reform. The implementation of the Second Decade of Education for Africa’s Plan of Action 2006-2015 is progressing slowly but surely and it has started to change education throughout the whole continent (AU, 2014). In higher education, the implementation has focused on four areas: the promotion of research and knowledge production, quality assurance, support for economic development and improved funding.

The Association for the Development of Education in Africa (ADEA) has published its Medium-Term Strategic Plan 2013-2017. This stressed that scientific and technological skills will be critical for achieving sustainable development and growth of Africa. This plan requires that the higher education system is reformed and ADEA has made efforts to promote transformational change throughout the many countries and regions of the African continent. (ADEA, 2013.) To achieve this change, ADEA has defined five strategic objectives: 1) to contribute to advancing policies, strategies, practices and programs, 2) to promote African-led education and training solutions to address national and regional needs, 3) to foster greater utilization of relevant ICT to...
accelerate the transformation of education and training approaches and outcomes, 4) to create a diverse and sustainable partner network and 5) to strengthen organizational capacity and effectiveness (ADEA, 2013.) However, the monitoring and evaluation of the Plan of Action have revealed that most higher education institutions are more oriented towards teaching than research, even although the latter plays an important role in the production of knowledge and the creation of innovations (AU, 2014). Secondly, even though there has been a rapid expansion of higher education, this has not been matched by improved employment opportunities for graduates, especially in the low-income, Sub-Saharan African countries. Traditionally, almost 80 percent of the higher educated individuals are employed within the public sector that is at the moment expanding only slowly and even the more rapidly growing private sector cannot absorb all of the graduates.

There does seem to be a mismatch between the needs of commercial enterprises and the degree courses offered by the higher education institutions. (Majgaard and Mingat, 2012). According to Ndulu (2014) this is also one major reason why young highly skilled professionals migrate to the developed world. Lastly, ICT has been expected to increase access to education and improve the quality of education in Africa. However, the most African countries have faced challenges to achieving the expected benefits. According to Souter, et al. (2014) these challenges have been the absence of comprehensive policies, lack of ICT investments, limited infrastructure and support the use of ICT in education, lack of necessary ICT skills and lack of up-to-date data.

The European Bologna Process, one of the major recent reforms in higher education, has also affected non-European regions like the African continent (Vögtle and Martens, 2014). For example, many African countries have switched to two-semester academic years, three-cycle study programmes and the change in the curricula to a system based on course credits (Sall and Ndjaye, 2007). This adoption of the Bologna Process has eased the North–South inter-academic cooperation, although it may be viewed as following in the footsteps of the former colonial powers. However, it has also provided models to improve the African inter-academic cooperation and networking in higher education. The balance between these demands and the development of quality in higher education is challenging but not impossible. (Sall and Ndjaye, 2007.)

In summary, higher education in Africa is now becoming integrated into the global higher education edifice. There are plans and strategies to develop higher education and know-how in many countries. Younger academics have obtained a high-quality education and they understand the importance of global academic networks. The developed world and its academics can actively support their African colleagues in their collaboration efforts. At present, human-kind is facing various global challenges which can only be resolved by global collaboration.

1.2 Academics at the middle of change

The academic staff has to appreciate and adopt all of the reforms and educational changes. How enthusiastically they implement these changes is related to their commitment to change and their job satisfaction. Thus, it is crucial to involve academics when new strategies are being planned and changes implemented. (Kindelan and Martin, 2014.) This literature review is focused on the academics in Europe and Africa.

In the past ten years, the role of the academic staff has changed dramatically. The increasing demands for excellence in teaching and research and the need to perform other non-academic tasks such as administrative work, quality assurance, counselling of students and marketing have become a part of the daily duties of many academics (Mapesela and Hay, 2006; Ylijoki, 2014). According to Ylijoki (2014), these changes can create a working environment, where the academics are compelled to work against their own values which obviously adds to their feelings that they are burdened with an excessive workload.

Many reforms and changes in the higher education have been initiated at the institutional or (inter)national levels, in which the academics have not had any say or clear role (Ylijoki, 2014). Usually, they have been encouraged, even forced, to adopt different kinds of standards in their teaching and research. This can be a reason for the result reported by Louvel (2013), who noted that academics in France did not adhere to the predetermined intention about how the planned curriculum change in higher education should be implemented. It indicated that academics used existing resources and networks of colleagues to cope with their changing roles. Thus the renewal process was more a result of trial and error rather than being a predetermined plan, complicated by the fact that success or failure could usually be only be assessed many years after the implementation of the reform. (Louvel, 2013.)
Secondly, according to Ng’ambi and Bozalek (2013) informal leaders have a major role in adapting new innovations such as emerging technologies in the higher education institutions in South Africa. They act as opinion leaders and agents for change, and their motivation for the use of technology seems to be intrinsic.

Ng’ambi and Bozalek (2013) recommended that these individuals should be viewed as executors of innovative practices, but they still require formal leadership which should formulate policies supporting the deployment of new technology in the home institutions. They also acknowledged that inadequate access to the internet and the lack of computers were the greatest institutional and individual constraints as were the lack of support, even resistance, from colleagues, as well time management problems. (Ng’ambi and Bozalek, 2013.)

The role of the deployment of new technologies such as e-learning has been evaluated as an agent of change in higher education institutions (HEIs). According to Salmon (2005) change can only succeed if e-learning is introduced into traditional teaching through centralization and provision of professional services or by implementing easy-to-use technologies backed up by investment in personal and departmental learning and development. Salmon stated that it is crucial to keep “ownership” of these technologies with the academics and their departments since only in this way will they develop their capacities over the longer term. (Salmon, 2005.) Ertmer and Ottenbreit-Leftwich (2010) have said that the implementation of new technologies in education requires teacher knowledge change, teacher beliefs change and teacher culture change. This will happen only, if HEIs support changes by creating a culture which allows teachers to try out new practices and get technical and pedagogical support. Teaching is not effective without an appropriate use of ICT; it adds student-centered practices and binds support service staff into education. (Ertmer and Ottenbreit-Leftwich, 2010.)

1.3 Description of project focusing on this case study

This study describes the educational changes occurring in three African higher education institutions (HEIs) from the point-of-view of e-learning and library services. The study is based on two projects “Improving the Quality of Higher Education in Public Health Sciences” (HEPHS I and II) which were implemented during the period of 2011–2016. The main aim of these collaborative projects was to improve higher education in public health sciences. Three African universities participated in different aspects of these projects, one of which was from North Africa and two from the Sub-Saharan part of Africa. The project was coordinated by the University of Eastern Finland (UEF), in partnership with the Karelia University of Applied Sciences. The funding was provided by the Finnish Ministry of Foreign Affairs.

The project collaboration was a continuation of a long-term one-to-one partnership with these three African universities. They had shown their interest in developing e-learning and library services into their higher education, so these three universities were chosen for the project (see Erkkilä, et al., 2016). The main aim was to improve the infrastructure of the partner universities to provide sustainable, high quality training and pedagogical programs, such as course modules in many areas of public health. It was expected that this project would promote the adoption of modern teaching and evaluation methods by the institutions and staff involved in public health. It was clear that the exploitation of these new methodologies would require support from the library and IT-services.

At the beginning of the project, two young experts from each institution were selected to undertake the training of the trainees (ToT). They were working as academic teachers, librarians and IT-personnel at their universities and they were expected to act as the agents for change in their own institution, i.e. the persons who would transfer their knowledge and skills to other members of their institutions and represent the foundations for their institutionalizing capacity building efforts.

Training of trainees can be divided into five phases:

1. Analysing the current situation and resources in e-learning and supporting services, IT and libraries in the partner institutions
2. Establishing a working platform to allow web-based collaboration
3. Training young experts in the utilization of web-based platforms and contact teaching, modern library and IT services.
4. Implementing in-house services in their home institutions: e-learning courses, learning environments, library and IT services and software implementations
5. Learning how to work and collaborate with individuals from different cultures.

The changes occurring in the higher education of the partner institutions were evaluated by applying the model of educational change proposed by Fullan (2007). The process of change consists of three phases in this model: initiation, implementation and institutionalization. First, initiation is the process which proceeds after a change; next, implementation describes how the change occurred in practice, finally, institutionalization refers to how the change has been integrated as an ongoing part of the system. The aims of the change process are defined as desirable outcomes, such as improved learning, new skills and attitudes. (Fullan, 2007.) There were different kinds of critical factors involved in each phase of the entire process; these are described in more detail in figure 1.

**Figure 1**: Factors associated with initiation, implementation and institutionalization (modified from Fullan, 2007)

This case study describes and evaluates the educational change during the phases of implementation and institutionalization in three African higher education institutions (HEIs) from the point-of-view of ToTs in the field of e-learning and library services. The following research questions were formulated. What kinds of goals did the ToTs formulate and what did they consider as requirements for the implementation of educational
change? What kinds of changes happened in ways of thinking and practises of ToTs and their institutes during the project?

2. Methodology

2.1 Data gathering and methods

This case study describes the findings related to the training of the seven trainees during the project “Improving the Quality of Higher Education in Public Health Sciences II” (HEPHS II) from the period of 2013–2016 using multiple sources of qualitative data. The ToTs were junior academic staff and support staff, such as lecturers, IT-persons and librarians. Throughout the project, the authors collected written, interviewed and video-taped material made by the participants of the project.

The data-types collected in the period from November 2013 till June 2015:

- Personal Study Plans (PSPs) of the ToTs, workshop in November 2013, (n=7)
- Three Moodle-chats with the ToTs were used in preparing for the field-visit and these were evaluated after the visit after training from January 2014 to May 2014, (n=7)
- Blogs were used during a training visit to Finland where the participants reflected on what they had learned during their stay in April 2014, (n=6)
- A video was made at the end of the visit in which the participants interviewed and filmed each other, describing their opinions about the visit and what they had learned in April 2014, (n=6)
- Focus group interview and anticipation dialogues at the end of the project in June 2015, (n=7)

Personal Study Plans (PSPs) were used as a tool for professional plans and learning reflections during the training. According to Ansela, Haapaniemi and Pirttimäki (2006), a personal study plan can be seen as a personal development path, which tracks the trainee’s own study path, holistic growth and development as a lifelong process. In their PSPs, the ToTs were requested to answer what kinds of competencies and expertise they have currently, what kinds of resources and needs they have, and which are their goals and expectations to the training.

Moodle-chats included their needs and expectations of ToTs for the four weeks tailored pedagogical programme. During the programme, ToTs reflected on their learning process and good practices what they have met in blogs and recorded videos. Seven ToTs participated in two hours long focus group interview and anticipation dialogues at the end of project. The group discussed about their own learning, collaboration during the project, challenges they had encountered, current infrastructure in their home institutions, support they had received and knowledge sharing with other personnel within and outside the universities. This discussion was guided, monitored and audio-recorded by the researchers.

According to Seikkula and Arnikil (2014) anticipation dialogue is a premeditated method, where the aim is to “recall” a good future. The first phase is an interview assessing what the participants consider would be the best case scenario; this is monitored by two facilitators; in the second phase, this scenario is supplemented by the creation of a plan. All of the participants were encouraged to think aloud as well as listening to the thoughts of their colleagues. (Seikkula and Arnikil, 2014.) At the beginning of the session, a facilitator provided a short background for discussion; he asked that the ToTs should envisage that they were living in the year 2020 and they should cast their minds back to the start of the project in 2015. The ToTs were divided into two different groups and every participant was interviewed from her/his own perspective on the following themes:

- What good things have happened during the past five years in the library and IT-services on your campus?
- What has made you happy in this positive progress? What did you do so that those things would come to pass? Who helped you?
- What were your worries and what helped in overcoming your worries?

After the interview, all the participants and facilitators discussed their future plans for after the project and what they hoped to achieve on their own campuses and together with partners so that the changes that they hoped to achieve would actually be implemented in the desired manner. All data were collected in English,
even if it was not the native language for participants and researchers. The used gathering methods were planned and implemented by researchers. The main idea to collect this data was to reveal the development of thinking of ToTs and to describe tangible results of project.

2.2 Data analysis and ethical issues

The written, interview and video-taped materials were analysed using qualitative content analysis. According to Mayring (2000) this is a method that may be used with different kinds of recorded communication such as transcripts of interviews, protocols of observations, videotapes and documents (Mayring, 2000). Firstly, the whole data was transcribed and the main and generic categories of a categorization matrix were created in a concept-driven or theory-driven way by using the theory of educational change devised by Fullan (2007), where the main categories were initiation, implementation and institutionalization. Subsequently, the data was coded into subcategories in a data-driven manner. Table 1 shows an example of the categorization matrix and the coding of the data.

Table 1: An example of the categorization matrix and the coding of the data. [categories adapted from the educational change model of Fullan, (2007)]

<table>
<thead>
<tr>
<th>Category</th>
<th>Theme</th>
<th>Sub-theme</th>
<th>Related research participant quote</th>
</tr>
</thead>
<tbody>
<tr>
<td>Institutionalization</td>
<td>Changes in thinking and practices of ToTs and institution</td>
<td>Sharing knowledge</td>
<td>“I arranged two sessions for junior staff and teachers”</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>“I saw how to use different resources like... the use of database KOHA, which we are deploying now.”</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>“...now I learnt how I (a librarian) can teach literature and how teacher teaches students...”</td>
</tr>
<tr>
<td>Collaboration</td>
<td></td>
<td></td>
<td>“We are committed to a national nexus of universities.”</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>“I’m lucky that I am a member of... a national organization for universities.”</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>“Through this collaboration we are able to get even resources for infrastructure...”</td>
</tr>
<tr>
<td>Support</td>
<td></td>
<td></td>
<td>“How to administration fully get to support the program, it is hard sometimes...”</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>“...funding is not so much and we are coping somehow.”</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>“They innovated e-learning unit to the faculty of medicine.”</td>
</tr>
<tr>
<td>Policy</td>
<td></td>
<td></td>
<td>“I communicate with dean and other faculties and put a proposal for action plan...”</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>“We did a strategy plan and e-learning was a big component... It has not provided us an impetus to go forward.”</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>“We have made some strategies to link more plan sessions in groups: technical and pedagogical and library.”</td>
</tr>
<tr>
<td>Infrastructure</td>
<td></td>
<td></td>
<td>“Bandwidth is our priority, because it is a big problem.”</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>“We try to develop mobile version”</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>“So with mobile devices, you have access to resource.”</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>“...resources are limited, it delayed our work sometimes.”</td>
</tr>
</tbody>
</table>

The data analysis and interpretation process were done according to Elo and Kyngäs (2008). The unit of the code was the statements made by ToTs in their material. The categories for analysis were shaped from the viewpoints of research questions, and only the data that fitted into the matrix was analysed. In this study, this approach made it possible to identify and understand the phases of change in partner institutions, cooperation, development, learning processes of ToTs and the outcomes of the project.

Two analysers were involved in content analysis and they created the categorization, labels and codes in collaboration. The authentic citations and examples of analysis are reported to assure the validity of the content analysis. English was not the native language for participants. All participants provided informed consent to use their verbal and written data in this study. Their anonymity was assured by obscuring their names and other cultural and geographical identifiers. The raw data have been accessed only by the research group.
3. Results

3.1 Initial situation and pedagogical training

In the initial phase of the project, the analysis of the current resources and the participants’ current expertise about e-learning and library services were assessed both in situ and by interviewing the ToTs. It was noted that the partner universities were very different from each other. For example, their student numbers varied from 1500 to 170 000 students; in this study, these three universities are designated as a small (SU), medium (MU) and a large (LU) university. The main resources for e-learning and modern library services are described in table 2.

Table 2: Main resources in the participating HEIs for e-learning and modern library services (based on estimation of ToTs)

<table>
<thead>
<tr>
<th>Universities</th>
<th>SU private university</th>
<th>MU private university</th>
<th>LU state-funded university</th>
</tr>
</thead>
<tbody>
<tr>
<td>The number of students</td>
<td>1500</td>
<td>2500</td>
<td>170 000</td>
</tr>
<tr>
<td>The number of computers available for students</td>
<td>150</td>
<td>50 in the Library, available 14 hours per day</td>
<td>250 in the Faculty of Medicine, use only with teacher</td>
</tr>
<tr>
<td>Percentage of laptops owned by students</td>
<td>30 %</td>
<td>30 %</td>
<td>10-15 %</td>
</tr>
<tr>
<td>Web-based learning environment and its use</td>
<td>no web-based learning environment</td>
<td>Moodle, 20% of teachers use it, 5-6 courses in health sciences</td>
<td>Moodle, some courses, e-exams and material repository</td>
</tr>
<tr>
<td>WLAN</td>
<td>WLAN 2 Mbit/s</td>
<td>Real internet connection 36Mbit/s and WLAN 2 Mbit/s</td>
<td>no WLAN</td>
</tr>
</tbody>
</table>

The greatest challenges in e-learning varied in the three institutions. In LU, the academics had not been trained in how to make the best use of Moodle in their teaching; in that institute, Moodle was mainly used as an archive for material. In MU, there were extensive differences between the departments and e-learning skills were not shared between teachers. Finally SU was not endowed with any kind of web-based learning environment; in this institute not only was there a need to create a web-based learning environment but also the academics who would implement this kind of teaching had to learn the principals of e-pedagogy as well as understanding the technology exploited in e-learning.

Fullan’s theory of change (2007), describes the implementation as a changed practice, where characteristics of change existed and some local and external factors affected the initial change. All partner universities were aware at the beginning of the project that they needed modern technology in order to update their education and support services. “Learning and ICT use are two things that cannot be separated if an effecting learning process is to take place…” (IT-person from SU), “For me the biggest experience what I got was that it opened my mind to look at the whole aspect of using technology in teaching… Sometimes when you have resources, but you don’t know how to use them, you need other people to see how they are using this kind of resources…” (IT-person from MU)

All participants set the following areas as their main goals for implementation 1) to provide high-quality services (ICT and library), support and train to students and academics at the university, 2) to improve collaboration with the administration and 3) to incorporate e-learning into the curricula. In the SU, the main needs were a reliable and an expanded network system through enhanced bandwidth, better co-operation
with administrative staff and academics and better library services. The needs of the MU involved distinctive and specific needs for ICT from the different departments; the ToTs stated that neither students nor academics had experience of e-learning, a lack of resources and teaching staff, and insufficient local network.

In the LU, the main limitations were of the paucity of technical support and computer labs for such a huge number of students, no staff competent to teach information and e-learning skills and insufficient resources. The ToTs were asked to consider how they envisaged their academic career and expertise would develop. They compiled their current competencies and needs by using PSPs. Thus, the librarians possessed the competence of professional librarians and they had some educational experience. Instead, the IT-participants had skills for dealing with computer networks, Moodle, general technical support, software and hardware analysis and design. Thus, they needed to expand their pedagogical skills and learn ways to assess know-how.

In spring 2014, ToTs participated in a four week pedagogical training, where they learnt the basics of pedagogy, how to teach in a student-centred way and how to exploit new technology in teaching. “Working in Moodle... it was not only some lectures’ material, but good experience on this process, how to do assignments, evaluate... (2nd teacher from LU). “I will introduce some of these new technologies to teachers, when I’m back at home and encourage them to embrace ICT in their classrooms.” (Teacher from MU). Especially, librarians and IT-persons claimed that now they better understood teachers and could provide more support than before. They had acquired a mutual language with the academics. “...now I learnt how I can teach literature and how teacher teaches students...” (Librarian from SU), “I am coming from the technological site and getting to the teaching methods and pedagogical issues..., if teachers have problem with technology... when you have an aspect of pedagogy, you can support more.” (IT-person from MU).

Additionally, the ToTs understood that they can develop their own teaching or support for teachers by applying e-learning methods and applications in a step-by-step manner. They did not need expensive machines or a large infrastructure, only enthusiasm, belief and the so-called e-attitude. With these attributes they could create their own teaching innovations and that these would be supported by the faculty. “They (administration) think things should be sophisticated and high-technology has to be good, but I see in this project that it should be as simple as possible and applicable... it saves time and efforts, and results can be seen quickly and easily.” (1st teacher from LU)

3.2 Institutionalization of change and received outcomes

Institutionalization is the term used to describe how the change becomes incorporated into both structure and practice. In this study, institutionalization was considered as the development of changed ways of thinking by the ToTs and changes in the practices within their institutions. Therefore subthemes were formulated to describe the changes - these were named sharing knowledge, collaboration, support, policy and infrastructure. ToTs with a teaching background put their new pedagogical ideas into practice and experimented with student-centred learning. Their initial experiences were encouraging and they became more motivated and confident not only to change their own modes of teaching but also to share their knowledge with their students and other teachers.

“...the pedagogical training, it really added value to my profession, because I have changed it (teach) from teacher-centred to student-centred... more students participated in and they were happy the way that teaching methods changed...” (Teacher from MU), “...students are able to learn independently, so teacher has not to say everything, he can give a chance to learn, collaborate with each other in groups... we also learn from students...” (Teacher from LU)

All of the ToTs prepared a training session on how to create e-learning material for students in their institutions. In LU, they developed a tutorial that was suitable for all of the university’s students; in it they described the basics of e-learning. “We make orientation session for students... to show them step by step how to login in the Moodle, ...how to use material, how to go through quizzes, how to make assignments...” (1st teacher from LU)

Some of ToTs noted that this had proved challenging, because it was not easy to change students’ attitudes away from traditional teaching towards e-learning. They suspected that students were not ready to take more responsibility for their learning.

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“E-learning is not a way to be lazy. Actually they (students) need work harder, so our aspect is also to arrange training of the students... We try to train blended them (e-learning and contact teaching)... They have to understand the full concept of e-learning.” (IT-person from MU)

Additionally, they arranged training for staff and they monitored whether or not the training had been successful in LU. “When I came back from pedagogical training, I arranged two sessions for junior staff and teachers, and tell how to teach in student-centred way and keep several exercises... and I observed during their teaching how the class was running...” (2nd teacher from LU). Tailored job shadowing provided open tools for librarians, which they transferred with the support of IT-persons to their own institution. “I saw how to use different resources like databank and e-sources and also the use of database KOHA, which we are deploying now.” (Librarian from SU) Collaboration increased between support staff and teachers, and together they had greater possibilities to demand changes in their institute. “Through this collaboration we are able to get even resources for infrastructure...” (IT-person from MU). They also had initiated co-operation at the national level and were actively participating in national networks and sharing their knowledge with others. “…I am a member of Telnet, which is a national organization for universities..., one of the projects is e-learning and e-library at national level.” (IT-person from SU), “We are committed to national nexus of universities... This is a commitment between all national universities to use others e-learning courses... we can use others’ courses without any fees.” (Teacher from LU).

The support from the faculty varied between the universities during the project. Initially, the amount of support was low, but when the faculties started to become aware of the advantages of new technology in teaching and libraries, they invested in new technology, infrastructure and even buildings. “How to administration fully get to support the program, it is hard sometimes... they don’t fully understand objectives of these... But when all in the faculty have used e-learning, it mixed all differently. Amazingly, you find that the amount of investment come for human capacity and infrastructure.” (IT-person from MU). Nonetheless, even if institutions had invested in infrastructure, there was little funding for support staff. The ToTs tried to prioritize their efforts for e-learning and library services taking into account the current situation. Indeed, some ToTs had enjoyed promotions in their academic career since they were viewed as key agents in promoting educational innovations. “We were lucky to have support from our administration and the faculty... They appreciated what we are doing and support us. They innovated e-learning unit to the faculty of medicine, it was the first time. Then I was choosing to be a director of e-learning centre of university... (1st teacher from LU).

All universities had devised strategies and policy statements involving e-learning and support services. According to the ToT from the MU, the problem seemed to be that HEIs did not follow their own mission statements and ToTs did not receive enough support. “We did a strategy plan and e-learning was a big component and I must say that strategy plan has not followed... It has not provided us an impetus to go forward” (IT-person from MU). The changes in the structure of institution caused confusion and the ToTs had faced criticism and suffered slights about their competence. “Administration changed and each one was a critical (for IT-development), but there was said in our strategy that it was my mission to develop e-learning platform.” (IT-person from SU)

In another institute, the ToT had been appointed as director of e-learning centre, and she had emphasized the importance of creating a strategy for e-learning; in fact she was a key person in these efforts. “I communicate with dean and other faculties and put a proposal for action plan...” (1st teacher from LU). ToTs had promoted future collaboration between teachers, IT-support and libraries by planning strategies and action plans together. “We have made some strategies to link more plan sessions in groups: technical, pedagogical and library.” (IT-person from SU)

The infrastructure in their institutes had improved somewhat during the time of this project, but it was still a priority in development of e-learning and support services. “Bandwidth is our priority, because it is a big problem.” (IT-person from SU), “We have a huge number of students... resources are limited, it delayed our work sometimes.” (2nd teacher from LU). At the same time, they had created new learning management systems, databases and mobile applications, because they understood that it was the only way to provide a modern e-learning and library environment for students and academics. “We try to develop mobile version,
because we have seen that typically they (students) have smartphones, that’s why we prove it wireless.” (IT-person from MU), “The most important is that we saw that this is possible.” (IT-person from SU).

4. Discussion

Our paper describes an educational change occurring in three African higher education institutions (HEIs) in e-learning and library services from the point-of-view of the ToTs. The theory of the educational change devised by Fullan (2007) was used as the theoretical framework. The deployment of e-learning and modern library services need clear goals, vision and support from institutions. The results demonstrated that all of the participating institutions had taken the first step to integrating e-learning and modern library services so that it had become a part of their daily practices. The key to success was the enthusiasm of both academics and support staff who were ready to take responsibility for development and implementation. However, even enthusiasm is not sufficient without support from the university administration. These results are in parallel with the study by Ng’ambi and Bozalek (2013), where the personal enthusiasm of the agents of change about these emerging novel technologies was the main motivator for their deployment. Ng’ambi and Bozalek (2013) presented a model where formal leadership was needed in order to exploit and support informal change agents in the adoption of innovations in higher education. In our study, the ToTs had set their own goals at the beginning of their training so that they were able to develop exactly those aspects of library and information technology that would be optimal for their own institution. They were anxious to deliver modern services for students and academics, and to be able to provide support and training on a regular basis. Additionally, they were enthusiastic that e-learning would become better integrated into the curricula.

All institutions faced challenges to implement these reforms and the ToTs recognized these problems. The lack of infrastructure and support services, inadequate co-operation with other academics and administration and the lack of awareness about the advantages of e-learning by students and academics were the obstacles which had to be confronted and resolved. The results demonstrated that long-term mutual training for staff on e-learning and library services can be considered as an agent for change in their institutions, but it demands collaboration and support from other teachers and support staff.

In this case study, pedagogy was a key to achieving a change. All ToTs participated in a four-week pedagogical training and during that time, they began to understand each other better e.g. the goals of the other ToTs and what was meant by good library and IT-services. They found a common language with which to collaborate and promote educational change.

The main issues in institutionalization were knowledge sharing, collaboration, support, policy and infrastructure. E-learning and modern library and IT-services were recognized as being essential to all institutions and their structure. According to Fullan (2007), the change can only be built into the structure of institutions through policy and only generated when there is a critical mass of administrators and teachers who are skilled and committed to change. Thus, the local training for academics and students capable of training their own staff was a key to success. ToTs were provided with pedagogical know-how and taught the skills allowing them to share their knowledge with others. Academics and students were provided with support by ToTs and they were eager to start e-learning and the use of modern library services. The trainings provided a foundation so that a practical reforms could be made e.g. they encouraged the committed academics to work together as agents of change.

In this study, all of the participating HEIs had devised strategies and issued policy statements about e-learning and support services, but their words had not always been translated into action. The ToTs were aware of this contradiction; some of them thought that it was a personal failure that even though they were following the stated aims of their institute, the administration had not understood or supported their efforts. This result differed from the study of Louvel (2013) where academics did not follow some predetermined plan in a change situation. One reason for this discrepancy is that here the ToTs were motivated, even enthusiastic, about adopting the new technology in their HEI. According to Ng’ambi and Bozalek (2013) these types of individuals should be viewed as executers who would be most likely to succeed in implementing innovative practices.

Both supportive policies and executers are needed when embarking on changing the policies of HEIs.
It was interesting to examine how the infrastructure had developed in HEIs, even in those cases where the resources remained at the same level as they had been at the beginning of the project. The ToTs were well aware of the needs of academics and students and were able to prioritize their developmental work to answer these needs. They were able to develop new systems, services and applications and they understood that progress can occur in a step by step manner without huge investments in infrastructure. Clearly, small steps were better than no steps at all. In many studies (e.g. Ng’ambi and Bozalek, 2013; Gupta, et al., 2017), a lack of sufficient infrastructure has been considered as the greatest institutional obstacle to deployment of new technology and services, but in this study it was noted that the development of innovations could be traced to certain key individuals, men and women of vision who understood the real needs of their HEIs and developed them steadfastly. When other academics and administration saw the promising results, the innovators were more likely to receive more resources from their HEIs. In summary, there are three foundation stones to developing e-learning and services in HEIs – visionary strategies, realistic policies and enthusiastic executors.

5. Conclusion

This article focused on the presentation of the empirical results from the participating ToTs in this project. Its main purpose was to describe and evaluate whether there had been educational change in e-learning and library services assessed via implementation and institutionalization in three African higher education institutions (HEIs).

Based on our experiences, we conclude that by the selection of enthusiastic agents of change and teaching them about up-to-date aspects of higher education including modern teaching technologies, one can innovate the practices of academic institutions. We noted that the most crucial aspect in achieving a positive outcome was that there had to support and a strategic commitment from the host institution.

Perhaps the most interesting finding was that an awareness of modern pedagogic skills and learner-centred education are crucial not only for academic teachers but especially for the support service staff. These skills make possible knowledge transfer throughout the home institution. It is important that all the individuals in an academic institution speak a common language and share the same value base and all are supporting the learning of the HEI’s students.

References


Designing Questions for Research Design and Design Research in e-Learning

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Abstract: This paper presents a model for developing research questions that are aligned to research aims for research design in e-learning. The model is proposed as a solution to the on-going problem of heterogeneity of research problems. The model is based on Burrell and Morgan’s four social paradigms, and integrates four research aims, namely, explore, explain, develop and describe; four design positions, namely, formalist, populist, functionalist and conventionist; and four pursuits of (hu)mankind, namely, virtue, value, power and knowledge. Four of Roodé’s (1993) research questions are mapped onto each of the consolidated paradigms. The feasibility of the model was tested against eight papers in previous issues of this journal. Two questions drove the study: what are the paradigms in which the selected articles can be classified, and how are these paradigms aligned to the research aims and research questions? The model was found to be useful in aligning the implied research aims and research questions of the selected papers. The model is proposed as a useful tool for supervisors and novice researchers to assist with the development of integrated research aims and research questions. Further research will include the development of generic question stems that can be used as the first few words of the questions that correspond to each aim.

Keywords: Research paradigm, research aims, research questions, design research

1. Introduction

In a recent volume of this journal two authors call for a “critical reflective approach to researching technology use” (Charbonneau-Gowdy, 2017, p.59) and propose “first steps that facilitate to overcome the heterogeneity of e-learning projects in favor of a better comparability and generalizability being necessary preconditions for theory development” (Rüth and Kaspar, 2017, p.94). There seems to be a lack of clarity in terms of what is being researched, as well as in how it is being researched. Somehow the stated aim of a research project does not match the eventual outcome. A key reason for this may be a mis-alignment of research aims and research questions. This article argues that the paradigm of educational design research (McKenney and Reeves, 2018) is a useful starting point for socially responsible research. The paper presents a framework for developing research questions that aligns research aims, research questions and the underlying beliefs of researchers regarding their research. The model is presented and tested against a number of articles in this journal to gauge its feasibility towards providing such improved “comparability and generalizability” (Rüth and Kaspar, 2017, p.94).

The call for (socially) responsible research in educational technology is not new and a notable contribution has been made over the years by Tom Reeves and others. (Reeves, 1995, 2000, 2006; McKenney and Reeves, 2018; Reeves, Herrington and Oliver, 2005; Oliver, Herrington and McKenney, 2011). They take as their point of departure research that is both grounded in theory and aimed at practical usefulness, thus fitting into what Stokes (1997, p.73) calls “Pasteur’s quadrant” (Figure 1.). The figure shows that research can be high in considerations of use, or in considerations of fundamental understanding, or high in both, but the forth quadrant remains empty such as no research can be low in both use and understanding.

![Figure 1: Pasteur's quadrant (Stokes, 1997, p.73)](https://example.com/pasteur-quadrant.png)

The challenge now, though, is to determine what type of research would fit into Pasteur’s quadrant and to develop a framework for generating questions within that quadrant. This article will present a model that considers four research paradigms and will link those paradigms to a set of research questions where there are two questions to each research aim. The feasibility of the model will then be tested against purposively selected articles from past volumes of this journal. The aim of the research is to explore the extent to which the selected articles can be classified into research paradigms, and to propose linked research questions for each article. Two questions drive the study:

1. What are the paradigms in which the articles can be classified? and
2. How are these paradigms aligned to the research aims and research questions?

The problem that is addressed by this model lies in the alignment of research aims and research questions. Novice researchers in particular often state a research aim and then mention a number of questions, but there is no clear link showing how answering those questions will lead to achieving the aim.

2. Literature survey

For Reeves, Herrington and Oliver “…at some level, all instructional technology research can be said to focus on questions of how people learn and perform, especially with respect to how learning and performance are influenced, supported, or perhaps even caused by technology” (Reeves, Herrington and Oliver, 2005, pp.100–101). They identify the following six characteristics of design research:

1. a focus on broad-based, complex problems critical to higher education, focus on broad-based, complex problems critical to higher education;
2. the integration of known and hypothetical design principles with technological affordances to render plausible solutions to these complex problems;
3. rigorous and reflective inquiry to test and refine innovative learning environments as well as to reveal new design principles;
4. long-term engagement involving continual refinement of protocols and questions;
5. intensive collaboration among researchers and practitioners; and
6. a commitment to theory construction and explanation while solving real-world problems.
(Reeves, Herrington and Oliver, 2005, p.103)

In framing socially responsible research in educational technology it may be useful to draw from one of the key works underpinning the closely aligned field of information systems, which also studies the relationships between technology and society. For many years the work of Burrell and Morgan on social paradigms and organisational analysis has underpinned much of the philosophical approaches to research in information systems. Burrell & Morgan (1979) identify two dimensions along which social science research is conducted. The dimensions are developed from our beliefs about the nature of social science and the epistemological and ontological nature of society. The epistemological and ontological nature of social science research varies between positivist and anti-positivist. The nature of society varies from a society of regulation to a society of radical change. Burrell and Morgan place these two dimensions at right angles and thus create a two-by-two matrix of four paradigms, namely, Radical humanist, Interpretive, Functionalist, and Radical structuralist (Figure 2).

Given that one cannot be subjective and objective at the same time, nor support radical change and regulation simultaneously, “the four paradigms are mutually exclusive. They offer alternative views of social reality, and to understand the nature of all four is to understand four different views of society. They offer different ways of seeing. A synthesis is not possible, since in their pure forms they are contradictory, being based on at least one set of opposing meta-theoretical assumptions. They are alternatives, in the sense that one can operate in different paradigms sequentially over time, but mutually exclusive, in the sense that one cannot operate in more than one paradigm at any given point in time, since in accepting the assumptions of one, we defy the assumptions of all the others” (Burrell and Morgan, 1979, p.25).

I argue that researchers should select a particular paradigm within which to work depending upon the subjective or objective aim of their research (Figure 3). Radical humanists are interested in the subjective world, but feel the need to transcend or even overthrow current societal arrangements.
Johannes C. Cronje

Figure 2: Four quadrants of sociological and organizational research (Burrell and Morgan, 1997, p. 25)

Their aim is to uncover hidden patterns and to explore alternatives. Interpretive researchers believe that the human experience of the world is subjective, and they have a concern to understand it as it is. Their aim is to understand given phenomena. However the word understand is not demonstrable. A researcher cannot stand up and understand something for the audience (or the reader) to see. It is therefore better to use the word explain as the keyword for this paradigm. Functionalists believe that the world is objectively discoverable, and that things can be improved by ‘tightening up’ the rules. Their aim is to develop solutions. Radical structuralism takes an objective world view. They concentrate on structural relationships, believing that radical change is built into the very nature of society. Their aim is to describe the position as it is.

Figure 3: The aim of each paradigm

The work of Burrell and Morgan has not been without criticism, notably from critical realists (Modell, 2015) who argue against the hegemonic dominance of the model, particularly with its emphasis on the exclusivity of the paradigms, and from pragmatists (Goldkuhl, 2012) who argue for more nuanced approaches to the study of complexity. On the other hand Garbutt (2016) sees the different paradigms as different routes on a map. The map provides information rather than judgement and it is for the traveller who has selected a particular route on the map to follow the instructions that go with that route.

Garbutt (2016) adds an axiological dimension of what I shall call concern to the use of the four quadrants. He maps them onto Ackoff’s (1976) four pursuits of humankind, viz. the scientific – the pursuit of (scientific) truth; the political-economic – the pursuit of power and plenty; the ethical-moral – the pursuit of goodness and virtue; and the aesthetic – the pursuit of beauty (as a value) (Ackoff, 1978, p.14). Garbutt’s resultant mapping sees four pursuits of researchers (figure 4) – Radical structuralism, he argues, is in pursuit of objectively measurable power while the functionalists look for objective, scientifically measurable knowledge. Interpretive researchers are in search of subjective, concrete value, and radical humanists seek an abstract, subjective virtue (Garbutt, 2016, p.5).

Figure 4: Adding the four pursuits of human kind

Anchoring Burrell and Morgan’s (1979) four paradigms in some form of scientific pursuit or another allows one to see the extent to which research in any one of them might be considered socially responsible. What remains now is to consider the relationship between these research paradigms and the process of design. In his seminal work on Design Thinking Peter Rowe (1987) presents a framework of four design positions that
architects take in their design of spaces. “First there is a functionalist position, distinguished by an emphasis on the accommodation of activities and the influence of building technology. The second is a populist position, which acknowledges and interprets contemporary commonplace building practices and user preferences. Third, there is a conventionist position, that uses a primarily historical reference; and finally, a formalist position that considers elements of form for their own sake” (Rowe, 1987, p.124). Although Rowe’s work uses architecture as its primary reference it can be argued that it is applicable to all design, including instructional design.

I argue that Rowe’s four positions map directly onto Burrell and Moran’s (1979) paradigms (Figure 5). The horizontal dimension relates to the existence or absence of a “best solution”. At the one extreme of the dimension is the conventional belief that there is one implied best solution to a problem and that regardless of whether or not that solution can be achieved, reaching it remains the ultimate functional goal. At the other extreme is the belief that there may be an infinite number of solutions and that these solutions are dependent on an infinite number of contexts. These contexts could relate to people (populist) or to form (formalist).

The vertical dimension relates to the abstract or concrete nature of the design problem or message. At the abstract extreme lies the formalist desire to follow the possibilities that the form presents, and the conventionist practice of using a set of abstractions that have developed over time. At the concrete extreme lies the practical reality of popular acceptance or functional use.

The conceptual model – adding the questions

Having now developed a conceptual model to integrate aims I move towards presenting a set of research questions that relate to each paradigm (Figure 6). For this I draw from Roode (1993), who argues that research questions and methods can be developed for each of the paradigms. He identifies four research questions that could be asked: ‘What is; how does; why is; and how should?’ Although Roode does not say so himself I believe that his questions map directly onto Burrell & Morgan’s (1979) model. ‘How should?’ is an essentially positivist question that calls for an objective, prescriptive answer, while ‘How does?’ resonates with the subjectively descriptive, interpretive nature of the anti-positivist. ‘What is?’ relates to a society of radical change as it tries to uncover or take an abstract stance to a situation, while ‘Why is?’ tries to understand what the rules are trying to achieve in a society of regulation. The problem with a question such as ‘How should?’ is that it may lead to speculation, and specifically in an objective environment one would prefer to have a question of a more strongly binary nature. I therefore propose that the question ‘How should?’ be replaced by ‘When does?’

To clarify, an example. The question ‘How should A be aligned with B?’ is more difficult to answer than ‘When does A align with B?’ The second question is clearly a research question, while the first may be regarded as speculative. For the purposes of this article therefore the question ‘When...?’ refers to some kind of measurement, and could be replaced with “To what extent...?” So the question could also be ‘To what extent does A align with B?’.

Figure 5: Adding the four design positions – developed from Rowe, 1978
3.1 A worked example

The purpose of the model presented above is to align research aims, paradigms, pursuits and design positions with research questions. In the following section I shall use the recurring theme of technology acceptance in e-learning to show how this model might be used to generate research questions for each paradigm. The key to this method is to use two research questions to arrive at a given aim. So if the aim is to explore, the questions will be: ‘What is (or are)?’ and ‘How does (or do)’? Likewise if the aim is to explain the questions would be ‘How does (or do)?’ and ‘Why is (or do)?’ To develop one needs to ask ‘Why is (or why is this not...)?’ and ‘When does (or when will)?’ Finally to describe one needs to ask ‘What is?’ and ‘When does (or when do)?’

A researcher working in the Radical Humanist quadrant may wish to explore the patterns of adoption that have emerged in a given area or field. The two questions that drive the research could then be something like: ‘What are the affordances of the technology that is currently infused into the system,’ and ‘how do teachers apply these affordances in their practice?’ On the other hand someone working in the interpretive quadrant wants to understand why certain patterns of adoption emerge. The aim of such research is to explain the patterns of adoption of the affordances of technology in a given area or field. The two questions would be ‘How does this technology get adopted in the field, and why does it get adopted in this way?’ The implementer tasked with user adoption may want to develop an implementation plan and would ask ‘Why do some teachers adopt this technology faster than others and when do the slow adopters also start using the solution?’ Finally, as is the case in evaluation studies, the aim of research would be to describe the state of the implementation of a given technology. The questions would be “what is the state of adoption in this area and when is this state reached?”

The worked example has shown how four discrete research projects could be undertaken, from four different design perspectives, in four different research paradigms, around the same theme and potentially using the same population and data set. It is simply the questions that change as the research aim changes. The following section will show how these questions can be used to drive design research in our field.

3.2 Application of the model to design research

Roode (1993) argues that research could take place sequentially through each paradigm to form a framework for what he calls process-based research. One form of process-based research that has gained some traction in the field of educational technology has been that of design research (Reeves, Herrington and Oliver, 2005; Oliver, Herrington and McKenney, 2011; McKenney and Reeves, 2018). Design research follows a cyclical approach (McKenney, 2011) in which a problem is analysed, a solution designed, implemented and tested, and the results used to inform a second, third and even fourth cycle of design and development (figure 7).
Van den Akker (2007, pp.45–46) presents a staged model of design research: Preliminary investigation, Theoretical embedding, Empirical testing; and Documentation, analysis and reflection on process and outcomes, which elaborates on what happens during each cycle. Preliminary investigation amounts to an exploration of terrain, and would therefore map onto the Radical humanist Explore paradigm. Since a theory is meant to explain, the Theoretical embedding phase would map onto the interpretive Explain paradigm, while Empirical testing amounts to development. Finally the Documentation, analysis and reflection on processes and outcome, maps directly onto the Radical structuralist Describe quadrant.

I propose a simplified version of this model to include four stages called, Design, Test, Learn and Apply. A design cycle comprises a single anti-clockwise rotation through the four paradigms as shown in Figure 8. A couple of turns of the wheel will result in a design project. The model Figure 9. shows how design research is a combination of designing and researching. The outcome of the design process is usually some physical, digital or intellectual product, while the outcome of the resultant learning is a set of principles that would lead to a research outcome such as a thesis or a paper.
4. Method

In the following section I will test the model against a number of selected papers published in earlier issues of this journal. The aim of this research was to explore the extent to which selected articles in this journal conform to the model. Two questions drive the study: What are the paradigms in which the articles can be classified, and how are these paradigms aligned to the research aims and research questions? In this desk study the articles were selected by way of a type of purposive sampling, known as Typical Case Sampling, which “is useful when a researcher is dealing with large programs, it helps set the bar of what is standard or ‘typical’” (Etikan, Musa and Alkassim, 2016, p.4). The sampling was done by performing a close reading of the titles in the tables of contents of all the volumes of the journal. The criterion for including a paper in the research was that the title of the article had to provide an indication of the paradigm in which the research took place. For instance the title: “Familiarity with technology among first-year students in Rwandan tertiary education” (Byungura et al., 2018) suggests that the article would Describe the familiarity of the students and thus fall in the Radical Structuralist/Describe quadrant. On that basis the article was selected. Once the articles were selected their abstracts were considered to confirm if a paradigm may be clearly derived from these.

Articles whose abstracts were acceptable were then read and analysed to extract the aim and research questions. In some cases the aims and questions were explicitly stated, and in other cases they had to be derived from the context. In some cases the authors may have used the word ‘understand’ when, in the context of this paper the word ‘explore’ may have been more appropriate. Likewise authors may have used ‘explore’ to mean ‘describe’ in such cases the words were changed and the changes indicated in the discussion. The research aim and research questions may be my own paraphrase of the stated or implied aims and questions of the relevant paper. The next section will first discuss papers that work in a single paradigm. Thereafter will follow a paper in which the entire design research sequence was followed.

5. Discussion of results

In this section I will discuss a number of papers in this journal and show how their aims and research questions may be aligned to fit into each paradigm of the model described above. Finally a paper will be discussed that shows how its authors moved through all four paradigms in a typical design research cycle.

5.1 Explore

In the abstract of her article about “seeking solutions to challenges in online and blended learning programs” Paula Charbonneau-Gowdy states her work to be “directed at uncovering challenges in Virtual Learning Environments” (Charbonneau-Gowdy, 2018, p.56 - My emphasis). The aim of uncovering underlying patterns places the work in the Radical humanist quadrant with the aim to explore. Charbonneau-Gowdy’s own explicitly stated research questions resonate with that aim. She presents three questions:

1. What tools are available that could help evaluate our online programs?
2. In what ways, if at all, do our research findings align with the framework of such a tool?
3. What solutions, if any, can this framework offer for moving forward in order to respond to the tensions we have uncovered in the online programs? (Charbonneau-Gowdy, 2018, p.57).

Charbonneau-Gowdy provides two ‘What are...?’ questions, while her second question, “In what ways...” (p.57) can be paraphrased as “How, if at all...”. Thus we see that in this case the aim of the article – to uncover, or to explore, is supported by two what questions and a how.
One of the stated aims of Knight and Barbera is to “explore how learners are navigating with current and emerging technologies in language learning tasks” (Knight and Barbera, 2018, p.67). They complement this with a two-fold research question: “Is there evidence of directional agency manifesting in other recent or emerging task-based language learning CALL scenarios that involve talk, and if so how?” (Knight and Barbera, 2018, p.72). Given that if the answer of the first part of the question is ‘no’, then there would be no second part, a better formulation of the question would be ‘What evidence is there...’ If such a change is made then the research aim, to explore, is well aligned with the research questions “What is... and how do...?”

Sánchez-Mena, Martí-Parreño and Aldás-Manzano state that “the main goal of this research is to explore teachers’ intention to use EVGs using the technological approach proposed by the Technology Acceptance Model” (2017, p.356). In their research the authors test seven hypotheses to explore the relationship between age, perceived usefulness and perceived ease of use, and attitude towards and intention to use educational video games. Although they present their hypotheses they do not formulate explicit research questions, although these can be extrapolated from the research to have been ‘What are the relationships between age, perceived usefulness and perceived ease of use, and how do these affect attitude towards and intention to use educational video games. Once again an article with the aim to explore, that answers ‘What is, and how does...?’ types of questions.

5.2 Explain

Costley and Lange did their research because “it is useful to understand the reasons why students decide to continue using MOOCs in the future” (2017, p.174). Instead of research questions they test four hypotheses:

H1. Levels of instructional design are positively correlated with future behavioral intentions.
H2. Levels of instructional design are positively correlated with germane load.
H3. Levels of germane load are positively correlated with levels of future behavioral intentions.

From these hypotheses I extrapolate a number of research questions:

1. What is the relationship between levels of instructional design and future behavioural intentions?
2. What is the relationship between levels of instructional design and germane load?
3. What is the relationship between levels of germane load and levels of future behavioural intentions? and
4. Why does instructional design affect future behavioural intentions?

It can be seen, then, that the aim to understand or explain in this instance, is refined, as the model proposes, by ‘What...?’ and ‘Why...?’ questions. However, it is necessary to replace the words “What is the relationship, with “How are these elements related”, so that the questions are aligned with the “How?” and “Why” questions that are appropriate for this paradigm.

5.3 Develop

Lawless and Allen’s paper “investigates methods of reducing stress on-line and proposes some principles for constructing on-line collaborative events to ensure that stress is eliminated or at least minimised” (2004, p.121). The aim of the research, therefore was to develop a set of guidelines, thus putting it in a functionalist paradigm. The resultant paper is clearly structured to answer two implied research questions, which are (my formulation) ‘why do students in an online course experience stress and under what circumstances (when) will this stress be reduced?’ They answer the first question through an extensive literature survey coupled with some interaction with students. The second question is answered through a case study in which they construct some stress-reducing exercises for their students and test the efficacy of these on the students. The end product is a set of guidelines for reducing stress in on-line learning.

5.4 Describe

The following paper aims to describe the perspectives of an instructor and students on the use of the Blackboard platform for delivering an engineering course over a period of nine years. Although the aim is never explicitly stated it can be derived from the sentence: “The results presented show students and instructor perspective towards use of LMS as a technology enhancing learning and teaching tool” (Uziak et al.,
2018, p.3 - My emphasis). The word *show* is sufficiently close to describe to infer such an aim. Similarly there are no explicitly stated research questions, but again they can be deduced from the results as being: ‘What are the affordances of the Blackboard platform used by the instructor and students?’ and ‘When do the students and instructor find these tools satisfactory?’ At this stage it needs to be pointed out that the word *when* is a statement of condition, not of time - it could also be paraphrased as ‘under what circumstances?’

As I pointed out earlier in this paper the aim: ‘to *explain*’ is used as an indicator for *understand* in the interpretive paradigm. Therefore a paper that “aims to understand the degree of familiarity with technology for first-year students at the University of Rwanda” (Byungura et al., 2018) is likely to fall into this paradigm. They state their research questions explicitly as: “(1) To what extent do first-year university students owned, accessed and used a range of digital tools? (2) What activities do these students perform with these digital tools? (3) Did these students get any previous computer-based training? (4) What is their level of confidence in using a range of digital tools?” (Byungura et al., 2018, p.32). As can be seen there are no ‘How...?’ or ‘Why...?’ questions here. Thus one questions the interpretive nature of the research. Furthermore a careful further reading of the research methods shows that a questionnaire, rather than interviews of focus groups, was used to gather data. The method thus suggests a descriptive, rather than an interpretive study. A full reading of the paper confirms this. The findings amount to descriptive statistics of ownership and use. It is clear that the authors of this paper substituted the word “understand” for the more correct “determine” and the aim of the paper is to *describe*, rather than to understand or explain. It will only be once researchers have interrogated these results further and augmented them by other interpretive methods that they would arrive at a true understanding.

### 5.5 One full research cycle

The aim of a paper by Véra Ferdiánová is “to introduce interactive materials for Monge projection, which are implemented into LMS Moodle, as well as show results of pilot research of influence of using these materials on students” (Ferdiánová, 2017, p.259). In her paper she refers to previous work (Ferdiánová and Poruba, 2016) in which a paper-based version was demonstrated, and at the end of the paper she discusses future development. It is clear, therefore, that the article under discussion is the description of one cycle in a design research process. The paper actually passes through five stages, *Describe, Explore, Explain, Develop,* and *Describe* again.

In the introductory sections of her paper she *describes what* some current problems are with three-dimensional visualisation and *when* (or under what circumstances) these problems are addressed by other researchers. She then goes on to *explore what* some current solutions are, and *how* they are being used, before coming to the conclusion that “All these approaches seem to be very enriching. Unfortunately, they have not been statistically tested yet – it cannot be statistically confirmed, which of these methods is more effective or brings more benefits” (Ferdiánová, 2017, p.260). Once she has identified a possible solution she continues to develop an *understanding of how* anaglyphic stereograms work, and *why* they might hold the key to developing a solution for students to practice three-dimensional visualisations in a digital, rather than physical analogue environment (Figure 10).

![Figure 10](image-url): Orthoscopic (left) and pseudoscopic (right) anaglyphic views (Ferdiánová, 2017, p.260)

After the discussion of the potential solution she goes on to *develop* and implement digital alternatives using *GeoGebra*. The first phase of the development is to ascertain *why* GeoGebra is an appropriate platform. She does so by discussing the advantageous features of the program and also by listing some of the prestigious awards it received. Following this she develops a set of interventions for *when* these may be appropriate (Figure 11).
The penultimate section of the article is where she describes the results of a pilot test of the intervention, where, with the aid of graphs and tables, she indicates what the results were of the students’ learning, and when these results showed an improvement over previous iterations.

This section thus shows how, in one article, Ferdiánová has taken us through the ‘Design, Test, Learn, Apply’ cycle, working sequentially through each of Burrell and Morgan’s (1979) paradigms of social science, and asking and answering Roode’s (1993) questions as appropriate for each paradigm. Finally, in the last section of her article she states categorically that “These results are motivation for us for our future work, because we would like to test the biggest group and would like to extend materials” (Ferdiánová, 2017, p.267), thus indicating that she and her fellow researchers are about to embark upon another design research cycle as described by McKenney (2011).

6. Conclusions and recommendations

In this paper I have proposed a model that aligns research aims with research questions for research in e-learning. The model is based on Burrell and Morgan’s (1979) four social paradigms, and integrates my own four research aims, namely, explore, explain, develop and describe, Peter Rowe’s (1987) four design positions, namely, formalist, populist, functionalist and conventionist, Ackoff’s (1978, 1976) four pursuits of (hu)mankind as refined by Garbutt (2016) as virtue, value, power and knowledge. To this synthesis I added a modification of four of Roode’s (1993) questions for research in information systems, and argued that, a selection of two specific questions were appropriate for each of the consolidated paradigms, as described in Table 1.

<table>
<thead>
<tr>
<th></th>
<th>Burrell and Morgan</th>
<th>Cronje</th>
<th>Rowe</th>
<th>Ackoff/Garbutt</th>
<th>Roode</th>
</tr>
</thead>
<tbody>
<tr>
<td>Radical Humanist</td>
<td>explore</td>
<td>formalist</td>
<td>Virtue</td>
<td>What is…?</td>
<td>How does…?</td>
</tr>
<tr>
<td>Interpretive</td>
<td>explain</td>
<td>populist</td>
<td>Value</td>
<td>How does…?</td>
<td>Why does…?</td>
</tr>
<tr>
<td>Functionalist</td>
<td>develop</td>
<td>functionalist</td>
<td>Power</td>
<td>Why does…?</td>
<td>When does…?</td>
</tr>
<tr>
<td>Radical structuralist</td>
<td>describe</td>
<td>conventionist</td>
<td>knowledge</td>
<td>When does…?</td>
<td>What is…?</td>
</tr>
</tbody>
</table>

The model was tested against eight Typical Case Sampled articles from this journal and it was found that it was possible to classify the articles into each of the four paradigms respectively, and that the articles answered research questions that corresponded to the mapping of Roode’s (1993) questions onto the model. It was found, however, that authors use the terms understand, explore, interpret etc. rather loosely and it was necessary to re-interpret those terms and substitute them with the words explore, explain, develop and describe. Such an interpretation was quite possible through a close reading of the article itself. It was also found that few authors provide clear, answerable research questions, some providing only hypotheses, and others simply hinting at what they were trying to find. Once again, though, through close reading it was possible to generate questions that conform to Roode’s (1993) question stems. I contend that, should authors
be more careful in their selection of aims and research questions, the resultant higher level of standardisation will reach to easier comparisons across articles.

Along with Roode (1993) I argued further that, in the context of design research, it was possible to work through the four paradigms sequentially, following a cyclic path as proposed by McKenney (2011) that amounted to a sequence of design, test, learn and apply. Once again this model was tested against an article in a volume of this journal (Ferdiánová, 2017) and it was seen that, although she did not explicitly use the research aims or questions, these could be derived from a close reading of the article itself.

To conclude then, the model seems to work well in making explicit the relationship between research aims and research questions and could be useful in describing socially responsible research. A number of recommendations follow. These recommendations are aimed at supervisors and novice researchers who wish to speed up the proposal writing process.

Firstly in order to make research aims explicit and easy to comprehend researchers are encouraged, at proposal stage, to use one of four words to describe the aim of their research, viz. explore, explain, develop or describe. It is always possible later in the research process to substitute these verbs for more nuanced words such as ascertain, understand, design, or evaluate, but to develop a crisp research proposal it helps to use simple words at the start.

Secondly two research questions should be developed that match the relevant paradigm as shown in Error! Reference source not found.. Once again, as the research progresses these question stems could be refined and replaced, but for an initial crisp proposal it helps to use the most basic form of the question stem. It is hoped that, should there be a greater standardisation of the terminology of paradigms, aims and objectives the much needed “comparability and generalizability” (Rüth and Kaspar, 2017) will be improved.

Finally, in the case of a design research project where a certain solution is both developed and tested it is useful to follow a cyclic path though all four paradigms, in which the problem is described, possible solutions explored, the most feasible route understood and a solution developed, after which the test results are once again described, thus forming both the conclusion of the first cycle and the point of departure of the next.

7. Limitations and further work

With only eight articles sampled this study amounts to a “proof of concept” rather than a large-scale interpretive study. Empirical verification of the model could be done by training a number of critical readers to scrutinise a particular canon and classify the texts accordingly. One could then determine the level of inter-rater validity to see the extent to which the model is transferrable between readers.

A further limitation of the model lies in the fact that the terms are so open to interpretation. As was shown in the case of Costley and Lange (2017) it was necessary to change the words What is the relationship between x and y to How are x and y related. To clarify these it would be useful to develop a number of typical What question stems, typical How question stems, etc. Novice researchers could then be encouraged to use such question stems in the development of their initial proposals. Obviously as students’ proficiency in understanding the relationships between research aims and questions develop they could use a completely different phrasing. In this way, for instance, the question When does? could be replace by Under what circumstances does?

Finally it must be remembered that this model is designed to be an initial tool to assist researchers to develop a clear relationship between their research aims and questions – it is not to be seen either as a recipe or a rigid rule for the development of research questions.
References


Reeves, T.C., 1995. Questions the questions of instructional technology research. In: Proceedings of the 1995 Annual National Convention of the Association for Educational Communications and Technology (AECT), (17th, Anaheim, CA, 1995); see IR 017 139. ERIC.


Medical Student Perceptions of Integration of a Customized Cloud Based Learning Operating System into Problem Based Learning Tutorials

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Abstract: Since its inception, the College of Medicine and Medical Sciences (CMMS) at the Arabian Gulf University (AGU) has adopted the problem based (PBL) pedagogy in Medicine relying on paper-based trigger material. However, delivery of such paper-based triggers during tutorial sessions was not optimal to promote medical student interactivity and engagement within tutorial sessions. As involvement of multimedia resources and tools in PBL are more valuable than simple print textual modes of learning and can have a positive impact on learning and knowledge integration, we aimed to digitize all our trigger material. Over the past three years CMMS has integrated after customization to PBL standards, the cloud-based operating system, UNIO into its problem-based learning (PBL) curriculum. The aim of UNIO integration was to digitize text triggers and enhance the quality of visual triggers in order to improve medical student interactivity and engagement within tutorial sessions. UNIO electronic platform was customized from a teacher-centered design to fit a PBL pedagogy. It was utilized to link student and tutor hardware within a group together for promoting interaction and collaborative learning. The effect of this teaching approach was evaluated from student responses to an in-house validated survey at the end of the fifth PBL module. Customization and integration of UNIO within the PBL curriculum resulted in an entirely paperless learning process. It created an integrated PBL system combining conventional text trigger in a digital form with digital media such as images, videos and other multimedia, while maintaining face-to-face setup. It also provided online and off-live access to content embedded at campus and open access to open source content online to both tutors and students. Results of the student satisfaction survey pointed to a predominantly neutral attitude towards integration of UNIO within our PBL tutorial sessions, but the item related to effectiveness of media triggers within UNIO received favorable responses from students. Further evaluation for a longer term is necessary for additional student feedback. Other forms of evaluation may be required in the aim of improvement and for justification of subsequent implementation of UNIO within our PBL curriculum.

Keywords: PBL, Medicine, Cloud-based learning, UNIO

1. Introduction

The College of Medicine and Medical Sciences (CMMS) at the Arabian Gulf University (AGU) in Bahrain has adopted since its establishment (35 years ago) the Problem-based learning (PBL) approach for teaching Medicine during phase II (Year 2 - 4 or pre-clerkship years) of the medical program. During this phase, students cover 92 health problems across 9 system-based units, with three units per year. Problem-based learning (PBL) is a student-centered educational approach, in which learning is based on authentic problems that are used as a vehicle to promote student learning of concepts (Barrows, 2002; Barrows and Tamblyn, 1980; Moust, Bouhuijs, and Schmidt, 2014). PBL is implemented in small face to face groups, while the tutors work as the facilitator of discussions among learners (Hung, Jonassen, and Liu, 2008). For PBL in Medicine, problems are presented to students in the form of a clinical health scenario. During their first tutorial session, both students and the facilitators are provided with a set of scenario-related learning triggers as the starting points of the PBL case. The students with the help of a facilitator discuss these triggers and generate the learning needs relevant to the health problem. These discussions foster learning by helping individual students to activate prior knowledge, to elaborate, and to stimulate the re-structuring of knowledge (Moust, Bouhuijs, and Schmidt, 2014). During the second tutorial session, the students review, discuss and present what they have learned during the week.

Up to three years ago, CMMS has embraced the traditional paper-based PBL, and the use of technology in PBL was limited and sedated. The relatively recent adoption of technology into PBL was driven by stakeholders
including the college administration, students and tutors. The aim of the college administration was to comply with the university’s initiative for integrating e-learning within some curricula and optimal utilization of the technology resources in which the university has invested heavily. Students’ evaluation of paper-based PBL over the past few previous years has consistently pointed to student demands for introducing more technology into their educational activities. This is anticipated from the IT savvy students who have grown up with technology and expect to learn through its application in their PBL experience. Other challenges of paper-based trigger material that students described include the inadequate quality and resolution of some hardcopy visual triggers, the lack of access to them after the tutorial sessions and the larger quantity of paper-based course material and ineffective organization of their paper resources.

Tutors were mainly concerned with students’ capacity for interaction and engagement during tutorial sessions. Hard-copy text triggers were presented to each student as paragraphs on one or two pages during the first tutorial session, and students could access triggers consequent to that in discussion. Complete exposure of the triggers eliminated any eagerness or imagination about the next trigger. Additionally, delivery of the paper-based visual triggers (Imaging scans, X-rays, histopathology slides, etc...) was inefficient, as students passed them from one to another and scrutinized them individually. Some students felt isolated and distracted from other group members and there was a lack of group focus in general. For tutors, this did not seem effective for students to achieve their learning needs as gradual unfolding and collaborative examination of triggers would be.

2. Literature Review

Over the past years, there has been increasing interest of integration of technology and application of multimedia to support PBL in medicine. The active and independent learning required and involved in PBL can be improved by the introduction of technology and multimedia, for they can offer media-saturated students a wide network of information and interactive simulations necessary to enrich the PBL process. In a systemic review of 28 studies on the effect of educational technologies in problem-based learning in health sciences education, Jin and Bridges (2014) listed some positive outcomes of integration of technology into PBL for student learning. These include providing rich, authentic problems and/or case contexts for learning, supporting student development of medical expertise through the accessing and structuring of expert knowledge and skills, and reducing perceived cognitive load.

The educational technologies that have been adopted to support problem-based approaches to learning include innovations such as learning management system (LMS), specialist learning software (e.g., CMapTools), immersive virtual environments (e.g., SecondLife), and resources such as 3-dimensional (3D) anatomy models and other forms of multimedia. PBL problems that are enriched with multimedia support contextual learning (Hung, Jonassen, and Liu, 2008; Bridges et al., 2012) and are more engaging and authentic than problems based on text alone and can have a positive impact on problem solving and learning, resulting in improved knowledge integration (Price Kerfoot, Masser and Hafler, 2005). This is the reason why most PBL programs use multimedia for the presentation of triggers for the problems in addition to the trigger text, as they enhance students’ observation skills, and provide them with new information to add to the cues obtained from the trigger text.

An example of a success story is the EDIT project at the Faculty of Health Sciences at Linkoping University in Sweden, in which web-based multimedia-enhanced scenarios replaced text-based PBL scenarios (Personn, Fyrenius and Bergdahl, 2010). The introduction of the web-based scenarios had positive effects in that it made the group more focused and did not have any long-term negative effects on the group dynamics. Other examples of enriching PBL problems in Medicine with multimedia is the use of virtual patients and interactive patient cases which allows students to practice clinical reasoning in real-life-like ways (Savin-Baden et al., 2010, 2011). Some studies relied on simulations, and the traditional PBL tutorial group meetings were alternated with sessions with a “Human Patient Simulator” in the simulation center (Harris, Ryan and Rabuck, 2012).

Educational technology can be used in PBL to support learners through the problem solving process by providing tools and resources; for instance, installation of large screen displays with Internet access has shown positive impact on tutorials at Harvard (Price Kerfoot, Masser and Hafler, 2005). Other uses have included networked computers to support tutorial groups (Koschmann et al, 1996). Additionally, the use of new
hardware, such as interactive whiteboards (IWBs) in synchronous face-to-face PBL has reshaped new forms of learning (Bridges, Botelho and Tsang 2010, Bridges et al., 2012; Beeland, 2002). We digitized our PBL process by utilizing pre-existing technology resources available at CMMS to a fuller capacity and customizing an electronic cloud based learning operating platform, UNIO, keeping in mind that such technology integration must support and preserve the basic principles of PBL. We aimed to explore students’ satisfaction with incorporating technology into their problem-based learning through a survey measuring the efficacy of UNIO in teaching the students and the students’ interaction with it.

3. Method

Faculty participants in the PBL process at CMMS were either holders of a doctorate degree in basic medical science or clinicians academically affiliated with the college. Student participants were medical students at CMMS in their pre-clerkship phase (Year 2) and had completed two PBL units so far.

The aims of this study are to:

- Explain briefly the customization process of the teacher-centered cloud-based platform, UNIO, and its integration within the PBL tutorials in Medicine at CMMS.
- Describe how through employment of pre-existing technology at CMMS, UNIO produced and presented a combination of digitized text triggers and other multimedia like graphics, sound, animation and video, as part of the weekly health problem.
- Provide first-time evaluation of student perception on integrating UNIO into the PBL tutorial sessions and its effectiveness for active learning.

3.1 Integration of UNIO into PBL tutorials

The electronic learning operating system, UNIO was adopted by CMMS at AGU in 2016 as an educational tool in PBL with the consent of CMMS Medical Curriculum Committee and higher authorities of the college and university. UNIO is a Cloud based electronic Learning Operating System developed by the award-winning Harness Handitouch UK Private Limited (London, UK). It is device and browser agnostic, and its many great features (Table 1) for effective learning created the opportunity for its integration within the PBL system.

Table 1: Features of the original platform UNIO before customization to PBL principles

<table>
<thead>
<tr>
<th>Features of UNIO</th>
</tr>
</thead>
<tbody>
<tr>
<td>Paperless</td>
</tr>
<tr>
<td>Teacher-centered learning</td>
</tr>
<tr>
<td>Introduces live, versatile white-boarding</td>
</tr>
<tr>
<td>Independent student annotations as a separate layer</td>
</tr>
<tr>
<td>Embedding of various form of content</td>
</tr>
<tr>
<td>On-campus and off-campus access to organized course material</td>
</tr>
</tbody>
</table>

3.1.1 Tutorial group linkage

Each group carried out their PBL tutorial sessions in designated classes equipped with a smartboard, a computer and proper seating. Each tutor was also provided with an IPAD for their tutorial session. The e-learning experts at CMMS were responsible for the technical integration of UNIO into tutorials. UNIO allowed for mapping of all members of a tutorial group together and linking by network media of all members within a tutorial group, including the tutor.

3.1.2 Embedding of PBL tutorial content

Problems for each unit were embedded and organized by problem title. Sub-titles of other content for each tutorial session were also added to allow easy student access and localization of required content (figure 1).
The tutor guide for the weekly problem within each unit was embedded by the e-learning expert two days before the first session of the tutorial. Embedded content associated with the problem included text triggers, student-tutor interactions, graphics, multimedia, radiology images, lab reports (figure 2), and learning resources such as textbooks and relevant Internet links. Tutors could also embed extra content they may feel necessary before, during and after the tutorial sessions. Students were given permission to embed content from the internet during the tutorial sessions.

Figure 1: Screen capture of the web-based platform page when accessing a course/unit after login into UNIO
A useful feature of UNIO is the annotation capacity. For each problem, every trigger was embedded on a separate UNIO page to allow for gradual revealing of triggers and annotations by students or the scribe (Smart board user) (figure 3).
3.1.3 Customization of UNIO

We took into consideration how crucial the design of an e-learning platform is to the students’ success (Reeves, 1998; Liaw, 2008; Lu and Chiou, 2010) and how it dictates levels of their engagement and interactivity in a PBL setting (Verstegen et al., 2016). The challenge with UNIO was that it was originally designed as a teacher-centered system with a lecture-based set-up, so considerable customization was requested from the developers to transform it for CMMS to maintain the PBL setting and principles. Many features were added, and below is a brief description of such features.

Figure 3: Screen capture showing annotations on a) trigger text or b) embedded visual trigger such as images by the scribe on the smartboard. These annotations are automatically broadcasted to devices of all students within the tutorial group.
“PRESENTER” feature. For each tutorial group, the e-learning experts have created an extra account for a virtual student known as “Smartboard User”. This account is designated for the scribe to utilize on the smartboard and log into UNIO with his/her tutorial group. The tutor assigns “PRESENTER” to the Smartboard User, so that whatever actions are carried out by the scribe (Presenter) at the smartboard is broadcasted to all students and tutor in that group.

“EXPORT” feature was a specific customization by request from students. Students can now export the entire content including all annotations made during the tutorial session in a PDF format and directly send it to any email account or print it.

“ZOOM” feature is very beneficial when students want a close-up of embedded content.

“HIDE CONTENT/REVEAL CONTENT” feature. The e-Learning expert embedded the problem tutor guide on a weekly basis with the student-tutor interactions already hidden for the student, but visible to the tutor. Students cannot reveal any of the hidden content (figure 4).

Figure 4: Screen capture of student-tutor interactions and tutor personal notes on the tutor’s I-Pad. These are hidden from all students within the group (Student View).

3.2 Survey instruments and dissemination

The anonymous student survey consisted of 25 questions that included Likert-type scale questions that evaluated students’ attitudes towards the integration of UNIO into PBL. The student survey was designed to assess four major domains: 1) the technical aspects of UNIO, 2) its effectiveness in PBL, 3) preparation for exams, 4) ease of application, and overall opinion of the electronic platform UNIO. The survey was paper-based and distributed to students and gathered by personnel from the Quality Assurance and Excellence Center (QAEC) at AGU. Students were assured of anonymity and were not asked to disclose any personal information. There were no incentives offered for completing the survey.

The Likert Scale used was a 5-point scale that offers a range of response options, from one extreme attitude to another, like “Strongly Agree” to “Strongly Disagree.” They also included a neutral midpoint. Values (points) were also assigned for each response as: Strongly Agree = 5 points; Agree = 4 points; Neutral = 3 points; Disagree = 2 points; Strongly Disagree = 1 point. These values were used to report a single average response for each item. The percentages of students responding with a score value were also calculated for each item.
4. Findings

118 out of 202 students (58.5%) responded to the survey. Table 2 shows that a neutral score (Score 3) was given for most items, indicating that students were not yet decisive about their satisfaction level. 30% – 40% of students were neutral to every survey item as shown in figure 5. The original scoring weights give “Neutral” a “3” scoring weight meaning more than disagreement but less than agreement, but does not represent an intermediary answer between disagreement and agreement. To compensate for this, we aimed to determine how the respondents generally leaned for each item. Accordingly, we assigned a 5-point scale that offered the response options with the following coding (values): “Strongly Agree” = 2 points, “Agree” = 1 point, “Neutral” = 0 points “Disagree” = -1 point and “Strongly Disagree” = -2 points. These points were used to report a single total response and determine the direction of the response for each item (Table 3).

Table 2 shows that students reported a satisfaction score bordering on “3” on the 5-point Likert scale on most items, which indicates an almost 60% satisfaction rate for most items. Similarly, Table 3 reveals a general positive lean for most items. There was concordance between the two methods in the responses to most items, with scores of less than “3” corresponding to negative directions. Five items scored lower than “3”, with the least score of 2.88 and a corresponding most negative value of -14 for item 13, which is related to students’ belief that UNIO made their study style better and UNIO’s efficacy to help students prepare for their exams. Another negative result was related to the difficulty students encountered in uploading images into UNIO pages and their skills with UNIO throughout subsequent units.

The highest scores were in the section exploring the effectiveness of UNIO in PBL. Students were most satisfied with integration of media triggers as a mean to increase their ability to identify their learning needs and with the embedding of extra online content during tutorial sessions to help them understand difficult and abstract concepts. These items received a score of 3.23 and 3.21 respectively corresponding to highest positive values of 27 and 25 respectively. Students were also in favor of UNIO enhancing in-class group learning and facilitating interaction. Organization of the learning triggers and other learning materials and the Zoom feature received favorable ratings as well.
### Table 2: Student responses to survey items as average score for each item

<table>
<thead>
<tr>
<th>Item Number</th>
<th>Average Score</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Technical</strong></td>
<td></td>
</tr>
<tr>
<td>Item 1</td>
<td>3.06 ± 1.39</td>
</tr>
<tr>
<td>Item 2</td>
<td>3.14 ± 1.27</td>
</tr>
<tr>
<td>Item 3</td>
<td>3.16 ± 1.27</td>
</tr>
<tr>
<td><strong>Effectiveness in PBL</strong></td>
<td></td>
</tr>
<tr>
<td>Item 4</td>
<td>3.12 ± 1.25</td>
</tr>
<tr>
<td>Item 5</td>
<td>3.20 ± 1.26</td>
</tr>
<tr>
<td>Item 6</td>
<td>3.16 ± 1.29</td>
</tr>
<tr>
<td>Item 7</td>
<td>3.18 ± 1.25</td>
</tr>
<tr>
<td>Item 8</td>
<td>3.23 ± 1.22</td>
</tr>
<tr>
<td>Item 9</td>
<td>3.21 ± 1.22</td>
</tr>
<tr>
<td>Item 10</td>
<td>3.07 ± 1.21</td>
</tr>
<tr>
<td>Item 11</td>
<td>3.10 ± 1.10</td>
</tr>
<tr>
<td><strong>Preparation for Exams</strong></td>
<td></td>
</tr>
<tr>
<td>Item 12</td>
<td>3.10 ± 1.22</td>
</tr>
<tr>
<td>Item 13</td>
<td>2.88 ± 1.21</td>
</tr>
<tr>
<td>Item 14</td>
<td>3.0 ± 1.18</td>
</tr>
<tr>
<td>Item 15</td>
<td>3.03 ± 1.23</td>
</tr>
<tr>
<td><strong>Application</strong></td>
<td></td>
</tr>
<tr>
<td>Item 16</td>
<td>3.18 ± 1.20</td>
</tr>
<tr>
<td>Item 17</td>
<td>3.18 ± 1.27</td>
</tr>
<tr>
<td>Item 18</td>
<td>3.04 ± 1.22</td>
</tr>
<tr>
<td>Item 19</td>
<td>2.92 ± 1.21</td>
</tr>
<tr>
<td>Item 20</td>
<td>3.04 ± 1.15</td>
</tr>
<tr>
<td>Item 21</td>
<td>2.90 ± 1.20</td>
</tr>
<tr>
<td>Item 22</td>
<td>2.95 ± 1.16</td>
</tr>
<tr>
<td><strong>Overall</strong></td>
<td></td>
</tr>
<tr>
<td>Item 23</td>
<td>2.97 ± 1.19</td>
</tr>
<tr>
<td>Item 24</td>
<td>3.03 ± 1.23</td>
</tr>
<tr>
<td>Item 25</td>
<td>3.03 ± 1.13</td>
</tr>
</tbody>
</table>

Student agreement to each of the items was assessed using a 5-point Likert scale: 1 - Strong disagreement; 2 - Disagreement; 3 - Neutral; 4 - Agreement; 5 - Strong agreement. The values represent mean ± SD.
Figure 5: Stacked bar graph representation of data for all items in the student satisfaction survey
Table 3: Evaluation of perception of students towards integration of UNIO into PBL while only considering the non-neutral responses

<table>
<thead>
<tr>
<th>Item Number</th>
<th>Evaluation of perception of students towards integration of UNIO into PBL while only considering the non-neutral responses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Item 1</td>
<td>I had no technical problems in accessing the platform.</td>
</tr>
<tr>
<td>Item 2</td>
<td>The UNIO platform is user-friendly.</td>
</tr>
<tr>
<td>Item 3</td>
<td>Accessing course materials off-campus through UNIO was easy.</td>
</tr>
<tr>
<td>Item 4</td>
<td>UNIO enhances my ability to write and organize my learning notes.</td>
</tr>
<tr>
<td>Item 5</td>
<td>UNIO enhances class group learning.</td>
</tr>
<tr>
<td>Item 6</td>
<td>UNIO facilitates student-tutor interaction and group discussions.</td>
</tr>
<tr>
<td>Item 7</td>
<td>Presenting the embedded content and monitoring the unseen helps me engage others in the group.</td>
</tr>
<tr>
<td>Item 8</td>
<td>Integration of media triggers (images, videos...) into UNIO increases my ability to identify the learning needs.</td>
</tr>
<tr>
<td>Item 9</td>
<td>During tutorial sessions, embedding of extra online content into UNIO could help students understand difficult concepts.</td>
</tr>
<tr>
<td>Item 10</td>
<td>The use of UNIO and electronic learning is preferable to me than the paper-based method for the tutorials.</td>
</tr>
<tr>
<td>Item 11</td>
<td>UNIO is also very effective for whole-class teaching such as real-time discussion-solving difficult concepts like &quot;Hodgkin Lymphoma&quot;.</td>
</tr>
<tr>
<td>Item 12</td>
<td>The UNIO enhances my ability to organize my learning material and enhances my preparation for the end unit examination.</td>
</tr>
<tr>
<td>Item 13</td>
<td>I believe my study style is better with use of UNIO and its application.</td>
</tr>
<tr>
<td>Item 14</td>
<td>Protection of in-class annotations by UNIO is useful for future referencing and studying for life exams.</td>
</tr>
<tr>
<td>Item 15</td>
<td>Off-campus access to UNIO without losing embedded content is beneficial for my weekly studying and exam preparation.</td>
</tr>
<tr>
<td>Item 16</td>
<td>UNIO, learning triggers and other problem-related material are well organized in UNIO.</td>
</tr>
<tr>
<td>Item 17</td>
<td>The &quot;Zoom&quot; feature of UNIO is very useful during the tutorial sessions.</td>
</tr>
<tr>
<td>Item 18</td>
<td>The &quot;Enact&quot; feature of UNIO is an efficient way of sharing and updating lesson content.</td>
</tr>
<tr>
<td>Item 19</td>
<td>I use UNIO to annotate my personal notes during the tutorial sessions.</td>
</tr>
<tr>
<td>Item 20</td>
<td>The quality of the media embedded as part of the weekly problems into UNIO is adequate.</td>
</tr>
<tr>
<td>Item 21</td>
<td>Uploading images is easy with UNIO.</td>
</tr>
<tr>
<td>Item 22</td>
<td>UNIO enhances my learning capacity during tutorials.</td>
</tr>
<tr>
<td>Item 23</td>
<td>The learning activities during the tutorials could be performed easily with the UNIO.</td>
</tr>
<tr>
<td>Item 24</td>
<td>I think that my skills in using UNIO have improved throughout the semester and I am now considered that UNIO is a good instructional tool and effective for learning.</td>
</tr>
<tr>
<td>Item 25</td>
<td>Overall I am satisfied with this platform.</td>
</tr>
</tbody>
</table>

“Weighted” refers to the response code value (-2 to +2) multiplied by the number of responses in each response category. Total is the sum of the weighted responses.

5. Discussion and conclusions

The current study describes briefly the customization of a cloud-based teacher-centered electronic platform, UNIO, as a form of educational technology to support the PBL in medicine process. One of the goals of such integration is to minimize lack of student interest, alienation and boredom that may influence the dynamics of PBL tutorial sessions and compromise active and collaborative learning. The main aim of the study is to focus on students’ perceptions to the integration of UNIO within the PBL medical curriculum. The response rate of the student survey evaluating their perception to UNIO was average at almost 60%, probably because it was not mandatory for students to respond, and there were no incentives offered to them.
6. Technical

It is important to make sure that the technical equipment does not disrupt the group process. Technical problems sometimes interfered with the group activities, and in the “Technical” section of the survey, the relatively lowest scores on accessing the platform at campus may relate to occasionally poor network connectivity at campus, or untimely access to UNIO at the beginning of the tutorial sessions. Nevertheless, back-up measures were always available, such as the continuous technical support from the IT department for minimizing any disruptions in the e-learning process. We always had paper-based triggers as back-up, in order to ensure that the tutorial groups could function even if UNIO did not.

The positive lean of the responses indicates that many students consider UNIO as user friendly. It is important that interactive software have an easy format that allows the learner to focus on the substantive problem rather than the mechanics of use. UNIO’s ease of navigation and user-friendly interface avoided distraction by technology during tutorial sessions. Such features in addition to ease of use, ease of access and interactivity are known to improve learners’ satisfaction rates (Gibbons and Fairweather, 2000; Chumley-Jones, Dobbie, and Alford, 2002). The off-campus access response leaned in the positive direction, and this could be due to the cloud-based nature of UNIO platform, in which content can be freely accessed and used anywhere via Internet access. A unique feature to our electronic PBL experience with UNIO platform is the ease of access to content anytime from anywhere. This allowed students to retrieve their tutorial sessions with their accompanying trigger material and class annotations anytime of their clerk-ship years. Additionally the high level of organization of embedded content was highly appreciated by students who did not face any difficulty in accessing the required content.

7. Effectiveness in PBL

The largest area of agreement occurred on most items related to the effectiveness in PBL and support for student learning, with scores exceeding 60% in the original coding method and leaning with highest positive scores when the “Neutral” score was coded with “0”. This section mainly focuses on the employability of UNIO during the face-to-face in-class sessions. Most students believe that UNIO enhances group learning and group discussions. This could be a result of the network linkage between all group members, which ensured sufficient real-time interaction between all group members. Additionally, the digitization of both text triggers and media triggers and the projection of the scenario on the smartboard might have enhanced group focus and collaborative learning during tutorial sessions. This is in line with other studies that claim that the use of interactive whiteboards in the classroom support the discussions during face-to-face sessions (Lu, Lajoie and Wiseman, 2010) and does lead to increased student engagement during the learning process (Beeland, 2002).

The ability of mixing embedded content and annotations is a very powerful feature of UNIO, especially when taking notes or highlighting certain elements on radiology images, pathology slides as well as other forms of illustrations. When done collaboratively by the group members and the “Presenter” at the smartboard, it engages students. This was possible since the “Presenter” did not take on a teacher role in the group, nor became excluded from the group process. The Presenter can take notes on behalf of the class, move pages, and even embed extra content from the web, which is automatically broadcasted to all group members. Annotations related to the trigger were made of brainstorming words, learning issues and questions on each trigger page.

The web format of UNIO has other advantages: first, the web-based scenarios have a gradually unfolding quality, which sparked curiosity in students, and the gradual unfolding of new triggers kept students in a state of suspense. Second, it enables the use of multimedia, which together with the hypertext format, creates a more dynamic way of delivering triggers compared to the previously used paper-based cases. Multimedia like graphics, sound, animation and video can promote student intellectual engagement and attention-holding (Reeves, 1998), two cognitive constructs that are crucial for the PBL process. For instance, appropriate visual triggers when planned and delivered effectively can be engaging and stimulate group discussion (Tseng, Chiang and Husu, 2008). Interestingly, the results from the evaluation item addressing the effectiveness of UNIO in integrating media content within triggers showed favorable students’ perception of the effectiveness of the visual media with which they engaged. This is not surprising as multimedia content in PBL is considered to be of greater realistic representation and authenticity than print material (Balslev et al., 2005 & 2008; Kamin et al., 2003; Parkin and Dogra, 2000; Personn, Fyrenius and Bergdahl, 2010).
Students seem to have been satisfied with the ability to embed content from the web into UNIO during tutorial sessions. Difficult concepts can be abstract and can only be comprehensible with a media presentation. When embedded, it is automatically broadcasted to and saved for all group members. For instance animations of physiological processes, 3D anatomical rotations and other concepts can be easily discussed during the tutorial session.

8. Preparation for Exams

There was an average response to the category of “Preparation for Exams”. However, when considering embedded content, by the end of the pre-clerkship phase all students would have 92 health problems embedded in a structured and organized manner, making access to content easy. All content, whether annotations or embedded by the e-learning expert, the tutor or the students, is preserved for the students until their BSc. exam at the end of their pre-clerkship phase. This can minimize the amount of hard copy material that students have to deal with for preparation for their exams.

9. Application

Most of the students feel that application of UNIO did enhance their learning capacity during tutorials. This could be related to the proper organization of the material, the quality of the embedded media, which is superior to some paper-based counterparts. Students appreciated the Zoom feature since the larger displays helped them identify many features in microscopic displays, radiology imaging and others.

10. Overall

UNIO actively involved technology and multimedia tools to successfully implement PBL and support students’ learning. Use of the customized electronic platform, UNIO, did not disrupt the group process or the PBL tutorial dynamics, retained the traditional face-to-face PBL for tutorials, and maintained the structure of our PBL traditional curriculum while extended the ability to use technology and multimedia. This is similar to Donnelly’s (2010) blended PBL structure, which he defined as face-to-face tutorials with online support. Another important unique feature of this platform is the on-campus and off-campus access to organized course material, especially important is the availability of all annotations and content that was embedded during the tutorial sessions.

The results of our student survey suggest that the students were averagely satisfied with the integration of UNIO within their PBL sessions. The most frequent rating for all items was “Neutral”, comprising 30% to 40% of responses for each item. The non-forced choice nature of the current survey may have contributed to the frequent “Neutral” response. When surveys include “Neutral” options, respondents sometimes tend to choose a neutral response because they do not want to exert the cognitive effort to form an opinion (Krosnick, 1999), or they might do so due to evasiveness (desire not to reveal one's true opinion), indecision (uncertainty about one's position), or indifference (lack of interest in an issue) (Baumgartner and Steenkamp, 2001). Some early research by Presser and Schuman (1980) found that typically between 10-20% of respondents chose the neutral option when it was provided compared to the same survey when it was not. Accordingly, we analyzed the data further by only including the non-neutral responses with positive and negative coding. One may argue that this step decreased the respondent pool to around an average of 70 for each item, making the response rate out of 202 students effectively at almost 35%. This may not be enough to represent the 202 students, but it does give an indication to the direction of responses without the “Neutral” option for each item.

One of the limitations of this study is the timing of the survey in relation to the units covered. Because the survey was conducted midway through the second year of PBL after completion of only two units, not all students may have been fully comfortable with the e-platform, due to diverse onset of exposure to e-learning for students, with relatively more recent integration of e-learning for some students than others. As such, we feel that student satisfaction is usually lower at the beginning because they have to adjust to the new method of learning while learning content at the same time (Chang and Tung, 2008).

Another limitation is the relatively low survey response rate with the average perceptions of this platform. There is a need for further directions to substantiate the effectiveness of this electronic platform in a PBL setting. It may be evaluation of UNIO midway through the units (after unit 5) and obtaining regular student feedback over a longer term. Other forms of evaluation may involve randomizing students into one of two
treatment groups: those with paper-based tutorials, and those with the UNIO-based, or comparing academic performance through exam scores between pre-and post UNIO cohorts (Jenkinson, 2009) at CMMS.

Competing Interests
The authors report no conflicts of interest of financial or non-financial nature. The authors alone are responsible for the content and writing of this article.

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Authors’ Contributions
All authors contributed equally to the development of the survey used in this project. Dr. Rima Abdul Razzak and Mr. Arpan Stephen are responsible for the customization process of UNIO. Prof. Zuheir Hasan and Dr. Rima Abdul Razzak carried out the data analysis, write-up and editing of the manuscript.

Ethics Approval
Ethical approval for this project was granted by the Research and Ethics Committee at the College of Medicine and Medical Sciences at AGU.

References
Barrows, H.S., 2002. Is it truly possible to have such a thing as PBL? Distance Education, 23(1), pp. 119 – 122.


A Comparison Between Virtual Patient and Peer-Assisted Learning in Teaching Basic Medical Knowledge and Skills

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Abstract: The Studentische Poliklinik is Germany’s first student-run free clinic. Prior to fulfilling clinical obligations there, students must complete an extensive peer-assisted learning program (PAL). Due to capacity constraints, a web-based learning program involving virtual patients has been launched. The aim of this study was to evaluate and compare the effectiveness of Virtual Patient Learning (VPL) vs. PAL in the acquisition of basic medical knowledge and skills. Forty undergraduate medical students (m=9; f=31) in their third year were randomly assigned to either the PAL (n=20), or VPL (n=20). Short-term (after each seminar) and long-term learning retention (after completion of the electives) was measured using a validated theoretical test. Objective structured clinical examinations (OSCE) were used to assess practical knowledge. Additionally, the course itself was evaluated. Differences in theoretical knowledge between students in the PAL and VPL existed over the short term (VPL median = 100%; PAL median = 80; p = 0.006), but not over the long term (VPL = 94.17; PAL = 95.62 %; p = 0.617). An assessment of practical skills showed no differences in OSCE scores between the two different groups (VPL = 79.30 %; PAL = 80.26 %; p = 0.141). Students assessed their learning experience and the comprehensibility of seminars as either “very good” or “good”. Basic medical knowledge and skills can be taught as effectively using VPL as PAL. Given the cost-effectiveness, high reproducibility and freedom of time and place, VPL should be performed more often when teaching family medicine in student-run free clinics. Ultimately, this may result in enhanced treatment quality and patient satisfaction.

Keywords: Student-Run Free Clinic, Peer-assisted Learning, Web-based learning, Virtual Patient, Medical Education, Family Medicine

List of abbreviations:
PAL – Peer-assisted learning; VPL – Virtual Patient learning; SP – Studentische Poliklinik; SRFC – Student-run Free Clinic; OSCE – Objective Structured Clinical Examination

1. Introduction

Ongoing economization in health care has resulted in less time for clinical teaching (Adili et al., 2013; Marburger Bund, 2017), and acceptance of real patients when teaching clinical skills is declining for ethical reasons. The virtual patient, a computer program that simulates real-life clinical scenarios, is therefore becoming increasingly popular in medical education. Virtual patient learning (VPL) has enjoyed increasing popularity in the fields of education, management of digital patient data and scientific literature for some time now (Ellaway, 2004). In the context of healthcare education, VPL was introduced for the first time in 1991 and since then has increasingly been mentioned in the scientific literature (Kononowicz et al., 2015). According to the Association of American Medical Colleges, VPL represents “a specific type of computer program that simulates real-life clinical scenarios; learners emulate the roles of health care providers to obtain history, conduct a physical exam, and make diagnostic and therapeutic decisions” (Association of American Medical Colleges, 2007). This definition attaches particular significance to understanding clinical reasoning, which is a core skill and one that is of paramount importance in healthcare education (Hege et al., 2018; Higgs et al., 2018; Lateef, 2018). A significant part of the VPL used in medical education therefore focuses on the acquisition of clinical reasoning skills (Kononowicz et al., 2015).

Cook, Erwin and Triola (2010) showed that when used as an additive teaching intervention, VPL is associated with a substantial increase in knowledge, clinical reasoning competence and skills. This is because VPL enjoys considerable advantages compared to traditional teaching formats. For educators, VPL “can provide a way to overcome the reduced student access to real patients” (Consorti et al., 2012). Furthermore, VPL gives students
the chance to acquire information in a comfortable learning environment and to look up information while working on cases. Moreover, VPL shifts the focus of lectures from a teacher-centered to a learner-centered perspective (Tworek et al., 2010), meaning that students actively perform the actions and make the decisions of a primary caregiver, rather than simply passively attending a lecture (Bryce et al., 1998; Cook, Erwin and Triola, 2010). The different process also means students are encouraged to take responsibility for their medical decisions, which can increase their motivation. In this context, Gormley, et al. (2011) concluded that although it is challenging for medical students to act as a “clinician” and take responsibility for actual cases, it appears to be the best way to learn. Students can experiment in a safe environment and practice clinical thinking, even though virtual patients are not the same as real patients.

Cook, Erwin and Triola (2010) concluded, “VPL may be noninferior in some instances”, which raises the question whether VPL can be considered an alternative to traditional educational methods. In a recent meta-analysis of twelve randomized controlled studies, Consorti et al. (2012) explored this question in more depth and found that in the acquisition of clinical reasoning competencies and skills, VPL was beneficial as a complement, as well as an alternative to PAL.

Despite a considerable number of preliminary publications on VPL, only few studies have been carried out in a randomized and controlled setting (Fleetwood et al., 2000; Janda et al., 2004; Kumta et al., 2003; Triola et al., 2006), and hardly any studies focused on the long-term learning retention of acquired skills. Moreover, we could not find any studies that compared VPL to peer-assisted learning (PAL). In PAL, senior students provide their junior colleagues with teaching and learning support, which has the advantages that trainees often consider peer-trainers to be more approachable than faculty staff, and trainers are more familiar with courses because they have already passed them (Siddiqui et al., 2018). PAL is often used to teach clinical reasoning and practical skills in skills laboratories (Field et al., 2004), and it plays an integral part in so called student-run free clinics (Meah, Smith and Thomas, 2009). It also leads to substantial growth in clinical competencies (Seifert et al., 2015).

A thorough review of the current literature did not reveal any studies investigating the educational outcomes of VPL as an alternative teaching format to PAL in the context of a student-run free clinic project. We therefore conducted this study to find out whether the use of VPL is as effective as a previously described PAL program (Seifert et al., 2015) in the acquisition of clinical reasoning competencies and practical skills. Our hypothesis was that VPL would result in similar educational outcomes.

2. Methods

2.1 Ethics approval and consent to participate

The study was approved by the Ethical Commission of the University Hospital Frankfurt (Goethe University) and no further approval was required. The study was conducted according to the Declaration of Helsinki (World Medical Association, 2013). All study participants gave their written consent for participation, which they could withdraw at any time.

2.2 Studentische Poliklinik

The Studentische Poliklinik (SP) was set up by the Faculty of Medicine of Goethe University Frankfurt and is Germany’s first student-organized, physician-supervised family practice for the medically underserved community. Prior to working during clinic hours at the SP, undergraduate medical students have to complete an extensive PAL program (Seifert et al., 2015). PAL covers the most common reasons for consulting a primary care physician (e.g. headache, hypertension, abdominal pain) and trains students to perform basic clinical skills (physical examinations, taking blood samples and medical histories).

2.3 Study Design

Forty of the medical students that applied for the SP elective in their first clinical year were randomized to either a peer-assisted learning group (PAL; n = 20; f = 17; m = 3), or a virtual patient learning group (VPL; n = 20; f = 14; m = 6). The groups attended the first and third modules of the SP elective together, but were trained separately in a second module that used either PAL (Field et al., 2007) or VPL (see below), depending on group. In addition, both groups attended regular curricular training consisting of eight physician-led examination classes and basic lectures in surgery, internal medicine, pathology and microbiology during the winter semester of 2016/2017 (October 2016 - April 2017).
2.4 Structure of the SP elective

The SP elective consists of three modules (Figure 2) that students have to attend to qualify to work as so-called "juniors" during consultation hours (Figure 2). This elective has been described in greater detail in previous publications (Seifert et al., 2015). The first module for both the PAL and VPL involved a clinical examination, medical history taking and basic clinical skills. The course consisted of six 1.5-hour units on abdominal examinations, cardiac examinations, pulmonary examinations, orthopedic examinations, prenatal care and medical history taking.

The second module was composed of eight weekly, case-based, and symptom-orientated primary care seminars. The aim of this module was to teach the students about clinical appearance, diagnostics and therapy options, as well as clinical reasoning with respect to common primary care topics.

Following theoretical and practical examinations, students worked as “juniors” with more experienced “seniors” in the third module, which was an SP consultation hour. Clinic duties involved medical history taking, physical examinations, and clinical competencies such as taking blood samples, and completing medical documentation. Each patient was seen by a junior-senior team before being presented to a primary care physician for further diagnosis and treatment.

Figure 2: Structure of SP's elective subject
2.5 Peer-assisted Learning Group

The PAL group was taught in groups of up to ten students by four trained peer-tutors (each tutor being responsible for two seminars) every week. Each seminar lasted about two hours and dealt with an important primary care topic (Figure 2) that was presented in a case-based clinical scenario. Patient actors were used to strengthen previously acquired knowledge concerning taking a medical history and performing physical examinations. Students were guided through the clinical cases by the tutor and supported by fellow students, creating a supportive environment that was also rich in feedback. Emphasis was placed on learning clinical reasoning, differential diagnostics and basic therapy options.

2.6 Virtual Patient Learning Group

Virtual patient cases created using the Moodle Learning Management System were used to train participants in the VPL (Dougiamas and Taylor, 2003). Every week, students were presented with a virtual patient case (Figure 3) that was identical to the case used in the PAL group. Cases differed only slightly from PAL cases, for example because information on clinical, diagnostic and treatment options were provided in additional text-boxes, and multiple-choice questions were used to compensate for the missing interaction with a student tutor (Figure 4). Correct answers were rewarded with motivational feedback and further information on the case, while wrong answers led to constructive feedback and detailed explanations concerning the various choices. VPL cases were enriched with photographs of typical clinical presentations, radiological findings and videos of clinical examinations. Cases had to be completed within one week, and students were free to choose the location and pace of case completion, as well as whether they wanted to work alone or in small groups.

Figure 3: Screenshot of a VPL case with an introductory case report
Figure 4: Screenshot of a VPL case including a single-choice question and feedback

**Performance measurement**

Four tests were carried out to measure theoretical and practical performance:

1. Long-term theoretical knowledge growth was assessed using 24-item single-choice questions taken from the German Institute for Medical and Pharmaceutical Examination Questions “IMPP” (Supplement). The test covered the learning objectives of the second module and was approved by a group of experts. Both test groups completed this test prior to the start of the elective and six weeks after completion of the second module. The 24 items were based on the primary care topics taught in the second module, and the results for both groups were compared. Furthermore, the post-test was used as a theoretical examination prior to the start of the third module.

2. The test took place in a seminar room. Overall, 90 seconds were allowed for each question, resulting in a total of 36 minutes. The questions were presented in a Power Point format and the students responded online using smartphones or tablets.

3. Short-term theoretical knowledge was assessed using five single-choice questions taken from the German Institute for Medical and Pharmaceutical Examination Questions “IMPP” covering the learning objectives of the recently completed patient case (Figure 5). Students were asked to answer these questions directly after completion of the VPL or PAL case, as applicable. While the PAL group was asked to answer the questions in the seminar room where the course took place, the VPL group had to answer the questions online (at the end of the VPL case seminar). VPL students could move back and forth within the patient case and were subject to no time restrictions. No time limit was set for the PAL students in order to create the same test conditions.

4. Furthermore, students were asked to evaluate their learning experience after each patient case in a five-question questionnaire that used a Likert Scale ranging from 1 = “strongly agree” to 6 = “strongly disagree” (Table 3).

5. To identify any differences in practical competence, both groups participated in a four-item Objective Structured Clinical Examination (OSCE) six weeks after completing the first two elective modules. This OSCE consisted of one item on history-taking, one on providing feedback, and two on physical examinations. Structured and validated checklists were taken from a pool of checklists which stemmed from the curricular “Examination and Clinical Skills” OSCE used in the third year of medical school (Figure 6).
Figure 5: Five questions were used after each seminar to assess short-term knowledge retention after VPL or PAL case completion. This is an example of the case history on “Headache”.

1. A 35-year-old driver and chain smoker wakes up at night - for 2 weeks - with severe right-sided headaches, which are repeated in attack form every two hours and last 30-60 minutes. Typical right-sided findings during the attack are conjunctival injection, lacrimation, rhinorrhea and Horner’s syndrome. Which of the following therapeutic measures has the greatest significance here?
   A) O2 inhalation
   B) Administration of glycerol trinitrate
   C) infraorbital alcohol injection
   D) Thermocoagulation of the ganglion stellatum
   E) i.v. infusion of valproate

2. What is the least to be expected in migraine?
   A) Nasal flow
   B) Aphasia
   C) Scotomas
   D) photophobia
   E) Nausea

3. A 49-year-old teacher has been suffering for years at least every other day from a bifrontal headache that lasts for several hours and is oppressive on both sides. It feels like he has a helmet on his head. Nausea or vomiting did not occur, and despite these headaches he could continue to work. Nevertheless, they significantly impaired his quality of life, especially since the usual headaches such as acetylsalicylic acid, paracetamol or ibuprofen are not effective. He smokes about 20 cigarettes a day, probably sleep poorly due to stress, but is otherwise healthy. The clinical-neurological findings are normal, including an eye ground mirror, as is the blood pressure. Which of the following drug therapies are the most suitable for this headache?
   A) Acetylsalicylic acid 100 mg/d
   B) Amitriptyline 50-150 mg/d
   C) Carbamazepine 400-1 600 mg/d
   D) oral glucocorticoid therapy (e.g. prednisolone regimen starting at 1 mg/kg body weight)
   E) Indomethacin 50-150 mg/d

4. Which of the following medications is not suitable for the acute therapy of a migraine attack?
   A) ASS 1000 mg i.v.
   B) MCP 20 mg i.v.
   C) Sumatriptan i.n.
   D) Propanolol 75 mg p.o.
   E) Ibuprofen 600 mg i.v.

5. What symptoms cannot be included in the aura of a migraine?
   A) Visual field failures
   B) Conjunctival injection
   C) Flicker scotomas
   D) Scintillations
   E) Ophthalmoplegia
Examination of the heart
Evaluate the student’s examination technique during the physical examination.

Student ID:

Part A

<table>
<thead>
<tr>
<th>Checklist physical examination</th>
<th>not tried</th>
<th>wrong</th>
<th>right</th>
</tr>
</thead>
<tbody>
<tr>
<td>General Inspection, Thorax, Edema</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Jugular Vein Inspection (inconspicuous)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hepatoc jugular Reflux Test (negative)</td>
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<tr>
<td>Palpation Tip of Heart Blow</td>
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<tr>
<td>Auscultation 3rd intercostal space left parasternal,</td>
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<td></td>
</tr>
<tr>
<td>parallel pulse scanning</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Auscultation 2nd intercostal space left and right</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>parasternal</td>
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<td></td>
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<tr>
<td>Auscultation axilla, carotid artery two-sided</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Special auscultation of mitral valve and aortic valve (left side position and seats)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Arterial Blood Pressure Measurement (two-sided)</td>
<td></td>
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</table>

Part B

<table>
<thead>
<tr>
<th>Focus on Examination technique</th>
<th>insufficient</th>
<th>moderate</th>
<th>good</th>
</tr>
</thead>
<tbody>
<tr>
<td>Examination technique [Optimal Conditions]</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Examination technique [Useful order]</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Dealing with the patient [salutation, presentation,</td>
<td></td>
<td></td>
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<tr>
<td>friendliness, considerateness]</td>
<td></td>
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<tr>
<td>Focus on dealing with the patient [Self-confident</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>manner]</td>
<td></td>
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</tbody>
</table>

Part A _______ of 18 points (equivalent to 70%)
Part B _______ of 8 points (equivalent to 30%)

Total Score: _______

Figure 6: Example of a structured checklist used in the OSCE to assess practical knowledge development

2.7 Statistical analysis

Microsoft Office 2016 (Version 16.12, © Microsoft Corporation, Redmont, USA) and Graphpad Prism 7 for Mac (Graphpad Software ©, La Jolla California, USA) were used for statistical analysis and the graphic display of data.

Long-term theoretical knowledge development within each group was analyzed using the Wilcoxon signed-rank test (‘Wilcoxon-Test’). Additionally, the Mann-Whitney-U-Test was used to compare the results of the theoretical pre- and post-tests, as well as short-term theoretical knowledge, practical knowledge and student assessments, for both groups. To improve the comparability of test results for the various OSCE scenarios, a specific formula was used to convert percentage ranks into grades ranging from 1 = “very good” to 6 = “poor”.

3. Results

3.1 Theoretical Examinations

In the theoretical post-tests both PAL and VPL students achieved significantly better results than in the pre-tests (PAL: p < 0.0001; VPL: p < 0.0001; Table 1).

A comparison between the two groups in the pre-test (58.75% for PAL and 53.55% for VPL) showed no significant difference, indicating that the two groups performed similarly in terms of theoretical knowledge at the beginning of the elective (p = 0.0653). The theoretical post-test results also showed no significant
difference between the two groups (95.62% for PAL and 94.17% for VPL). This shows that the impact of PAL and VPL on the acquisition of long-term theoretical knowledge was similar.

Item-analysis revealed significant knowledge growth in seven of eight primary care learning objectives in the PAL group and six of eight in the VPL group (Table 1).

In six of the seven short-term theoretical tests, no significant difference was found between PAL and VPL students (Table 2). VPL students outperformed PAL students in the question on the clinical presentation of “dyspnea” (p= 0.0116). This case was presented by a different peer-tutor because the regular peer-tutor was ill.

However, considering all seven short tests, VPL students tended to have better results, with an average of 100% comparing to 80% in the PAL group.

Table 1: Theoretical Pretest and Posttest in the PAL and VPL

<table>
<thead>
<tr>
<th>Item</th>
<th>PAL pre (%)</th>
<th>PAL post (%)</th>
<th>p- value</th>
<th>VPL pre (%)</th>
<th>VPL post (%)</th>
<th>p- value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Complete test</td>
<td>58.75</td>
<td>95.62</td>
<td>&lt; 0.0001</td>
<td>53.55</td>
<td>94.17</td>
<td>&lt; 0.0001</td>
</tr>
<tr>
<td>Abdominal pain</td>
<td>20.00</td>
<td>96.67</td>
<td>&lt; 0.0001</td>
<td>25.56</td>
<td>90.00</td>
<td>&lt; 0.0001</td>
</tr>
<tr>
<td>Hypertension</td>
<td>91.67</td>
<td>96.67</td>
<td>0.4531</td>
<td>79.44</td>
<td>98.33</td>
<td>0.1250</td>
</tr>
<tr>
<td>Tuberculosis</td>
<td>46.67</td>
<td>93.33</td>
<td>&lt; 0.0001</td>
<td>37.78</td>
<td>98.33</td>
<td>&lt; 0.0001</td>
</tr>
<tr>
<td>Lower-back pain</td>
<td>51.67</td>
<td>95.00</td>
<td>&lt; 0.0001</td>
<td>39.44</td>
<td>96.67</td>
<td>&lt; 0.0001</td>
</tr>
<tr>
<td>Dyspnea</td>
<td>66.67</td>
<td>100.00</td>
<td>0.0001</td>
<td>71.11</td>
<td>100.00</td>
<td>0.0005</td>
</tr>
<tr>
<td>Pregnancy</td>
<td>60.00</td>
<td>85.00</td>
<td>0.0029</td>
<td>32.78</td>
<td>86.67</td>
<td>&lt; 0.0001</td>
</tr>
<tr>
<td>Headache</td>
<td>48.33</td>
<td>100.00</td>
<td>&lt; 0.0001</td>
<td>24.44</td>
<td>88.33</td>
<td>&lt; 0.0001</td>
</tr>
<tr>
<td>Diabetes</td>
<td>85.00</td>
<td>98.33</td>
<td>0.0156</td>
<td>71.67</td>
<td>95.00</td>
<td>0.0859</td>
</tr>
</tbody>
</table>

Table 2: Results of the short tests in the PAL and VPL

<table>
<thead>
<tr>
<th>Item</th>
<th>p- value</th>
<th>Average PAL (%)</th>
<th>Average VPL (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>All tests</td>
<td>0.0102</td>
<td>80.00</td>
<td>100.00</td>
</tr>
<tr>
<td>Hypertension</td>
<td>0.806</td>
<td>100.00</td>
<td>90.00</td>
</tr>
<tr>
<td>Tuberculosis</td>
<td>0.707</td>
<td>80.00</td>
<td>80.00</td>
</tr>
<tr>
<td>Lower-back pain</td>
<td>0.888</td>
<td>80.00</td>
<td>90.00</td>
</tr>
<tr>
<td>Dyspnea</td>
<td>0.011</td>
<td>80.00</td>
<td>100.00</td>
</tr>
<tr>
<td>Pregnancy</td>
<td>0.180</td>
<td>100.00</td>
<td>100.00</td>
</tr>
<tr>
<td>Headache</td>
<td>0.188</td>
<td>90.00</td>
<td>100.00</td>
</tr>
<tr>
<td>Diabetes</td>
<td>0.139</td>
<td>80.00</td>
<td>100.00</td>
</tr>
</tbody>
</table>

3.2 Student Evaluations

Students from both study groups assessed their learning experience positively, with most students rating their general learning progress as either “very good” or “good” after course completion (Table 3).

Furthermore, both groups rated the comprehensibility of their seminars as high (Median 1) and the amount of content as appropriate for the given time period (Table 3). No difference was found between PAL and VPL seminars.

However, significant differences between PAL and VPL students were found in answers to control questions, with VPL students reporting “I don’t know more than before the lesson”, and thus indicating a lower learning effect in five out of eight cases.

When asked to rate the seminars using school grades (1 being “very good” to 6 being “unsatisfactory”), students gave the PAL seminar an average grade of 1.6, and the VPL seminar an average of 2.1.
Table 3: Course evaluation and self-assessment of the PAL and VPL

<table>
<thead>
<tr>
<th>Item</th>
<th>PAL</th>
<th>VPL</th>
<th>p-value</th>
<th>PAL</th>
<th>VPL</th>
<th>p-value</th>
<th>PAL</th>
<th>VPL</th>
<th>p-value</th>
<th>PAL</th>
<th>VPL</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abdominal pain</td>
<td>1</td>
<td>2</td>
<td>0.083</td>
<td>1</td>
<td>2</td>
<td>0.535</td>
<td>1</td>
<td>2</td>
<td>0.312</td>
<td>6</td>
<td>5</td>
<td>0.143</td>
</tr>
<tr>
<td>Hypertension</td>
<td>2</td>
<td>2</td>
<td>&gt;0.999</td>
<td>2</td>
<td>2</td>
<td>0.260</td>
<td>1</td>
<td>1</td>
<td>0.895</td>
<td>5.5</td>
<td>5</td>
<td>0.087</td>
</tr>
<tr>
<td>Tuberculosis</td>
<td>1</td>
<td>1</td>
<td>&gt;0.999</td>
<td>2</td>
<td>1</td>
<td>0.184</td>
<td>1</td>
<td>1</td>
<td>0.549</td>
<td>5</td>
<td>5</td>
<td>0.096</td>
</tr>
<tr>
<td>Lower-back pain</td>
<td>1.5</td>
<td>2</td>
<td>0.898</td>
<td>1.5</td>
<td>2</td>
<td>0.508</td>
<td>1</td>
<td>1</td>
<td>0.181</td>
<td>6</td>
<td>5</td>
<td>0.008</td>
</tr>
<tr>
<td>Dyspnea</td>
<td>2</td>
<td>2</td>
<td>0.714</td>
<td>2</td>
<td>2</td>
<td>0.356</td>
<td>1</td>
<td>1</td>
<td>0.241</td>
<td>6</td>
<td>4</td>
<td>0.005</td>
</tr>
<tr>
<td>Headache</td>
<td>1</td>
<td>2</td>
<td>0.140</td>
<td>1</td>
<td>1</td>
<td>&gt;0.999</td>
<td>1</td>
<td>1</td>
<td>0.630</td>
<td>6</td>
<td>5.5</td>
<td>0.110</td>
</tr>
<tr>
<td>Pregnancy</td>
<td>2</td>
<td>2</td>
<td>0.166</td>
<td>1.5</td>
<td>2</td>
<td>0.025</td>
<td>1</td>
<td>1</td>
<td>0.007</td>
<td>5</td>
<td>5</td>
<td>0.598</td>
</tr>
<tr>
<td>Diabetes</td>
<td>1</td>
<td>2</td>
<td>0.235</td>
<td>2</td>
<td>2</td>
<td>0.395</td>
<td>1</td>
<td>1</td>
<td>0.761</td>
<td>6</td>
<td>4</td>
<td>0.003</td>
</tr>
</tbody>
</table>

3.3 Practical Examinations

Students in the PAL and VPL showed no significant difference in their ability to perform a symptom-orientated physical examination and take a medical history (p = 0.1415). On average, PAL students obtained 80.26% and VPL students 79.30% in the SP OSCE (Table 4).

Item analysis showed no significant difference in any of the four OSCE items, medical history taking (p=0.1545), giving feedback (p=0.6420), abdominal examination (p=0.8709) and cardiac/ or pulmonary examination (p=0.3462) (Table 4).

Table 4: OSCE results of the VPL and PAL groups

<table>
<thead>
<tr>
<th>Medical history taking</th>
<th>Feedback</th>
<th>Abdominal examination</th>
<th>Cardiac/pulmonary examination</th>
<th>Average results</th>
</tr>
</thead>
<tbody>
<tr>
<td>PAL average %</td>
<td>86.76</td>
<td>69.50</td>
<td>93.27</td>
<td>91.02</td>
</tr>
<tr>
<td>VPL average %</td>
<td>84.30</td>
<td>72.11</td>
<td>87.68</td>
<td>84.10</td>
</tr>
<tr>
<td>PAL average grade</td>
<td>1.35</td>
<td>2.7</td>
<td>1.15</td>
<td>1.25</td>
</tr>
<tr>
<td>VPL average grade</td>
<td>1.63</td>
<td>2.47</td>
<td>1.37</td>
<td>1.63</td>
</tr>
</tbody>
</table>

4. Discussion

The aim of this study was to compare for the first time VPL and PAL with respect to the acquisition of basic medical knowledge at a student-run free clinic. Overall, our results revealed no significant difference between the teaching formats in terms of long-term increase in theoretical knowledge, and the acquisition of practical skills, when examined using an OSCE. The students also evaluated the quality, content and comprehensibility of PAL and VPL seminars similarly.
A significant difference in favor of the VPL group was found in short-term theoretical knowledge, while self-assessed learning progress was perceived to be higher in PAL seminars.

### 4.1 Theoretical Examinations

The results of the theoretical post-test, in which both groups showed an overall increase in knowledge of almost 40% and performed almost equally (PAL = 95.62%, VPL = 94.17%), indicate that the use of VPL is as effective for teaching basic medical knowledge as the PAL that is often used at student-run clinics (Burke et al., 2007; Choudhury et al., 2014; Seifert et al., 2015). Furthermore, a comparison of short-term theoretical test results to post-test results showed almost no loss in performance in either group over a period of six weeks, indicating that teaching quality and comprehensibility were high in both seminars.

Since the post-test was used as a graded examination in the SP elective, students most probably wanted to perform well, which may have influenced the results of the long-term theoretical test. Previous studies have identified a clear correlation between the type of student assessment and resulting student performance. This was found to be particularly true for summative assessments such as the long-term theoretical test, which tend to show an increase in student performance regardless of the prior training format (Raupach et al., 2013).

There may be several reasons for the significant difference in short-term theoretical knowledge in favor of the VPL group. In the VPL cases, students could navigate freely within the patient case. They also had hyperlink functions to further literature. Furthermore, it should be borne in mind that the PAL case seminars were generally two hours long, whereas the VPL seminars had no time restriction. Therefore, students automatically had more time to become familiar with the topic. Students may therefore have spent more time working on VPL cases than students who had to solve the same case with time constraints (Gunning and Fors, 2012). The tests themselves involved no time restriction, regardless of seminar type. Future tests of VPL cases should therefore include time and content restrictions.

A phenomenon called the testing effect (Kromann, Jensen and Ringsted, 2009) may also explain the better short-term performance of the VPL group. When working on VPL cases, students had to answer many single-choice questions that were similar to those in the examination that followed the seminar. This may have contributed to the measured performance differences.

### 4.2 Practical Examinations

The OSCE results showed no significant difference in medical case history taking and physical examination skills between students trained using virtual patients and those trained by peer tutors, indicating that the use of virtual patients is as effective for teaching clinical skills as peer-led seminars. The use of multimedia content in the VPL cases, such as video footage of physical examinations and clinical competencies, may have compensated for the absence of a patient and the practice in examination techniques that is regularly used in PAL seminars. But it should be taken into consideration that both groups received the same practical training in the first module of the electives in order to ensure the quality of treatment was acceptable when examining real patients in the SP consultation hour for the first time.

On the other hand, several studies confirm the usefulness of VPL in the acquisition of clinical skills. Parsons et al. (2008) and Triola et al. (2006), found that virtual patients can improve students’ communication and clinical skills. Moreover, practicing history taking skills in VPL cases is also well regarded by students (Deladisma et al., 2008; Huang, Reynolds and Candler, 2007). Nevertheless, further studies are required to investigate the use of VPL in the acquisition of practical (motor-)skills.

### 4.3 Student Evaluations

Students evaluated both VPL and PAL seminars similarly positively in terms of quality, amount of material covered and comprehensibility. However, students in the PAL group self-assessed their learning progress more positively in five out of eight cases. Interestingly, this was not reflected in the theoretical and practical examinations. A possible reason for this difference is the lack of direct oral feedback on student performance from a peer-tutor (i.e. when performing a physical examination or commenting on the case scenario) in the VPL group. Various studies (Archer, 2010; Ruesseler et al., 2017; Van De Ridder et al., 2008) have highlighted
The importance of structured feedback in undergraduate clinical education. Tworek et al. (2010) found that “virtual patient learning may not produce effective feedback”. We tried to include as much written feedback as possible in the VPL seminars, i.e. after completion of single-choice questions. When students answered a question incorrectly, they were given a detailed explanation of what they did wrong and what their possible incorrect reasoning might have been. In addition, further information was provided to enable them to solve the problem. To overcome the disadvantage of a lack of feedback, Tworek et al. (2010) propose “adaptive feedback” with multiple feedback levels, as employed in our VPL cases (e.g. revealing the correct diagnosis step by step, or providing expert opinions).

4.4 Strengths and limitations of this study

Various limitations to this study need to be considered when interpreting the results. At forty students, our sample size was relatively small compared to other studies, which might have influenced calculated effect sizes. As mentioned before, the results of the theoretical short-term test may have been influenced by the testing effect (short-term) and by the desire of both study groups to perform well in the summative written examination six weeks after course completion (long-term). This may have led to false-positive results in the theoretical test.

Compared to other studies on the subject, the present study was randomized and controlled to assess the use of VPL as an alternative to PAL on multiple levels. Objective and subjective growth in clinical competence was measured, and the VPL design evaluated, using validated instruments. Furthermore, the knowledge assessment at three points in time over a 14-week period gives a comprehensive overview of learning progress in both teaching interventions.

5. Conclusion

Despite its limitations, the originality of this paper should be emphasized. This work is the first to compare the use of VPL and the more traditional teaching method of peer-assisted learning in the context of a student-run free clinic.

The results of this study confirm our earlier hypothesis that VPL seminars are as effective as PAL seminars, and demonstrates that both teaching formats can be used to teach basic medical knowledge and skills in a student-run free clinic. As only a few randomized controlled trials on VPL and its teaching efficacy exist, it should be mentioned that our study was able to show an increase in both short-term and long-term knowledge. In addition, fundamental practical skills like medical history taking and physical examinations can be taught using VPL cases.

The VPL seminars were well received by students and freedom with respect to the time, place and pace of learning was highly appreciated.

We think that VPLs are a valuable alternative to PAL seminars and are well suited to training medical students to assist at student-run free clinics. However, VPL seminars need to be further adapted and revised to include a more detailed feedback function. Our approach of providing relevant feedback was effective but should be individualized to a greater degree. For example, individualized feedback on the strengths and weaknesses of each student could be given after case completion.

Our VPL cases all had the same linear structure and the students were guided through the case by answering questions and receiving information on the patient. Future studies should examine more complex and branched case formats, even though the development of such VPL cases is likely to be more cost-intensive and difficult to set up.

Acknowledgements

The authors would like to thank all students involved in the Studentische Poliklinik for their hard work. We also would like to thank Dr. Petra Tiarks-Jungk for her outstanding commitment towards treating underserved patients and her enthusiastic teaching of family medicine.
References


Appendix

**Supplement: 24-item single-choice test used to assess theoretical knowledge growth**

1. Which of the following medications is not used in the eradication therapy of H. pylori gastric mucosal infection?
   A) Amoxicillin
   B) Clarithromycin
   C) Metronidazole
   D) Ciprofloxacin
   E) Bismuth

2. Your patient, Rudi Racket, has been complaining for weeks about epigastric pain that improves after eating, and very black stool. Diarrhoea and flatulence do not occur. The physical examination is unremarkable, except for epigastric pain. The patient’s temperature is 37.2 °C. Your guaiac test is positive. The patient’s blood count indicates iron deficiency anaemia. Which further diagnostic measure would be the least effective?
   A) H. pylori detection by 13-C breath test
   B) Explorative gastro duodenoscopy
   C) H. pylori detection by blood culture
   D) H. pylori detection by urease rapid test
   E) Abdominal Sonography

3. Where is bacterial gastritis most frequently located?
   A) Fundus
   B) Corpus
   C) Antrum
   D) Pylorus
   E) Bacterial gastritis is equally common in all parts of the stomach.

4. You diagnose primary hypertension in your patient (50 years old, male, BMI: 30.4 kg/m², smoker). Which of the following measures is not indicated after the initial diagnosis?
   A) Weight reduction
   B) Administration of alpha-methyl-DOPA
   C) Administration of an ACE inhibitor
   D) Smoking cessation
   E) Sporting activities

5. Which of the following clinical pictures can cause secondary hypertension?
   A) Hypovolaemia
   B) Hypothyroidism
   C) Carotid sinus syndrome
   D) Addison’s disease
   E) Renal artery stenosis

6. At what blood pressure level is hypertension (stage 1) diagnosed?
   A) >120/80 mmHg
   B) >80/60 mmHg
   C) >140/90 mmHg
   D) >170/105 mmHg
   E) >180/110 mmHg

7. Which antibiotics usually belong to the standard treatment of (typical, non-multi-resistant) tuberculosis?
   A) Ethambutol + Linezolid
   B) Isoniazid + Rifampicin
   C) Doxycycline + Ethambutol
   D) Pyrazinamide + Levofloxacin
   E) Isoniazid + Clindamycin

8. Which statement on the diagnosis and therapy of tuberculosis is correct?
   A) The gamma interferon test allows the distinction between latent infection and active disease.
   B) The initial tuberculosis infection almost always leads to flu-like symptoms.
C) Patients with open tuberculosis do not need to be isolated in most cases.
D) Tuberculosis acquired abroad is not subject to reporting obligations.
E) Post-primary tuberculosis may occur when receiving immunosuppressive therapy.

9. Which of the above measures is the least appropriate when open tuberculosis of the lungs is diagnosed in a hospital ward?
A) Isolation of the patient by accommodation in a single room
B) Notification to the responsible health authority
C) Special disposal of waste contaminated with infectious material
D) Immediate BCG vaccination of contact persons that are tuberculin positive
E) X-ray examination of the thorax of contact persons who have undergone tuberculin conversion in the current temporal context.

10. Which of the following does not positively contribute towards deterioration in back pain (so-called “yellow-flag”)?
A) Heavy physical work in monotonous posture
B) Fever
C) Depression
D) Loss of job
E) Private or professional dissatisfaction

11. Mr. K.M. comes into your medical practice and describes pain around the right lumbar spine that suddenly occurred the day before when lifting a box. After a detailed anamnesis, you learn that the pain is motion-dependent and radiates into the thigh. The radiation ends above the knee and the patient does not show any numbness. During the physical examination, you notice pain-related limitation of movement in the lumbar spine, no sensory disturbances or a reduction in strength. Mr. M. is otherwise in good general condition. The symptoms described are highly likely to be what disease?
A) Extraradicular back pain
B) Extravertebral back pain
C) Complicated back pain
D) Uncomplicated back pain
E) Radicular back pain

12. The Ott measure (e.g. Ott 30/34 cm) is most suitable for assessing the...
A) Bendability of the thoracic spine
B) Stretchability of the thoracic spine
C) Bendability of the lumbar spine
D) Extendability of the lumbar spine
E) Extensibility of the cervical spine

13. You will receive the following laboratory findings: Which form of anaemia is present here and what is the most likely cause?

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>erythrocytes</td>
<td>4.1 T/ml</td>
</tr>
<tr>
<td>haemoglobin</td>
<td>9 g/dl</td>
</tr>
<tr>
<td>haematocrit</td>
<td>30 %</td>
</tr>
<tr>
<td>MCV</td>
<td>73 fl</td>
</tr>
<tr>
<td>MCH</td>
<td>20 pg</td>
</tr>
<tr>
<td>MCHC</td>
<td>27.3 g/dl</td>
</tr>
</tbody>
</table>

A) Macrocytic hypochromic anaemia - vitamin B12 deficiency
B) Microcytic, hyperchromic anaemia - vitamin B12 deficiency
C) Microcytic hypochromic anaemia - iron deficiency
D) Macrocytic hyperchromic anaemia - iron deficiency
E) Normocytic, normochromic anaemia - vitamin B12 deficiency
14. What is the most common cause of microcytic hypochromic anaemia?
A) Folic acid deficiency
B) Haemoglobin deficiency
C) Vitamin B12 deficiency
D) Calcium deficiency
E) Iron deficiency

15. What is anaemia often associated with in intrinsic factor deficiency?
A) Bronchial Carcinoma (preneoplasia)
B) Haemolytic anaemia
C) HIV
D) Type A gastritis
E) Crohn’s disease

16. In a normal pregnancy, which change in the maternal organism is the least significant?
A) Hyperventilation
B) Training of varicose veins in the vulva and vagina area
C) Increase of the cardiac output per minute
D) Increase of blood lipids
E) Diarrhoea

17. How long does a regular pregnancy last?
A) 36 weeks post menstruationem
B) 38 weeks post menstruationem
C) 40 weeks post menstruationem
D) 40 weeks post conceptionem
E) 42 weeks post menstruationem

18. The most common cause of pregnancy anaemia with haemoglobin levels below 110 g/L is:
A) Iron deficiency
B) Latent folic acid deficiency
C) Vitamin B12 deficiency
D) Increased folic acid requirement of the foetus
E) Reduced iron absorption in the intestine

19. and 20. 17-year-old Mrs. Becker comes to you and complains about unilateral headaches that have been going on for six hours now. During that time, your wife would have vomited twice. She also reports that she had "such a flicker in her eye" before the pain began. When asked, she says that the pain is worsened by physical exertion. During the physical examination a clear photophobia is noticeable. The temperature of the Pat. is 36.8°C.

19. What's the most likely tentative diagnosis...
A) Meningitis
B) Migraine with aura
C) Migraine without aura
D) Tension headache
E) Subarachnoid haemorrhage

20. ... and what immediate therapeutic measures should be considered?
A) I.v. antibiotic treatment with cefotaxime and ampicillin, and additional dexamethasone i.v.
B) Ice bag treatment and application of peppermint oil, as well as relaxation therapy
C) Immediate referral of the patient to the stroke unit via ambulance
D) Treatment with ASS 1000 mg i.v., and additional MCP 20 mg i.v., and Sumatriptan i.n.
E) Migraine prophylaxis with Propanolol 80 mg p.o and Amitryptylin 100 mg p.o

21. A 30-year-old man suffers from recurrent attacks of severe headaches, which subside after 1-2 hours of analgesic therapy. Which of the above symptoms is not part of the suspected diagnosis of cluster headache?
A) Miosis
B) Heavy sweating in the area of the forehead and face
C) Ptosis
D) Rhinorrhea
E) Photopsia

22. Type 1 diabetes mellitus differs primarily from type 2 diabetes mellitus:
   A) The formation of the glycosylated blood protein HbA1c
   B) An increased renal threshold for glucose
   C) Postprandial C-peptide concentration in the blood is extremely low despite elevated blood sugar levels
   D) A slowing of the nerve conduction speed
   E) Pathological blood sugar levels in the oral glucose tolerance test

23. A 57-year-old, symptom-free self-employed master baker measures fasting blood glucose levels of 137mg/dL during a routine examination. In the subsequent oral glucose tolerance test, a 2-hour plasma glucose value of 266mg/dL was observed. The following findings are also collected: HbA1c 63mmol/mol (7.9%), serum creatinine 0.9mg/dL, body mass index 33.4kg/m2 Which of the following procedures is the best initial treatment for the patient?
   A) Start of a monotherapy with basal insulin
   B) Inpatient admission to a diabetes clinic for weight reduction
   C) Diabetic training, lifestyle change and prescription of metformin
   D) Oral antidiabetic 3-fold combination therapy
   E) Start of intensified insulin therapy

24. 12 % HbA1c was measured for Ms. A. Which of the following statements about this parameter is the most accurate?
   A) If the insulin dose is adjusted using HbA1c, it is not necessary to consider blood glucose profiles.
   B) The blood glucose setting can be traced back over the last 2-3 months using HbA1c.
   C) HbA1c is formed by the enzymatic binding of glucose to the terminal COOH group of the haemoglobin alpha chain.
   D) HbA1c is determined with a pulse oximeter.
   E) The parameter is not susceptible to disturbing factors.
Contextualisation of the Information Literacy Environment in the South African Education Sector

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Abstract: This study embarked on an in-depth content analysis of the information literacy environment in the South African education sector. The review of literature encompasses a comprehensive critical analysis of available appropriate and contemporary literature, which further expounds the research problem. This research adopted the qualitative method of data collection; hence, policy documents, conference proceedings and journal articles about the subject matter were analytically evaluated to identify whether there is a research gap that may have remained unanswered in previous studies. The study emphasises various ICT tools and techniques that will promote e-learning in South African educational sector; this was done in recognition of its essential role. South Africa struggles with challenges associated with the digital divide, a result of the inability of many to access ICT tools capable of enhancing their performance, particularly in a racially divided country such as South Africa, where a separate educational development policy was pursued during the apartheid era, in favour of the white minority. The trends in information literacy and essential issues regarding information literacy skills in South Africa are highlighted. The challenges associated with information literacy in South Africa are presented, and different opportunities in information literacy are also discussed. The paper concludes with the gaps and options in information literacy in South Africa. Finally, this paper offers a comprehensive review of the information literacy development in the South African education sector, which constitutes an essential perspective in the understanding of the global information literacy development.

Keywords: Information literacy, ICT4D, information access, contextualisation, education sector.

1. Introduction

This study focuses on the concept of information literacy as it influences teaching, learning and development in South Africa. In this paper, the status of information literacy is discussed, revealing the extent, condition and present situation. The trends in information literacy, which reflects the direction and essential issues in information literacy in South Africa, are highlighted, coupled with the challenges and opportunities associated with information literacy. Different perspectives in education are presented. This article also focuses on the cost of internet access, its speed or delays, the level of information and communication technology (ICT) infrastructure and electricity generation, as some of the significant challenges affecting the growth of information access. Various intervention programmes, initiated by corporate organisations in relation to information literacy, are also mentioned. These organisations are the Molteno Institute of Language and Literacy (MILL), Trydian Interactive and Chevron Interventions. It must be noted that modern teaching requires the ability to find, evaluate, organise and communicate information, and the awareness that information is in a state of continuous flux, which means that it changes as quickly as it is available. Teachers, in the view of Solomon, Wilson and Taylor (2012, p.4), are expected to continuously expand their knowledge to be successful in and up to date, and this ability requires information literacy. In South Africa, owing to the legacy of the apartheid, before 1994, there was inadequate allocation and provision of school and public libraries, particularly in the disadvantaged rural communities. Consequently, information literacy levels of most teachers and learners are low. Furthermore, learners’ outcomes are low because they lack information literacy skills to find information to boost their academic achievements.

Many contemporary researchers have commented on the concept of information literacy, for instance, Durodolu (2019, p.4), who sees information literacy as a necessary requirement to survive the predicament brought about as a result of information overload, and affirmed that to moderate this difficulty, it is vital to gain skills that will enable people to recognise reliable sources of information on the internet or any e-learning platform- particularly by educators whose roles and obligation it is to increase the boundaries of knowledge. Association of College and Research Libraries (ACRL) (2016) perceived Information literacy as a combined
ability covering the insightful discovery of information, the awareness of how information is created and valued, and the use of information in forming new knowledge and partaking ethically in communities of learning. (ACRL, 2016, p.4). In the same vein, Chartered Institute of Library and Information Professionals (CILIP, 2018, p.3) defined Information literacy as the capacity to reason critically and make valued judgements about acquired information. This definition implies that knowledge of information literacy enables citizens to display knowledgeable views and opinion that empower them to engage in activities that makes them responsible citizens.

The Scottish Information Literacy Project (2013) describes information literacy as the panacea for stimulating problem-solving abilities, particularly those problems attributed to the modern use of technology that drives information access. It maintains that information literacy assists scholars with critical thinking skills, to seek answers to important questions, to seek information from various sources, form intellectual opinions and evaluate sources of information for informed judgment the ability to seek answers to critical questions, find information from various sources, form intelligent opinions and evaluate sources of information for informed judgement necessary for decision making. Another area where information literacy is crucial is in the field of e-learning, which is a new concept that encourages the use of electronic technologies in accessing educational courses outside the physical classroom environment, in some cases, educational delivery is done via online arrangement (Banciu, Petre and Boncea, 2019, p.465). Even though it is convenient and flexible to use e-learning platforms, the effective use of it requires information literacy. In this study, e-learning is synonymously used to refer to the application of ICT tools and techniques to promote learning.

2. South African context

South Africa’s Bill of Rights is unwavering in the ambition that all citizens should have the right to basic education, including adult basic education and further education. This is in recognition of the fact that education and skills development holds the key to the future prosperity of South Africa. Given this, the government, at all levels, gives special attention to education and skills development. To demonstrate its seriousness about this undertaking, the government spends a considerable part of its budget on education. In the 2012-13 fiscal year, for example, education constituted more than 21% of the government’s total spending. The massive task of promoting quality education is a shared responsibility of two ministries: the Department of Basic Education (DBE) and the Department of Higher Education and Training (DHET). The DBE deals with all schools, from Grade R to Grade 12, and adult literacy programmes and the DHET deals with universities and other post-school education and training institutions and coordinates the Human Resource Development Strategy for South Africa (South Africa, 2013a, p.168).

The South African Schools Act (1996) came into effect on 1 January 1997, with the principal objective of bringing about a uniform system of administration and funding of schools. The education learning programme extended from Grade 0 (better known as Grade R, for “Reception”) to Grade 12. This Act provides for compulsory attendance of school for learners between the ages of 7 and 15 (or on the completion of Grade 9). This is known as the mandatory or general education phase. Every provincial Member of the Executive Council (MEC) for Education is legally obliged to allocate a place at a school for every child in the compulsory attendance bracket. If this cannot be done, because of a lack of capacity, the MEC must take urgent steps to remedy the situation (Department of Education, 1996, p.6). Learners from the socio-economically disadvantaged rural communities do not pay school fees (quintile 1-3).

According to Statistics SA (2013, p.3), in a country of approximately 52 million people, 580 577 candidates wrote the matric (final) examinations in 2013, 61% of whom passed to obtain the National Senior Certificate. Just over half of the learners achieved a bachelor’s pass, making them eligible to apply for university study in South Africa. A bachelor’s pass requires, at a minimum, a rating of 4 (or a C) in four subjects from a designated list of subjects. The body responsible for primary and secondary education is the DBE, with 6 231 secondary schools, 3 821 763 learners and 142 181 educators (DBE, 2012, p.3). In 2013, the South African government spent 21% of the national budget on education. Some 10% of the education budget was for higher education. Total spending on education, in 2011, was 6% of the gross domestic product (GDP) (World Bank, 2013).

One of the noticeable effects of apartheid was in the area of economic inequality between the different race groups in South Africa (Keswell, 2005, pp.1-2). The difference in income between whites and blacks, before the first general democratic election, was sizeable, with the average salary of whites being more than five times
that of blacks. Of equal significance was the impact of the apartheid governments social engineering policies specifically regarding race and language that occurred in the field of public education, for instance, the implementation of the Bantu Education Act of 1954, which recommended differential access to education, based on race. Keswell (2005, pp. 1-2) acknowledges that the decade after the end of apartheid brought about significant changes in the social and political life of all races, changes which continued in the second decade. The structural defects of education during the apartheid rule were dealt with in the post-1994 policy outline, which proclaimed fundamental changes. However, numerous challenges continued within the education sector and regarding policy in diverse areas, such as funding and capacity building, both for historically disadvantaged institutions (HDIs) and students, especially those from educationally disadvantaged backgrounds (Odhav, 2009, p. 33).

According to the Departments of Basic Education and Higher Education and Training (2011, p. 10), the responsibility for educating teachers is the joint responsibility of national and provincial government authorities. It is the statutory duty of provincial colleges to train primary school teachers, while the universities train secondary school teachers. The South African Constitution states that teacher education should fall under central management and control. The national education policy introduced many innovations in the sector to enable quality control appropriate to provincial requirements (DBE, 2010, p. 10).

According to the Departments of Basic Education and Higher Education and Training (2011, p. 11), there is a scarcity of qualified teachers knowledgeable enough to teach specific subjects or learning areas. Primarily the following subjects were identified: mathematics, the sciences, technology and languages, arts, culture, economic and management sciences, African languages, sign language and Braille. In special needs schools, in the early childhood development sector and, especially, in rural and remote schools, the shortage of teachers is significant.

Teacher development in South Africa is perceived by the Departments of Basic Education and Higher Education and Training (2011, p. 13) and many stakeholders as not adequately coordinated and monitored, confusing and burdensome. The Integrated Quality Management System, in particular, is considered to be time-consuming, and it overburdened teachers with the official procedure. Neither teachers nor district officials are adequately trained to manage this official protocol, and the professional training available to teachers is not so relevant as to elevate their performance.

In the South African Millennium Development Goals Country Report (2005, p. 6), it is indicated that South Africa is on track to meet the millennium development goals. The report shows that the current evaluation of South Africa is as a new middle-income country. The rate of primary school enrolment, since 1995, has remained stable, at about 95.5%, and secondary participation rates are currently approximately 85%, representing an increase of about 15 percentage points since the early 1990s. Also, the male and female enrolment ratio is around 97%, representing a higher overall participation rate. The learner to facility ratio has declined, from 43 to 1, in 1996, to 38 to 1, in 2001, as a consequence of the emphasis on relieving backlogs, indicating that more children are gaining access to classroom facilities than before.

3. Methodology

This study employed a qualitative research design, which is guided by the interpretive paradigm because it relies comprehensively on practical methods of content analysis in which concepts are discussed to convey an in-depth understanding of the topic being investigated and bringing new knowledge. This study uses qualitative content analysis as a means of data collection in which existing documents, conference proceedings, journal articles and policy documents on information literacy, in the context of the South African environment, were studied analytically. The researcher embarked on this study to identify whether there is a research gap, which has remained unanswered in previous studies. Key phrases, listed below, were used as a search strategy in selected academic databases, like EBSCOhost, Scopus and Web of Science, and government databases.

This study embarked on a literature review process aimed at addressing issues associated with the use of information in educational development in South Africa. The search strategy was to select key phrases that will unveil new knowledge carefully. In doing this, the study was able to categorise, analyse and integrate the
findings of scholars and policy documents, from relevant institutions, to address the issues raised in the research. The key phrases selected for this study are as follows:

- Information literacy in South Africa
- South Africa’s Bill of Right
- Information access and use in South Africa
- Use of ICT in South Africa
- Cost of internet
- Challenges of information use
- Electricity generation

To achieve this, policy documents from the Departments of Education, Department of Basic Education and Higher Education and Training, and the National Library of South Africa (NLSA), as well as the South Africa Post-Apartheid Higher Education Policy and Marginalisation and South African Millennium Development Goal Country Report, were all included in the study and the relevant portions were evaluated to gauge its efficacy in support of this research endeavour.

4. Status of information access and use

After the end of apartheid in 1994, the DBE has been committed to ensuring equal access to education. The introduction of no-fee schools has helped the government to achieve this goal, but this has not translated into quality education (Paton-Ash and Wilmot, 2013, p.127). Even though it has been established that student performance depends on the availability of library facilities, fewer than 8% of public schools in South Africa have functional libraries (Equal Education, 2011). There is no organised curriculum for computer training and information science literacy; its introduction was a result of the curiosity and enthusiasm of a few teachers in private schools. However, there was a dramatic turnaround when the national Department of Education organised a conference on ICT and education. This, as Boekhorst and Britz observe (2004, p.68), was followed by the Technology Enhanced Learning Investigation (TELI), in 1996. This effort led to an improvement in the broad-based information literacy course that is available in schools, community centres, industry-based training sites and other learning centres. However, in spite of this curriculum development, many schools continue to falter in this regard, due to a lack of adequate power supply, especially in disadvantaged rural areas, and because of insufficient funds to maintain the modern technology (Boekhorst and Britz, 2004, p.68).

Hart and Zinn (2007, p.19) reveal that the introduction of the new school curriculum, in 1996 and then again in 2005, offered new opportunities, because it encouraged library development in the sense that the capacity to “collect, analyse, organise and critically evaluate information” was identified. The authors further reveal that the new curriculum made provision for adequate resources and accelerated library development. Despite this, it has been reported that, at many schools, libraries are not available for use because of the dual responsibilities of the “librarians”, who are both librarians and classroom subject teachers (South Africa, 1997). The extent of the focus of teacher-librarians on library services at schools is not clear. It is, however, clear that 30% of those who claim to be teacher-librarians simultaneously occupy essential positions such as principals, deputy principals and heads of departments (Hart and Zinn, 2007, p.93). The authors further stress that sources of funding for school libraries are not clear, and it has been established that few schools allocate funds to the library (Hart and Zinn, 2007, p.93). Another limitation to library development in South Africa is the reluctance of the school authorities to recognise the need for school libraries. It is incredible that more than 20 years after the democratic government was ushered in, there is still no school library policy in place. The building and provision of school libraries are not taken seriously because of a lack of strategic planning.

According to the Library and Information Services (LIS) Transformation Charter (National Library of South Africa (NLSA), 2014, p.5), a team was established to eradicate illiteracy and inequality by building an informed and reading nation. Part of the responsibilities of the organisation is to ensure the recognition of information as having the ability to eliminate poverty and empower people because well-informed people are responsible citizens (NLSA, 2014, p.5). Therefore, libraries are expected to play a central role in access to information for all South Africans. Furthermore, the charter emphasises that the South African government and all its developmental partners should actively support the initiative to promote information literacy, develop a modern library and information system and ensure the right of access to information as a fundamental human right for all citizens (NLSA, 2014, p.5).
Fourie and Krauss (2010, p.303) observe that the information literacy training of teachers in South Africa was funded by UNESCO, with the support of the Departments of Informatics and Information Science of the University of Pretoria. This led to a partnership between the university and some schools, especially those located in the disadvantaged rural areas. Computers were donated to schools to encourage the teachers to acquire information literacy skills. It was also an avenue to test the drafted road map on the Media and Information Literacy (MIL) curriculum. Fourie and Krauss (2011, p.303) note that two training courses for teachers were designed and registered through the Department of Continuing Education at the University of Pretoria. The training programme began in May 2010, with 54 hours’ attendance, over nine Saturdays. Even though the UNESCO MIL curriculum was implemented to meet the needs of teachers, as working adults in a developing community, the merits of the training included access to enormous resources of information that can be tailored to any circumstances, enhancing the quality of teaching and learning through the support of international experts (Fourie and Krauss 2011, p.303).

The Bridges to the Future Initiative in South Africa (BFI-SA, 2010), mentioned in the assessment report by USAID on South Africa (2013, p.1), is an initiative to use the power of technology to bring about a positive turnaround in education by designing an interactive, computer-based learning tool to improve literacy levels in schools. The approach was to use the influence of interactive, user-friendly, computer-based instruction and learning methodologies for literacy learning. The BFI-SA (2010) holds that information literacy is an empowerment skill, capable of fostering personal development and community upliftment, and is essential for active participation in the modern world. The report notes that, in spite of this, a low level of literacy is still widespread in South Africa, and the challenge is further complicated by the multicultural and multilingual nature of the country. As a result, an innovative project was designed to enable the use of ICT in local languages and to develop literacy and other learning skills in South Africa (USAID South Africa, 2013). The pilot project was kick-started in Limpopo, with the ambition to replicate its benefits throughout South Africa. BFI-SA is a collaborative multi-agency, coordinated under the sponsorship of the national Department of Education. Multimedia resources and instructional media were carefully designed to aid classroom activities and help the imagination of learners. They were designed in English and other local languages such as Sepedi, Tshivenda and xiTsonga. The project was facilitated through ICT infrastructure, in a blend of adult basic education training (ABET) centres (ABET, 2013). ABET lays the foundation for learning and development in schools, developing skills and attitudes geared toward social, economic and political participation and transformation in secondary schools across the province. Multi-purpose community centres are institutions tasked with the implementation and development of communication and information programmes (Rabali, 2005, p.1). According to BFI-SA (2010), the issue of the digital divide in education and technology was addressed in South Africa as a result of this project by improving literacy, basic education and technological literacy, thereby helping the educators and learners to determine their own social and economic future better. This initiative was promoted, in partnership with public and private organisations and with the support from international agencies and public-spirited foundations, using the tools and techniques of ICT, and adapted to accommodate diverse content and learners.

BFI-SA (2010) reveals that multi-agency collaboration is supported by the national Department of Education, with partnerships that include the National Literacy Institute, the Trydian Interactive and E-learning Development Company and the Molteno Institute of Language and Literacy (MILL), formerly known as the Molteno Project. The MILL is a non-profit organisation that funds literacy programmes and research across Africa from its headquarters in Johannesburg (http://www.molteno.co.za). Trydian Interactive ICT is an innovative organisation, with specialised skills in custom courseware development, deliverable through the web, intranet or cell phone. The organisation is situated in Pretoria, and it is equipped with technology that has a global impact in bringing about a highly accessible and convenient way of learning (http://www.trydian.com/). Chevron, a formidable oil and gas company, in its global energy for learning initiative, has partnered with the Western Cape Department of Basic Education to fund the renovation and restocking of community secondary school libraries, and has also transformed the libraries with modern ICT tools, including computers and various types of audio-visual equipment, aligned with the national school curriculum (http://www.youtube.com/watch?v=uhSMZhfJcck).

In all aspects of ICT development in education, South Africa can boast of decades of projects and programmes embarked upon by communities, the private sector, civil society, donor agencies and government bodies. The wide range of tested models for ICT access, digital content development, teacher training and professional growth, optimal usage, partnerships and resource mobilisation have encouraged significant learning among
innovators, practitioners and policymakers. This has also led to at least 22% of computer penetration in South African public schools (Shafika, 2007, p.2). In spite of the improvement in ICT in South Africa, there are still significant challenges confronting this sector. Shafika (2007, p.2) holds that harnessing various initiatives to bring about proper management and harmonisation of information literacy in education encourages optimal use of technology to improve investment in ICT to enhance teaching and learning. That will be valuable to learners and increase their chances of employability in a frequently changing labour market. Shafika (2007, p.2) also observes that the policy on ICT in South Africa dates back to 1995, with the emergence of TELI, which in 2001, with the support of the national Department of Education and the Department of Communication, mapped out a strategy for ICT in education, which laid the foundation for e-education. The ambition of this policy was to encourage both primary and secondary sectors to acquire ICT competence by 2013. Shafika (2007, p.2) states that to make this vision a certainty, schools were encouraged, through different techniques to develop e-schools, with the support of both teachers and learners.

There is an abundance of evidence that clearly shows that, if efforts are channelled in the right direction, ICT can support teaching and learning accomplishments. However, the introduction of ICT tools and techniques does not automatically improve the quality of education. Therefore, the pedagogical and technical expertise of the teacher is critical. As in most countries, the effort of government has been to focus on teachers’ development, as the key to the effective implementation of policy and curricular development, using ICT as a platform for educational development. The current predicament arises from the growing level of poverty, the lack of proper funding and an exponential rise in the student population (Hennessy et al., 2010, p.40).

Internet use has become relatively common in many secondary schools in South Africa, but there are still challenges in some areas (Matlala, 2015, p.8), mainly in disadvantaged rural communities. However, the challenges of internet connectivity, online library resources, computer facilities, computer literacy training and relevant instructional software are familiar in urban areas as well.

4.1 Policy framework

In recognition of the value of access to information in South African society, section 32(1) of the Constitution of 1996 affirms that access to information is the fundamental right of every citizen, whether the information is in the custody of the state, the corporate sector or individuals, as long as it will uphold a culture of transparency, responsibility and accountability in the private and public sectors as against the strict confidentiality and official procedure that will not foster a culture of openness, and can impede access to information. South Africa is the first country in Africa to recognise the importance of access to information in the Constitution. Given this, it can be inferred that the Constitution of South Africa realises the importance of information to the education and development of our citizens and, therefore, to deprive anybody of it, is against the letter and spirit of the law.

Numerous policy frameworks have been put in place in South Africa to promote information use, for instance, the Presidential National Commission on Information, Society and Development Two advisory bodies have been set up to help the President form an opinion on matters that have to do with the development of an inclusive information society. According to the Department of Public Service and Administration of South Africa (2012, p.1), the government put in place a policy framework to ensure the mutual control and governance of ICT as an essential division of corporate governance within departments in a standardised and coordinated manner. The agenda offers a set of central beliefs and processes to which all government departments must conform.

The national Department of Education has developed guidelines to enable teachers to use ICT in classroom instruction. Currently, a few programs have been designed to help teachers develop ICT skills in South Africa, programs such as SchoolNet South Africa, Educators’ Development Network and Microsoft Partners in Learning (Shafika, 2007, p.16).

The broadband policy, tagged “South Africa Connect”, contains details of activities to improve broadband in South Africa, improve access to the broadband connection at a reduced cost of 2.5% or less of the average monthly income and also increase the speed of broadband. The Independent Communication Authority of South Africa (ICASA, 2018), the regulatory body for the South African communications, broadcasting and postal services sector, was established to complement the ambition of improved broadband identifying standards, download and upload speeds, latency, waiting time for installation and fault clearance.
4.2 Human resources development

Teachers are significant participants in curriculum delivery in any educational environment, and they help to elicit outstanding performances from learners. Nevertheless, there is a general shortage of human resources. The vacancy rate, by January 2012, averaged 8.7%, 10.2% and 8.7% for principals, heads of department and teachers, respectively. In 2008, 5,942 new teachers graduated from various institutions in the country, representing a 74.5% increase in four years. Based on this estimation, a considerable improvement was expected in the next two years, and by 2014, over 14,000 new teachers were expected to join the workforce (South Africa, 2013a). In 2013, there were approximately 25,000 public schools and 391,708 educators (South African info, 2015).

The population of newly qualified teachers is decreasing. Personal payroll data indicates that approximately 10,100 teachers in public schools leave the profession annually, but approximately 5,000 recently-qualified teachers have been joining each year (DBE, 2011, p.100).

Access to ICT resources in South African schools has enjoyed steady improvement over the years. By 2007, more than 80% of school principals and 60% of teachers reportedly had access to a computer system at school. By 2009, 23% of schools had a computer centre, though this figure varies according to the province, from the highest in the Western Cape, of 60%, to 10% in the Eastern Cape (Department of Education, 2011, p.92). The evidence reveals that teachers have access to the internet in their various schools. According to the Census, school, access to the internet at home, by learners, doubled from 9% to 20% between 2001 and 2009. But there is an indication, based on statistics, that the internet remains more popular among the privileged few in society (Department of Education, 2011, p.93).

4.3 Finance

Expenditure on basic education, in 2015-16, was approximately R203,468 billion. Over the next three years, nearly R640 billion is expected to be spent on basic education (Davis, 2015). Since November 2007, the Department of Education in South Africa has collaborated with corporate organisations in subsidising education for students to the level of R40 a month. In view of this, the Fundisa Fund organised a three-pilot project fund, designed to financially assist students, on merit, in view of the fact that the Department of Education made available R9.2 billion, as an intervention fund, and, at the same time, the National Student Financial Aid Scheme committed the sum of R21 million (South African info, 2015). The South African Democracy Education Trust, established as a trust fund in honour of former South African President Thabo Mbeki, is an initiative supported and funded by MTN, the Nedbank Group and the National Lottery Distribution Trust Fund.

4.4 Facilities and equipment

In November 2013, the Ministry of Basic Education published lawfully obligatory Norms and Standards for Public School Infrastructure, amending the South African Schools Act 84 of 1996, to regulate issues relating to minimum uniform rules and standards expected of public-school infrastructure. This Act recommended, among other things, the minimum space in a school that should be apportioned to each learner and educator, an electricity supply that conforms to the appropriate law that serves to maintain personal and hygienic conditions and efficient sanitation facilities. It is mandatory for all schools to have a library or a media centre appropriate for the school, laboratories must be available for science, technology and life sciences, sport and recreation facilities should be available to ensure the physical and mental development of learners, electronic connectivity must include internet facilities, a fax machine, telephone facilities and intercom, and above all the facilities must be subject to upgrading to meet the prevailing circumstances (Department of Education, 1996).

There has been a rapid growth in the number of schools with computers and other instructional media for teaching and learning in South Africa, even though there is a wide gap, comparatively, between provinces in the use of these facilities. Statistics have revealed, according to Angathevar and Mammo (2006, p.202), regional disparities in the growth rate of ICT, with Gauteng, Northern Cape and Western Cape far ahead of other provinces. Computer penetration in South African schools shows that, of the 25,582 schools, only 50.9% have computers and just 22.6% use computers for teaching and learning (Isaacs, 2007, p.9).
The Accelerated School Infrastructure Delivery Initiative (ASIDI, 2013) was established by the Department of Education to eliminate backlogs in school infrastructure and to fast-track provision of infrastructural support in South African schools. It is also expected to upgrade the benchmark of schools, to perform at an optimal level, and to get rid of insufficient, risky and inadequate physical infrastructure.

5. Issues about information access and use in South Africa

School library and information services are required to make available to learners and teachers an extensive range of information for curricular support, exposing learners to different ideas, knowledge, skills, understanding and opinions. Moreover, the service, according to the DBE (2012, p.3), must inculcate a culture of reading and writing, uphold respect for intellectual property and maintain information literacy skills acquisition to access process and use information resources in different formats, including digital formats, where accessible and suitable. The South African school curriculum is resource-based, to integrate resources to increase information-literate learners and a culture of reading.

Information literacy is the prerogative of a professionally and proficiently qualified school librarian or school media specialist. However, Hoskins (2006, p.59) observes that, in South Africa, of the 23 established universities, only three can educate school librarians, and they are the University of KwaZulu-Natal, the University of Zululand and the University of the Western Cape. The qualification at the end of the three years’ training is referred to as the Advanced Certificate in Education (ACE) (School Library Development and Management) in KwaZulu-Natal, and the ACE (School Librarianship) in the Western Cape (Zinn, 2012, p.89). As a result of the significant shortfall in the number of school librarians, many secondary schools have suffered a major setback. For instance, fewer than 8% of South African public schools have efficient and well-designed libraries, and there is no policy framework to coerce school governing bodies and principals to establish libraries (Paton-Ash, 2012, p.ii).

6. Challenges and opportunities associated with information access and use

South Africa is one of the countries struggling with problems related to the digital divide, a result of the inability of many to access ICT tools capable of enhancing their performance. Naidoo and Raju (2012, pp.33-44) note that the Department of Education has set up the Extended Curriculum Programme, explicitly designed to aid academic activities, by developing independent learning skills, which are at the heart of information literacy. This is necessary, particularly in a racially divided country such as South Africa, where a separate educational development policy was pursued during the apartheid era, which, in spite of government efforts to bring about change, is still noticeable, because learners from educationally disadvantaged environments continue to struggle with the use of modern technology, especially with instructional media and web facilities that have been incorporated into the school system. Given this, the possibility of learners achieving total information literacy will depend mainly on their educational background.

De Jager and Nassimbeni (2002, p.168) concur with the view that many students gain admission to higher education institutions without prior knowledge of the use of a library and other modern information resources. Information literacy training is therefore of paramount importance, even though trainers are warned to be mindful of the fact that many students are not equally exposed to the skills at an early stage. They should, therefore, strive to bridge the digital divide by introducing intervention programmes to assist such students. Fourie and Krauss (2010) suggest that information communication technology for development, otherwise known as ICT for development, or ICT4D, may be the catalyst for teachers’ information literacy empowerment.

Boekhorst and Britz (2003, p.64) acknowledge that modern society must be acquainted with information and ICT skills, even though knowledge is partly learnt in daily activities. For it to enable efficient learning, it ought to be part of the school curriculum. Initially, in South Africa, there was no curriculum for computer education and information literacy.

Fourie and Krooden (1999, p.3) explain that the University of South Africa, the Bureau for University Teaching and the Centre for Software Engineering were all involved in the development of a module, namely Research Information Skills. This module was given a test run on a selected number of students, many of whom expressed anxiety about their inadequate knowledge of computer and library skills. This shows that the lack of experience in using information technology will impede learners’ ability to master research information skills.
The impact of the apartheid era has been identified by Fourie (2008) as a significant reason why ICT does not enjoy equitable access in South Africa. In consequence, the government implemented the Accelerated and Shared Growth Initiative of South Africa (ASGISA), because of the realisation that modern technology is a catalyst for improvement in education, which can boost productivity and efficiency and reduce unemployment.

6.1 Cost of getting the internet

There has been significant growth in internet penetration in South Africa, but the major challenge is that only a fifth of the population enjoys internet access. The internet is not affordable, because ADSL is priced beyond the reach of many in South Africa. Buying a large data bundle costs substantially less per megabyte than a small data bundle (Wild, 2013).

6.2 Speed and time-consuming internet

Cost, inadequate access and slow connectivity of the internet impede economic growth and job creation in a contemporary economy. In South Africa, average internet connection speeds are low, but are among the highest in Africa ( Hampton, 2013), at 4.90 mbps (Net index, 2013), which is inadequate for timely access to information.

6.3 ICT infrastructure

The Global Information Technology Report (2013) reveals that South Africa performs comparatively well in ICT infrastructure, based on the survey in the Networked Readiness Index, but its rank is dragged down by digital content inaccessibility. The assessment was based on electricity production (kWh/capita), mobile network coverage, international internet bandwidth (kb/s per user) and secure internet servers (per million users in population).

6.4 Electricity generation

None of the modern information access devices can function without adequate electricity supply. South Africa supplies two-thirds of Africa’s electricity and is ranked as the fourth cheapest electricity producer in the world. Almost 90% of South Africa’s electricity is generated in coal-fired power stations; other sources are nuclear energy, hydro-electric power and pumped storage schemes. Eskom is the company responsible for electricity generation in South Africa (http://www.energy.gov.za/files/electricity_frame.html).

The opportunity for information access has become brighter in South Africa, especially for teachers, whose profession depends solely on up-to-date information. Statistics about South African households (Statistics SA 2014, p.13) reveal that 40.9% of households have a minimum of one person with access to the internet at their home, workplace or somewhere else, 10% of the households now have internet access, and 30% of people access the internet from their workplace (16%), schools (5.1%) or at numerous cyber cafés (9.6%). Predictably, more homes in the metropolis enjoy internet access (16.4%), in contrast to the rural areas (2%) and urban centres (9.2%). The window of opportunity for information access by rural dwellers is offered by the broad coverage of telecommunication facilities, which allows them to use mobile devices to access the internet (17.9%). The percentage of South Africans using cellphones to access information is 30.8% of the total population of 81.9%, who have access to cellphones. These new statistics reveal a marginal increase in internet usage in South Africa compared to previous years.

7. Conclusion

Information has been described by Elliot (2007) as the fifth factor of production, the use of which can lead to the development and improvement of other factors. Many countries have put policies and measures in place to ensure that citizens have access to quality information, as this will enable the workforce to accelerate economic development and give the country a competitive advantage in the community of nations.

The post-apartheid government of South African has stressed the need to make education and information available to previously disadvantaged communities. It has, therefore, expanded the geographical scope of learning to capture those outside the range of quality education and access to information, which is considered a prerequisite in the endeavour to bridge the gap of inequality that currently exists. Consequently, a considerable amount of time, energy, resources and partnerships with donor agencies have been diverted to achieve this ambitious scheme. Regardless of these efforts, much is yet to be achieved, especially regarding...
The imbalances that exist in accessing technology, which is a key driver in contemporary education systems, and the obstacles that hinder the dissemination and implementation of media and information literacy in South Africa. Other areas of change that need urgent attention are the absence of qualified teachers, most notably in the rural areas, training for the instructors, and the non-implementation of IT literacy in the curricula as a result of insufficient human resources, all of which are indispensable fundamentals for imminent development. Addressing these challenges can help to close the gap in the digital divide and assist in stimulating social inclusion.

The difficulties associated with the digital divide and the resultant social and economic challenges are vastly prevalent in South African society today, for instance, access to ICT facilities, especially the internet, is not universally available, and, therefore, it is mainly to the previously disadvantaged majority that is deprived of access, while a minority does have access. This places them in a favourable position since access to information will empower them to take advantage of the potential of the country and be part of the engine of growth. To bridge the gap of the digital divide in South Africa, the difficulty in accessing the internet must be addressed, and equal prominence must be given to the information literacy programme.

Information is fundamental to the progress and development of any nation. From time immemorial, the availability of information has always played a significant role in the development of nations. An ill-informed citizen will not be able to hold government accountable for their actions; thus, democratic principles can be violated in a community of uninformed people. If information is readily accessible to people, the level of transparency will increase, and many of the socio-political challenges of a country can be resolved. The law establishing freedom of information in the developing countries of Africa varies from country to country, with different levels of application. The government of Nigeria passed into law the Freedom of Information (FOI) Act to increase people’s access to information. But, even though the FOI Act is now law in Nigeria, the political will to give effect to it is lacking. Many states of the federation have yet to adopt the Act; thus, access to relevant information from the government is difficult. Restricted access to public information has aggravated corruption, which is one of the reasons for the decline in education, which has had a ripple effect on library development.

Information literacy was accommodated in the post-apartheid curriculum of 2005 as crucial to South African education in which capacity to use information resources well will give the country a competitive edge. Regardless of the increase in the government’s budgetary allocation to Education yet there is consensus that apartheid legacy still continues, because many people are still caught in the problem associated to digital divide. There is constitutional provision in South Africa to guarantee to enable everyone equal access to information, irrespective of this constitutional provision, there restriction to certain information by state security to cover up information of public interest.

In South Africa, a similar law also enables people to seek and obtain information from private organisations, especially those that offer public services and enjoy government funding. Information from various sources can help to reduce illiteracy. A country with a high degree of literacy can participate more effectively in economic development and is capable of self-development, which is a prerequisite for human progress. A country that sets up a platform to reduce ignorance will enable literacy to develop and combat various societal challenges. Information-literate citizens can maximise a country’s potential and turn limitations to opportunities.

On the other hand, poverty remains a common phenomenon in an environment where illiteracy dominates. Information literacy is related to political literacy, which is the level of citizens’ awareness of their rights, duties and responsibilities that empower them to take the right decisions. People, who are not well informed, may lack the ability to vote for leaders that will represent their interests and promote national integration and cohesion. Political literacy can be considered as a skill essential to empower citizens to participate effectively in the act of governance, which includes a better understanding of government policy and its effect on larger society, and to enhance citizens’ ability to form independent political opinions.

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Codifying Game-Based Learning: Development and Application of LEAGUÊ Framework for Learning Games

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Abstract: Educational games are now seen as effective learning tools. However, there is a gap in the literature regarding the core dimensions of Game-based learning (GBL) for comprehensive design, analysis, and evaluation due to inconsistent use of elements. The literature on GBL reports an extensive diversity of elements used for the design and evaluation of GBL without any categorization of micro and macro-level elements. Hardly any studies systematically decompose these aspects to derive factors/sub-factors, obstructing identification of any clear pattern. The problem is not the scarcity of GBL research but inconsistency in terminology, scope, definition, and usage of elements leading to the absence of a holistic view of GBL for effective design and evaluation. This study bridges the gap by outlining terminology and scope with four conceptual levels and then systematically categorizing GBL elements by scope, definition, and usage. The methodology used is directed content analysis of GBL literature collected through a previous systematic literature review. Dimensionalization of GBL and further decomposition into factor/sub-factors based on theoretical constructs, has resulted in a consistent and clear pattern delineating the structure of the educational game design, analysis, and evaluation. Further codifying metrics and mapping the relationship among GBL dimensions deduce into a conceptual framework (called LEAGUÊ) that facilitates greater insight into the process of learning with educational games, where to focus and what to evaluate. The LEAGUÊ framework can be applied for the analysis, design and evaluation of learning games. The framework is put in practice by utilizing the framework components (dimensions, factors/sub-factors and relations) to develop three items: 1) an analysis instrument, 2) a card-based ideation and design toolkit, and 3) an evaluation guide that can assist educational game designers, researchers, educators and evaluators for the analysis, design and evaluation of learning games respectively. This paper exemplifies the application of framework for the analysis of learning games using the analysis instrument (developed using LEAGUÊ framework) with one case study as an example.

Keywords: game-based learning, educational games, learning games, framework, dimensions, factors, relations, game analysis, evaluation, design

1. Introduction

Game-based learning (GBL) is an innovative educational paradigm that utilizes games as a mode for transferring learning (Tan, Ling et al., 2007). Educational games are considered to have the potential of deeply engaging learners with any topic, allowing active participation in the learning process (Wallner and Kriglstein, 2011). Although much effort is put in game-based learning studies internationally, robust and comprehensive design for effective learning games remains unclear. Game designers create exciting games but neglect the quality of teaching materials in a game. On the other hand, educators focus on educational materials but do not know about how to create exciting games (Shi, Y.-R. and Shih J.-L., 2015). Bellotti, Kapralos et al. (2013) stated that educational games, like any educational tool, must be able to show that necessary learning has occurred. Therefore, it is crucial to systematically evaluate them to affirm their impact (Marciano, Miranda et al., 2014). The diverse characteristics of learning games make their evaluation a difficult task. However, evaluation is the only means to verify that educational goals are achieved and spot any functional vulnerability (Djelil, Sanchez et al., 2014). Dondi and Moretti (2007) highlighted two critical issues related to GBL evaluation.

First, the construction of a general framework is extremely difficult unless it is an abstract one. Second, the differences between the processes of analytical evaluation (looking at aspects individually based on identification of single aspects) and global or holistic evaluation (considering the characteristics of GBL product all together). There are some difficulties with both approaches. The analytical approach lacks a theoretical model essential for unifying all the different aspects of GBL evaluation and might cause unnecessary fragmentation. Whereas in holistic approach, the judgement is too comprehensive and there is a high degree of subjectivity which presents a need to use other complementary methods for validation.

Many researchers have attempted to describe what the critical elements are to create a learning game. The review of these theories draws only one conclusion: There is no consensus among researchers about the
terminology and the comparable importance of GBL elements (Oprins, Visschedijk et al., 2015). Furthermore, it has been a constant challenge to understand the relationships between the different aspects embedded in GBL (Ahmad, Rahim et al. 2015). Our previous review study on GBL highlighted the following problem areas: 1) Most GBL frameworks and studies focus on exploring any single aspect of GBL, making it difficult to identify all core dimensions; 2) Use of a wide diversity of elements for designing and evaluating educational games does not allow the identification of any clear pattern; 3) Very few studies systematically decompose GBL aspects based on their theoretical construct, not allowing the hierarchical decomposition in terms of scope; and 4) The inconsistency in definition, usage, scope and terminology (e.g. dimensions, factors, etc.) of elements in GBL literature. Therefore, to systematically analyze GBL concepts, there is a need for proper categorization of the wide variety of elements available in the literature (Petri and von Wangenheim, 2017).

This study attempts to overcome the identified problems by performing directed content analysis on the dataset of existing GBL literature collected through a systematic literature review (Tahir and Wang, 2017). The GBL elements extracted from the systematic review are hierarchically decomposed (using operations such as coding, categorization, abstraction, comparison and integration) into core dimensions, factors and sub-factors based on scope, frequency of occurrence, relationship between codes, underlying meaning across codes, and mapping to existing theoretical frameworks and constructs defined by researchers in the domain of GBL. The metrics and relations between core dimensions are also detailed (using a similar process) for a complete analysis. The result is a conceptual framework named LEAGUE (Learning, Environment, Affective-cognitive reactions, Game factors, Usability, User) that list the core GBL elements in a hierarchy of scope. The comprehensive hierarchical structure of the framework makes the application of the framework suitable for analysis, design, and evaluation of learning games. Therefore, LEAGUE framework is put in practice by utilizing the framework components (dimensions, factors/sub-factors, metrics and relations) to develop three tools: an analysis instrument, a card-based ideation and design toolkit, and an evaluation guide to assist the GBL community. However, this paper will only focus on application of the framework for the analysis of learning games using the developed analysis instrument. The paper is organized as follows: Section 2 discusses related work, Section 3 describes the method for development of the framework, Section 4 presents the results of directed content analysis in the form of LEAGUE conceptual framework, Section 5 illustrates the application of the framework and, finally Section 6 concludes the study with discussion and future research.

2. Related work

The multidimensionality of GBL demands to consider several aspects important for its design and evaluation (Furió, D. et al., 2013). However, there is still a debate around which aspects to consider (Oprins, Visschedijk et al., 2015).

2.1 Systematic reviews and evaluation studies on educational games

Many review studies in GBL (Perttula, Kiili et al., 2017; Djelil, Sanchez et al., 2014; Petri and von Wangenheim, 2017; Tahir and Wang, 2017) have reported the use of a wide diversity of evaluation aspects for educational games. These aspects are inconsistently defined, and most studies do not systematically decompose into their constituents (Oprins, Visschedijk et al., 2015; Petri and von Wangenheim, 2016). For example, some studies consider the concept interactivity as one of the main dimensions of GBL (Annetta, 2010), while other studies use interactivity in a narrow scope as a factor to achieve a GBL dimension (Djelil, Sanchez et al., 2014). Moreover, others use it as a sub-factor of a factor interface (Omar and Jaafar, 2010). There is no clear distinction between micro- and macro-level elements.

Our insight into evaluation studies showed a similar trend where most researchers used predefined ad-hoc criteria, selecting different aspects for evaluating educational games. Moreover, existing GBL models/frameworks are less used in empirical research (Tahir and Wang, 2017). Virvou and Katsionis (2008) evaluated usability and likeability in the VR-ENGAGE game for education. Pourabdollahian, Taisch et al. (2012) employed flow dimensions for measuring learner engagement in serious games for manufacturing education.

Papastergiou (2009) focused on evaluating learning effectiveness and motivation of GBL in computer science education. Giannakos (2013) and Yu, Hsiao et al. (2005) used learning performance as a measure in their evaluation studies. The aspect of usability has also been widely used for evaluating educational games, but different studies used different factors to access this aspect (Liao and Shen, 2012; Mei, Ku et al., 2015; Wallner...

### 2.2 Game-based learning concepts in existing frameworks

Although several GBL design and evaluation models/frameworks exist, it is essential to highlight that each of these models/theories focuses on analyzing and understanding educational games using different aspects, where most researchers focus only on one or two specific aspect(s). Thus they could supplement one another, but individually these studies are relatively narrow and may account only for a portion of a complete picture of GBL design and evaluation (Fu, Su et al., 2009; Tan, Ling et al., 2007). Here are some main aspects explored in various GBL frameworks/models:

**Learning:** Most of the researchers in GBL mainly focus on education/learning aspects. Four-dimensional framework by (De Freitas and Oliver, 2006) focuses on learning to help tutors evaluate the potential of employing simulation/GBL in practice. Connolly, Stansfield et al. (2009) describe an evaluation framework that focuses on the pedagogical aspect, introducing attributes to measure the GBL environment with attention on the learner and learning. Another evaluation framework proposed by (Wang, Liu et al., 2015) also emphasizes learning perspective with respect to learning results, learner motivations, and learner experience.

**Flow:** Conversely, some researchers focus on flow and enjoyment aspects in educational games. Kiili (2005) introduced an experiential gaming model to facilitate flow experience serving as a link between game design and educational theory, but not offering a complete game design. EGameFlow proposed by (Fu, Su et al., 2009) is a scale for assessing the level of enjoyment delivered by e-learning games. Kiili, Lainema et al. (2014) presented a flow framework to analyze overall playing experience of educational games through dimensions of flow.

**Game design:** Serious game design assessment framework implemented by (Mitgutsch and Alvarado, 2012) structures different game design elements to analyze the formal conceptual design of serious games. It recommends on how to shape serious games assessment in terms of design. Chorianopoulos and Giannakos (2014) presented the design principles for serious games in mathematics. Shi and Shih (2015) also focused on game design aspects proposing 11 game factors for GBL design that described a thinking process to design and evaluate educational games using game elements.

**Usability:** Some researchers focus on usability (Mohamed, Yusoff et al., 2012; Rêgo and de Medeiros, 2015; Omar and Jaafar, 2010) and present heuristics for evaluating the usability of educational games. These researchers incorporated concepts of learning, gameplay, interface, and enjoyment within heuristics for evaluating GBL usability. Yue and Zin (2009) proposed six usability evaluation constructs for the design of history educational games.

**Pedagogy and game design:** Some researchers have a combined focus on learning and game design as two critical aspects of educational game design and evaluation. Some of the frameworks include educational games design framework by Ibrahim and Jaafar (2009), a framework for the analysis and design of educational games by Alevens, Myers et al. (2010), an adaptive digital GBL framework proposed by Tan P.-H. et al. (2007), a RETAIN model presented by Zhang, Fan et al. (2010), a GBL evaluation model (GEM) by Oprins, Visschedijk et al. (2015), and a Game object model (GOM) proposed by Amory (2007). Rooney (2012) presented a framework consisting of play, fidelity, and pedagogy for serious game design.

### 2.3 Content analysis

Qualitative content analysis is a data reduction and sense-making effort that requires data samples to comprise of purposively selected texts that can inform research objectives and attempts to identify meanings and core consistencies (Hsieh and Shannon, 2005; Loh, Sheng et al., 2015). Three different approaches exist for content analysis: Conventional, Directed, and Summative. In the directed approach, analysis begins with relevant research findings/theory as guidance for the initial codes, and the goal is either to validate or conceptually extend a theory/ framework. Depending on the research question, it has two strategies to begin coding. If the aim is to identify and categorize all possible instances of any specific phenomenon, then it might be useful first to read and highlight the text representing the instances of that phenomenon and then start coding. The second strategy immediately begins coding with predetermined codes (Zhang and Wildemuth, 2005).
3. Development of the framework

This study applied directed content analysis based on the work of (Hsieh and Shannon, 2005). The general objective of this study is both to validate and conceptually extend the existing research on GBL design and evaluation by analyzing, interpreting, and organizing the many aspects to fill the gap in current literature regarding inconsistency in systematic categorization and use of features for GBL design and evaluation.

The content analysis was guided by the following research questions based on problem statements identified in the introduction: RQ1 What are the core dimensions for the design and evaluation of educational games?; RQ2 Which factors are important for achieving each of these core dimensions?; RQ3 What are the sub-factors for assessing these factors based on theoretical constructs (if any)?; RQ4 What metrics can be used to quantify these factors/sub-factors for educational game evaluation?; and RQ5 Are the GBL dimensions interrelated?

3.1 Directed content analysis

The process of content analysis followed the steps defined by (Zhang and Wildemuth, 2005). The steps included: preparing data, defining the unit of analysis, developing coding strategy, testing coding strategy, coding all data, assessing coding consistency, drawing a conclusion from coded data, and reporting method and findings. Content analysis is applied because it plays an important role for theory development. The goal of a directed approach to content analysis was to fill the gap in literature regarding consensus and inconsistency in GBL elements and extend conceptually the existing theory. The existing frameworks reviewed were instrumental in attempting to ensure that there were no omissions and aid in the categorization process.

The directed content analysis was an iterative process involving progressing through extracted data to further analysis using the following set of operations: coding, categorization, comparison, abstraction, integration, and iteration (Spiggle, 1994; Engl and Nacke, 2013) in such a way that preceding operations shaped the following ones. The analysis was not performed linearly but moving back and forth between stages. The complete process is presented in Figure 1.

3.1.1 Corpus for analysis

The data set for directed content analysis comprised of data extracted from 58 articles on GBL evaluation literature from our previous systematic literature review (Tahir and Wang 2017). The selected articles comprised of GBL frameworks, evaluation studies, and reviews. The corpus completely focused on GBL literature and not on the integration of gaming and learning fields to be in line with (Loh, Sheng et al., 2015).

According to Loh, Sheng et al. (2015) the answer to the question “does learning plus game equals to serious games?” is 20% Yes and 80% No because only some measures can be commonly found in all three industries. Other than that, the measures are unlikely to transfer from one industry well into another. Therefore, the core elements that are optimal for use in design and evaluation of game-based learning must be specifically focused on GBL literature to properly assess, measure, and improve educational games. The data items extracted from selected papers include: Dimensions, factors, sub-factors, metrics, interrelated dimensions/factors/sub-factors, relation type and/or description, and definitions of dimensions/factors/sub-factors. All the information was entered into an Excel spreadsheet.

3.1.2 Defining unit of analysis

To remove the inconsistently in the terminology used in varying scope across studies, we introduced and defined four conceptual hierarchical levels concerning scope (dimensions, factors, subfactors, and metrics) for analysis of GBL components. Hierarchy is important when defining attributes for a specific application domain (Kececi and Abran 2001). The scope of terminology is defined as follows: the term “Dimension” refers to a broader concept but isolated within its kind and not a composition of different aspects, representing the main goals/objects of GBL. Each dimension represents one specific aspect of GBL. The term “Factor” refers to the elements important for achieving a specific dimension, and the term “Sub-factor” refers to further categorized elements that constitute that specific factor. The term “Metrics” is the gauge to measure a factor/sub-factor either through objective or subjective data. This can be depicted (high to low level) as: Dimension > Factors > Sub-factors > Metrics.
3.1.3 Coding strategy

We adopted the first strategy for coding (see Section 2.3) because the aim is to identify and categorize all possible instances of GBL components in the selected corpus systematically and consistently. Therefore, before starting the analysis, we read the text and extracted the text data for each of the four conceptual levels (dimensions, factors, subfactors and metrics) in the spreadsheet that appeared to represent them on first impression (as used in each study), and then started coding for each level (top-down). The definition of these concepts that appeared in text were also extracted. As we wanted to be sure to capture all possible occurrences of GBL elements therefore first extracting all the identified text without coding might be a good...
way to increase trustworthiness. Hence, the analysis starts with identifying core dimensions and proceeds with factors & sub-factors (with reference to the level above). The extracted data for dimensions were coded using the predetermined codes that emerged from existing GBL literature during initial review (see section 2.2). The predetermined or initial categories used for coding dimensions were learning, game design, flow, and usability (see Section 2.2). Any dimension that could not be categorized with the initial coding scheme was given a new code. Therefore, new categories appeared during categorization and were further analyzed, using a set of operations mentioned in section 3.1, until the final core dimensions were attained. During analysis and categorization, comparison was performed to explore the similarities and differences across incidents.

Furthermore, several concrete instances were found that shared common features and therefore abstraction was used to group the previously identified categories into more general higher order conceptual classes. Abstraction was also performed on unit of data that was recognised as an empirical indicator of more general construct. After the complete analysis six core dimensions were identified (listed in section 4). The subsequent analysis focused on analyzing the sub-categories, including factors for each dimension, sub-factors for each factor, metrics, and relations using similar operations. The analysis of sub-factors mostly resulted in the integration of constructs where possible by using existing concrete theories/models (e.g. sub-factors of flow were integrated by Csikszentmihalyi’s flow model) for aiding the process and enhancing the validity of final GBL components which are theoretically grounded. For metrics and relations, the extracted data was listed for relevant dimension, factor and subfactors. They were then categorized for each dimension (combination of dimension in case of relation e.g. learning and game factors, learning and affective-cognitive reactions etc.) based on frequency, underlying meaning and relationship. The categories formed were further analyzed using operations such as comparison, abstraction and integration to identify the generic metrics types for assessing any factor/sub-factor and key relations between dimensions.

The coding was checked for consistency at each level, where both authors discussed and finalized the categories formed. The analysis and findings resulted in a conceptual framework presented in the next section.

4. The LEAGUÊ conceptual framework

This section presents the results of directed content analysis in the form of a hierarchical integrated conceptual framework called LEAGUÊ (see Figure 2).

4.1 Dimensions

Figure 3 shows the six dimensions in LEAGUÊ identified as key constituents of GBL design and evaluation. The dimensions are presented in the order of letters in LEAGUÊ and not with respect to the importance of one over the other.

4.2 Factors and sub-factors

Each dimension in the framework has a set of factors. Factors are intermediate-level concepts, and the framework entails such 22 factors (see Figure 4). Factors in the framework are further systematically categorized into sub-factors based on their theoretical construct, allowing a hierarchical decomposition. The sub-factors are easier to quantify and also serve to reduce the subjectivity often associated with assessing the factors. However, the choice of components for evaluation should depend on the overall evaluation objective and type of data required. Sub-factors are mostly devised by integration and mapping of conceptual elements using well-developed and widely accepted models/theories in areas where researchers had consensus in the literature. Figure 2 presents the complete hierarchy and association, including sub-factors to each factor.

The sub-factors of learning objectives (L1, Figure 2) comes from (Aleven, V., et al., 2010). Learning task/activity (L2/3, Figure 2) is the specific task (designed in line with desired learning objectives and employed learning theory) that outlines the interaction of learners, using specific game characteristics, orientated at specific outcomes (El-Sattar and Hussein, 2016). The sub-factors of learning outcomes (L4, Figure 2) are adapted from the GEM model (Oprins, Visschedijk et al., 2015). The sub-factors of enjoyments (A1, Figure 2) are assimilated from EGameFlow (Fu, F.-L., et al., 2009), which uses flow as a structural foundation, and therefore has some common sub-factors as flow (Rêgo and de Medeiros, 2015; Tseloudi and Tsiatsos, 2015). The sub-factors of motivation (A3, Figure 2) are adapted from the well-established ARCS model (Su, Chen et al., 2013).
The sub-factors of flow (A4, Figure 2) are adapted from the flow framework (Kiili, Lainema et al., 2014) and present the original component of flow presented by Csikszentmihalyi (Perttula, Kiili et al., 2017). The sub-factors of the interface (U1, Figure 2) are integrated by mapping the factors found in GBL literature to Nielsen’s heuristics (Yue and Zin, 2009). This resulted in 9 sub-factors, one heuristic “help users recognize, diagnose, and recover from errors” could not be mapped to GBL literature. The analysis further clarified that in educational games, the focus is on error prevention and confirmation messages rather than error messages. The review of GBL literature showed the lack of psychosocial indicators used for evaluating educational games. Although the importance of psychological needs and psychosocial stages is highlighted in (Tan, Ling et al., 2007), further details are not provided.

Figure 2: LEAGUÊ hierarchal structure and components

Therefore, the psychosocial well-being indicators (Ê3/2, Figure 2) are obtained from PSWBI (Negovan, 2010). The PSWBI scale is validated with students for psychometric properties, construct validity, reliability, and internal consistency. However, its use for educational games is to be explored.
The sub-factors of technical (E1, Figure 2) include: technology type (technology used for GBL), technology issues (e.g., issue of mobility in mobile technology) and meet technical requirements (Zaibon and Shiratuddin, 2010; Pappa and Pannese, 2010). The sub-factors of context (E2, Figure 2) are adopted from the framework by (De Freitas, S. and M. Oliver, 2006). The sub-factors not directly integrated by using existing theories/models...
were analyzed using a set of operations mentioned in Section 3.1 and selected based on scope, frequency of occurrence, and the relationship between codes and underlying meaning across codes.

4.3 metrics

The metrics represent the lowest level in the hierarchy, which are used to collect evaluation data (Figure 2). The output of a metric interprets the status of sub-factor/factor: the degree to which the educational game possesses a given attribute. The choice of metrics depends on the type of data required, either subjective or objective, qualitative or quantitative. We identified 83 metrics from the corpus of analysis, which were then coded and categorized into five types. The complete exhaustive list of metrics for each factor/subfactor is not provided here. Instead, the aim is to give guidance on the key metrics types used in GBL evaluation that can be utilized and adapted for different evaluation studies depending on the evaluation goals and selected factors/sub-factors. As a result, GBL metrics are coded into five main categories presented in Figure 5. The first three metrics will result in objective data, while the last two will be useful for collecting subjective data. To illustrate, we introduce some typical examples for each category in Figure 6.

4.4 Relations: High-level abstraction of game-based learning

The highest abstraction of the framework is displayed in Figure 8. We identified ten key relations from directed content analysis presented in Figure 7 (see Figure 8 for the direction of relations). The structure of GBL is depicted by the hierarchical layout presented in Figure 2. The high-level abstraction of the LEAGUÊ framework describes the internal operation of GBL and classifies the six dimensions into generic and domain-specific. Learning, Game Factors, and Affective-Cognitive Reactions are the core domain-specific dimensions that represent the GBL phenomenon and process. Environment, Usability, and Users are the generic dimensions that influence the core dimensions and are essential for any software application to be effective for its users. An educational game is a game for education purposes that imparts learning by involving learners in the learning process. Game Factors generate Affective-Cognitive Reactions that absorb users in playing the game and positively influence the Learning. The main trick for an effective GBL approach is to keep generic dimensions in line while tweaking the Learning and Game Factors dimensions to integrate, create a balance and work in accordance with each other for enhancing the Affective Cognitive Reactions in order to meet the purpose of the educational game. We have introduced a term T-relation (see Figure 8) for the...
association between Learning, Game Factors, and Affective-Cognitive Reactions as the core process of GBL, where the integration of game and learning enhance affective reactions (Kiili, K., 2005). The generic dimensions not only influence the GBL phenomenon (domain-specific dimensions) but are also linked with each other. Usability should address the intended users and also cater to the technical and context related specifications of the environment. The technical specification and context (environment) should also map to the learner profile and capabilities (user). The overall process of GBL is a complex phenomenon and requires a multidisciplinary approach.

<table>
<thead>
<tr>
<th>Dimensions</th>
<th>Relation</th>
<th>References</th>
</tr>
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<tbody>
<tr>
<td>Learning &amp; Game Factors</td>
<td>Integration/</td>
<td>(De Freitas and Oliveira 2006; Aloven, Myers et al. 2010; Zhang, Fan et al. 2010; Wallner and Kriegstein 2013; El-Sattar and Hussein 2016; Pappa and Pannese 2010)</td>
</tr>
<tr>
<td>ACR &amp; Learning</td>
<td>Positive effect</td>
<td>(Kiili, Lainema et al. 2014; Thomas, Schott et al. 2004; Oprins, Visschedijk et al. 2015)</td>
</tr>
<tr>
<td>Game Factors &amp; ACR</td>
<td>Generate</td>
<td>(Rooney 2012; Abdul Jabbar and Felicia 2015; Ronimus, Kujala et al. 2014)</td>
</tr>
<tr>
<td>Integration of Game Factors and Learning &amp; ACR</td>
<td>Increase</td>
<td>(Kiili 2005; Zhang, Fan et al. 2010; Rooney 2012)</td>
</tr>
<tr>
<td>Usability &amp; Learning, Game Factors, ACR</td>
<td>Influence</td>
<td>(Gibson and Bell 2013; Shi and Shih 2015)</td>
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<tr>
<td>User &amp; Learning, Game factors, ACR</td>
<td>Influence</td>
<td>(De Freitas and Oliveira 2006; Abdul Jabbar and Felicia 2015; Mei, Ku et al. 2015; Yu, Hsiao et al. 2005; Mitgutsch and Alvarado 2012; Shi and Shih 2015)</td>
</tr>
<tr>
<td>Environment &amp; Learning, Game factors, ACR</td>
<td>Influence</td>
<td>(De Freitas and Oliveira 2006; Oprins, Visschedijk et al. 2015; Dondi and Moretti 2007; Vivrou and Katsiogianni 2008)</td>
</tr>
<tr>
<td>Usability &amp; Environment</td>
<td>Address/Cater</td>
<td>(Vivrou and Katsiogianni 2008)</td>
</tr>
<tr>
<td>Usability &amp; User</td>
<td>Address/Cater</td>
<td>(Vivrou and Katsiogianni 2008; Mei, Ku et al. 2015)</td>
</tr>
<tr>
<td>User &amp; Environment</td>
<td>Map</td>
<td>(De Freitas and Oliveira 2006)</td>
</tr>
</tbody>
</table>

Figure 7: Relations in LEAGUE

Figure 8: High-level abstraction of LEAGUE

There is another viewpoint to the LEAGUE framework, which divides it into two views: technology-centric, and human-centric. The technology-centric view includes three dimensions (Game Factors, Usability, and Environment) related to technological aspects of game-based learning and the human-centric view also includes three dimensions (Learning, Affective-Cognitive Reaction, and User) related to human aspects (cognitive, behavioral, identity) of GBL. The idea here is to model the technology-centric dimensions in such a way that they facilitate human-centric dimensions.

5. Application of the LEAGUE framework

The framework organizes the GBL dimensions regarded in the literature as significant in producing an effective learning game. For each dimension, a set of configurable factors, sub-factors, and the basic vocabulary is provided to facilitate the application and use of framework components in multiple ways.
The framework can be applied in the process of design, analysis, and evaluation of game-based learning. The dimensions in GBL (depending on the evaluation objective) might be considered in isolation (picking and selecting components) for a specific evaluation study. However, GBL dimensions are linked to each other in terms of cause and effect and can be viewed as a collective whole to understand the process and help in design and analysis. The LEAGÜ framework is put in practice by utilizing the framework components (dimensions, factors/sub-factors, metrics and relations) to develop three items: LEAGÜ analysis instrument, LEAGÜ ideation and design toolkit, and LEAGÜ evaluation guide for analysis, design and evaluation of learning games respectively. Using each of the three items is divided into a set of stages or activities to scaffold the process. This paper will primarily focus on applying the LEAGÜ framework for the analysis of learning games using the developed analysis instrument.

5.1 Analysis of learning games using LEAGÜ analysis instrument

This section presents how the LEAGÜ framework is applied for the analysis of learning games using the LEAGÜ analysis instrument. The instrument is aligned with the framework in terms of the elements required to specify a learning game. An example study is also presented which demonstrated its use. It can be useful to understand the potential of educational games in a specified environment by knowing the strengths and areas in which it could improve. The learning game is analyzed based on whether it contains the elements deemed important for game-based learning by splitting the subject matter into its basic and fundamental components (dimensions specified in the LEAGÜ framework, see figure 3).

The analysis instrument consists of three parts: a primary analysis form, a secondary form to reinforce in-depth analysis, and a reflection form. The primary analysis form (see Figure 9) breaks the complex GBL paradigm into smaller parts based on framework components (factors in the LEAGÜ framework, see figure 4) to gain a better understanding of how learning takes place in the learning game. Each question in the form regarding all six dimensions is answered for the game being analyzed. The factors laid out in the primary form may help analyze the learning game in terms of individual elements essential for an effective game-based learning approach and highlight any areas that are weak or neglected in the game. At the end of the form there are two rows to list the overall strength and weakness of the game with respect to each dimension by critically analyzing the given answers.

The secondary form (see Figure 10) supports an in-depth analysis of each element of primary form by splitting it further into simpler questions (based on sub-factors in LEAGÜ framework, see figure 2) to deeply analyze its constituents and facilitate the thinking process to construct the answer for each question in the primary form. The secondary form can be used on its own or can also be used only as a guide to give concrete answers in primary form. Building on this analysis, the relationship between individual components will be considered using the reflection part. The reflection questions (see Table 1) determine the effectiveness of the learning game as a collective whole by analyzing the relations between individual components (see figure 7 and 8 for relations in LEAGÜ framework). This is giving the opportunity to reflect on the design choices made in the game and if they are effective or need improvement. For example, if the game is appropriate for target users in terms of usability, learning content, strategy or game elements used; if the game can be used to support different context and informal or formal learning considerations; and if the game has a balance and harmony in learning and game factors used etc. Similarly, for reflection form each of the seven reflection questions are answered for the game being analyzed and revisions or improvements needed in the game are listed in the last row based on the reflections made. Therefore, the steps of the framework application for analyzing a learning game using LEAGÜ analysis instrument consists of the following steps in the specified order: 1) description of the different aspects of the game by answering the questions in the primary form (Figure 9), using secondary form (Figure 10) for in-depth analysis and detailed description (if needed), 2) identification of strengths and weaknesses of the game by analyzing the answers, 3) reflection on the relationships between core elements of the game (using Table 1) and 4) critically analyzing the reflections made to highlight the refinements or improvements needed in the game to make it effective.
The instrument can be used to support an analysis process undertaken by any stakeholder (designers/developers, researchers, and intermediates like teachers/parents etc.) to ensure that they take into account the key issues and essential factors associated with game-based learning to support practice. The analysis of learning games using the three forms provides the analytical as well as holistic picture of whether the learning game is an effective GBL approach and not just the tool itself. This analysis will include all aspects worth considering, from the right content and strategy to appropriate game elements and software for target users in order to apply the game within the specified context. To illustrate the application of the framework for the analysis of learning games, the instrument is used to analyze an empathy game as an example.

5.1.1 Case: Empathy game

The illustrated game is an online empathy game for primary school children (8-14 years old), which can be played in school or at home with friends. The game is about making stories for different characters using personality traits to develop a strategy for achieving a goal. One of the players plays the role of the selected character, and the other two players help the character to complete the tasks assigned according to personality traits and goals, which creates the challenge factor. The game uses this activity to teach empathy and enable players to develop the ability to understand and share the feelings of others. The game is suitable for interactive and collaborative learning.
Figure 10: Secondary in-depth analysis form
Completing the analysis instrument highlights the particular challenges, strengths, and weaknesses in terms of essential GBL components needed to embed desired learning through the game into effective practice. The beta version of this game was analyzed using the LEAGUE analysis instrument, and the results are presented in Figure 11 for the primary form and Figure 12 for the reflection part. The secondary form was used as a guide to think more in-depth and give a concrete answer for questions in the primary form. The last part of the primary form (the strength and weakness of the analyzed game) and the reflection form (the revisions/improvements needed in the analyzed game) are not shown in the figures but instead described below.

**Strength of the analyzed game:** In this particular game, a notable strength is a collaborative learning approach that might be used to support the cyclical transition from storytelling towards developing empathy through discussion and reflection on actions. However, learning is not tied to any curriculum content, developing a strategy to achieve a goal using personality traits, and the outcome facilitates reflection and additionally may support creative thinking and imagination. This approach has the potential to additionally teach cooperation, listening, and improve storytelling after time as it uses social interaction between players, as well as this help to engage learners who prefer self-directed and interactive ways of learning. Another strength is the use of characters to tell the story. The game does not require significant technical support and can be easily played with a device with an internet connection. The game also uses bright colors and simple and consistent screens with straightforward controls and navigation.

**Weakness of the analyzed game:** On the other hand, game aesthetics lack the effective use of multimedia. The game does not provide any help or support for playing the game first time and also lacks the use of rewards or other resources to generate additional purpose to engage in storytelling or facilitate reflection through the use of props. One of the least successful aspects is that the game does not provide any instructional support to facilitate children to feel emotions or differentiate between them to generate empathy unless they self-reflect on their story. The players are not given the control to move back in the game even if they accidentally press a button or miss a task, which is a significant drawback along with no feedback is given for in-game activity. Game is mainly text-based, not much visualization in the game. The tasks are not very clear and challenging to understand at least the first time (reading through text) and could be supported with multimedia usage, e.g., audio, animation, or videos. Also, the game does not provide tasks with an increasing difficulty level.

**Reflections made:** The reflection tool supports a deeper reflection on the interrelation between different essential elements to apprehend whether the learning game is effective for the purpose. In this case, depending on device availability, learners may want to play the game in school as well as home context supporting formal as well as informal learning processes, reinforcing the learning outcomes. However, the game requires three players to start the game but does not support connecting with players online, so this might be a problem in a context where more children are not present. The player should know how to read as the game is mostly text-based, and also have the vocabulary to create a story as storytelling in the main activity in the game, which makes it more suitable for talkative children who can put their thoughts into words. The challenge for helping a character to achieve the goal give players confidence to verbalize their thoughts into a story without being self-consciousness as they are playing for another character and not themselves. The game uses characters and traits that resemble different types of children in the target age group, and thus provides a safe space for children to talk about situations that may be hard to discuss outside of a game environment. The complete analysis of the reflection part is presented in Figure 12.
Revisions/improvements needed in the analyzed game: From the analysis, the game designer can identify the need for a better fit between the use of game elements to facilitate the learning outcomes and to emphasize on creating greater challenges for the children and more importantly support increased reflection upon empathy learning through instructional support and feedback and thereby offer improved opportunities to work in a team.
6. Discussion and conclusion

This study expands on GBL design and evaluation literature to overcome the shortcomings in current research on problem areas highlighted in the introduction by conducting a directed content analysis. The results of the analysis are translated into a conceptual framework, LEAGUE, which shows the multidimensionality of GBL requires evaluation of several aspects referred to as core dimensions (RQ1), including Learning, Game Factors, Affective-Cognitive Reactions, Usability, and User and Environment. Each dimension focuses on certain factors and sub-factors that constitute it. The framework presents 22 factors (RQ2), 74 sub-factors (RQ3), and five metrics categories (RQ4). The dimensions of GBL are related to each other, and it is essential to assess the relations presented as a high abstraction of LEAGUE for more significant insights into educational games (RQ5).
framework provides a detailed picture of GBL that will guide not only researchers and evaluators but also designers and developers of educational games. The proposed framework is built on components grounded in theory. Each component has a strong basis for formation that is supported by theoretical constructs in GBL literature and not merely based on suspicion.

Most of the existing GBL frameworks focus on some specific elements, which make them difficult to use in practice when the target genre differs from default game genres used in research (Shi and Shih 2015) or when the objective is design and analysis of complete GBL experience and not just focusing on few individual aspects of it. Thus, the existing models and frameworks could supplement one another, but individually these are relatively narrow and focus on a portion of the complete picture of GBL design and evaluation (such as Learning Mechanics-Game Mechanics (LM-GM) model can help identify the learning and game mechanics to draw the LM-GM map for a game but neglect the other elements that equally account of an effective learning game). The specificities of LEAGUE in relation to other frameworks can be highlighted by the comprehensiveness of the framework (detailing the individual parts in order to allow analysis in terms of presence/absence as well as overall picture and interconnection between the core dimensions) that can be equally useful for analytical and holistic evaluation providing a theoretical model essential for unifying all the different aspects of GBL and thereby solving the two critical issues related to GBL design and evaluation highlighted by Dondi and Moretti (2007) (see introduction). Furthermore, dimensions presented in LEAGUE are higher-level concepts and not restricted by the game genre.

The LEAGUE framework is put into practice by developing three tools (an analysis instrument; an ideation and design toolkit; and an evaluation guide) based on the framework components (dimensions, factors/sub-factors, metrics and relations) to support GBL practitioners and researchers. Therefore, the LEAGUE framework can be applied for analysis, design and evaluation of learning games using the three developed items; LEAGUE analysis instrument, LEAGUE ideation and design toolkit, and LEAGUE evaluation guide respectively. This paper described how the framework could be applied for the analysis of learning games using the analysis instrument, exemplified with a case study of an empathy game. The LEAGUE analysis instrument can be used by the stakeholders of educational games, including designers, researchers, and intermediates like teachers/parents, to ascertain its effectiveness. Educational game designers/developers can use it to analyze the educational game (both early stage game prototypes or later alpha/beta versions of the game) to identify the loop-holes and make improvements in the design. It is often recommended to carry out analysis early because it is easy to make changes and improvements at an early stage of development as they get more expensive later, and it is useful to carry out analysis before actual evaluation. Educational game researchers are interested in gaining insights regarding the game’s effectiveness and suitability in different domains with respect to its designated purpose and application context. Therefore, they can use this instrument to learn more about the different elements used in the games and the relationships between them and gain experience from both successful and failed game concepts in order to improve in designing effective learning games and critically question the effects and consequences games may have on target users, especially in the case of vulnerable groups. Teachers/parents need to be convinced of the positive effect of game-based learning because otherwise, they will choose not to use them. Therefore, they can use the analysis instrument for analyzing the learning game to assess the potential and develop trust and conviction for justification to use the game as an efficient tool or not.

The proposed framework is also employed in workshop sessions for ideation and design of learning games for various learning domains using the LEAGUE ideation and design toolkit, and to conduct evaluation studies using the LEAGUE evaluation guide. The complete process of using the framework for design and evaluation of learning games along with the results will be presented in another paper, and framework components will be further validated and developed. Future research will focus on automating or partially automating GBL evaluation using the proposed framework and game data logs. The future work will also focus on developing a web-based ideation and evaluation tool that will facilitate the educational game design and evaluation process during different phases of the development lifecycle and help professional and game companies working with game-based learning.

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When is Open and Online Learning Relevant for Curriculum Change in Higher Education? Digital and Network Society Perspective

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Abstract: Digital and network society learning happens in new, timeless and borderless spaces. Such society members are always connected and online, sharing and co-creating knowledge, and their learning needs serve as the biggest driving forces for higher education curriculum change. Open online learning methodology seems to be the best-suited way to implement this change, in order to meet the needs of digital and network society. This research aims to investigate why and when open online learning is relevant for digital and network society and how open online learning supports curriculum change in higher education to meet the learning needs of digital and network society members. Theoretical research findings are discussed to: a) define the characteristics of digital and networked society, b) identify emerging ways of learning of a digital and networked society, and explain why open online learning is best suited for their needs, c) discuss the gap between the new ways of learning and higher education curricula and how open online learning is relevant for its change. Empirical research is based on global semi-structured interviews. The results of the research demonstrate that open online learning should serve as a solution for curriculum change in higher education to respond to digital and network society learning needs. Higher education curricula should change to ensure better flexibility, recognition of non-formal learning in formal curricula, better collaboration and exchange of people with diverse cultural and social experiences. Assessment and recognition of prior learning in the formal curricula of universities could be one of realistic scenarios for faster adaptation and introduction of more diversified learning paths. The research findings support the need to change the pedagogical approach from teacher-centred into a learner-centred, small-group orientated, multi-dimensional model of teaching, which raise further challenges and research dilemmas for academic community, in order to integrate important elements of change into university practices.

Keywords: digital and network society (DNS), open online learning (OOL), higher education (HE) curriculum.

1. Introduction

European Digital Economy and Society Index (DESI, 2018) data show that in 2017, 79 % of Europeans went online regularly (at least once per week). 70 % of Europeans read news online and 65 % use social networks. The largest increase relates to the use of the internet for voice and video calls, where the share of the internet users went from 39 % in 2016 to 46 % in 2017. Students leave higher education (HE) and join diverse society groups and lifelong learners select open online learning (OOL) possibilities, including massive open online learning courses (MOOCs). The UNESCO and Commonwealth of Learning study (Patru, Balaji, 2016) reveals the potential of MOOCs to reach sustainable development goals, but Butcher and Rose – Adams (2015) argue that they are too narrow to meet learners’ needs. However, universities do not change enough to meet the needs of digital and network society (DNS); to better uptake the use of digital technologies to offer OOL opportunities; to apply innovations in teaching and learning; and to allow better flexibility and accessibility to HE for better fulfilment of learner needs. Thus, learners search for more flexible OOL possibilities, for digital and accessible curricula, as well as for flexible forms of recognition of learning achievements (Guardia, Maina, and Sangra, 2013; Orsini-Jones, 2015).

A field of particular significance is the field of OOL, though still in early adoption. Research in OOL reveals that new innovative learning design, flexibility in time and space, and open teaching and learning models enable various society groups, of different age and with diverse possibilities, to access formal HE. However, OOL does not become a considerable part of HE available for DNS and their emerging learning needs.

We define OOL as a set of specific characteristics that are typical of open distance learning (Tait, 2000; Thorpe, 2002; Simson, 2013; Cole, Shelley, and Swartz, 2014): open and flexible learning online, ensuring accessibility to open / distance learning courses; collaboration carried out by learners in online learning activities as integral
to both learner support and course content; developing new open knowledge and open learning practices as a result, exploiting and exploring learning groups themselves as resources for study and personal development; as well as sharing learning outcomes among learners, with the teachers and with society at large.

This research aims to investigate why OOL is relevant for DNS and how OOL supports curriculum change in HE to meet the learning needs of DNS. Research is based on literature review and empirical study. Theoretical research findings are discussed in order to:

- define the characteristics of DNS,
- identify emerging ways of learning of DNS and discuss why OOL is best suited for their needs,
- discuss the gap between the new ways of learning and HE curricula and how OOL is relevant for its change.

Empirical research is based on data collection using semi-structured interviews with thirteen experts through a wide geographical scope to support the conceptual theoretical reference of timeless and spaceless DNS. Semi-structured interview questions elaborate on:

- the characteristics of DNS,
- emerging ways of learning of DNS nowadays,
- discussion on how universities meet the emerging needs of DNS learning ways, and
- how OOL supports transformation of HE curricula.

Qualitative data were classified using the thematic analysis model.

When it comes to curriculum development, due to its advantage of using technology for delivery over distance and time, OOL has both the potential and the need to advance to the forefront of the educational sector and can supply a solution for HE curricula to meet the emerging learning needs of DNS. This is what we want to argue in this paper.

2. Digital and network society

The literature review is streamlined into the following directions: a) characteristics of DNS, the changing societal context and the factors affecting the need to change curricula, b) new ways of learning in relation to OOL, c) the way HE curricula should transform, to respond better to the needs of DNS.

The term network society was coined by van Dijk (1991) and Castells (1996). Van Dijk (1991) defines the network society as a society in which a combination of social and media networks shape its prime mode of organization and most important structures at all levels (individual, organizational and societal). He compares this type of society to a mass society that is shaped by groups, organizations and communities organized in physical co-presence. Castells (2014) emphasizes that digital innovations are a fundamental factor for social changes and considers changes of organizational structures and policies to be the most important issues of DNS. We adhere to Castells’ term “digital and network society” (DNS), as it highlights the important nature of digital technology and its penetration throughout society. Network and technology are the central structural characteristics of our society, playing an important role in comprising the capacity of the society to transform itself.

Besides the societal concept development, Castells’ term of DNS today is an important projection of the development of new learning spaces and places. DNS is characterised by its new culture of “real virtuality” and “self-expanding network” existing in new media of transcending time and place, called “timeless time” and “space of flows” (Dijk, 1999). Globally- and physically - situated society members spend “timeless time” in the new culture of “real virtuality”, capturing entirely unique learning situations, communicating unique experiences, and merging learning spaces and places into the “space of flows”; online space through multiple media.

Castells (2014), framework has been taken up by different scientists: it serves as a background to analyse the impacts of spatial transformation in the network society (Rytkönen, 2015), designing spaces for networked learning (Jones, 2015; Nordquist and Laing, 2015), and relationships between professional work and
information communication technology in the DNS (Baker, Warburton, Hodgkin, and Pascal, 2014; Juchnevič, 2016).

The characteristics of DNS, the new culture and new dimensions of time and space, shape new characteristics of learning process; learning forms and methods, places and spaces; as well as new features of ever – changing virtual learning environments. OOL potential offers tremendous possibilities for HE institutions to improve and move learning design to open learning spaces, to new cultures of learning and the new “space of flows”. First, we need to discuss how far research in OOL defines new emerging ways of learning that best suit DNS members.

3. Emerging learning ways

Researchers suggest that digital technologies will radically transform what people learn, how they learn, and where they learn (McLoughlin and Lee, 2010; Redecker, 2011), yet there exists some disagreement on the speed and scope of this change. Hutchison, Tin, and Cao (2008) indicate that the existing dominant systems of education were built by and for baby-boomers in the industrial world; whereas the current generation of users operates in DNS with mobile devices in hand, and are creative, result-oriented, self-focused, achievement-oriented and comfortable in an image-rich interactive environment. These target groups enter educational systems with different expectations, which, together with societal contexts, need to be reflected in curriculum development.

One characteristic of emerging learning ways among DNS members is that formal, non-formal and informal education are gradually merging and clear boundaries between these sectors are blurring (Cameron and Harrison, 2012). Learners can explore more than what they get from a traditional classroom. People have started to take part in online learning networks based on their personal or professional interests. Digitalization has opened entirely new possibilities for education and learning. The rise of OOL, realised through such forms as open educational resources, MOOCs, collaborative activities and others, show a great potential of providing university level education free from traditional conditions, such as cost and academic background (Chuang and Ho, 2016; Graham et al., 2018; Katy, 2014) offering other attractive forms of OOL and bringing new challenges. Knowledge and information are widely accessible online, creating opportunities for learning in different ways.

Online learning provides the possibility of accessing information in extended and fragmented formats to develop in-depth perspective, as well as a wide and complex approach to the phenomenon (Knerr, 2013). Therefore, digital competence is fundamental for participation in education, social, cultural and political life (Mavrou, 2017) and hence, learning in DNS and digitally enhanced educational experiences play a vital role for social integration, educational success, employment opportunities, and overall quality of life (Krumsvik, 2009; Stone, O’Shea, May, Delahunty, and Partington, 2016).

Many characteristics of new learning ways preferred by DNS match very well the characteristics of OOL. Research in OOL argues that OOL improves collaboration, successfully innovates pedagogies for effective social interaction online, and leads to improved student achievements (Laurillard, 2009). OOL supports active learning, participation and co-creation of knowledge and sharing of experiences. Good practices are described in terms of involving DNS members to create and distribute quality content of a variety of formats through various media channels, to implement peer evaluation and peer learning, collaboration and integration of shared knowledge bases of subjects involved (Arruabarrena, Sanchez, Blanco, Vadillo and Usandizaga, 2019).

One of the most emphasized characteristics of the way DNS learns is how people are connected online and participate in the network, how they constantly share, as well as interact with their peers. Interaction is the one of the key characteristics of OOL, tightly linked with the purpose it us used for. Hernandez-Lara, Perera-Lluna and Serradell-Lopez (2019) claim that communication, interaction and collaboration methods used in OOL improve learning results. Extensive research publications describe how OOL may open HE and change and improve curricula through integrating social networks and promoting collaborative learning (Fernandez-Ferrer, Cano, 2016). OOL by nature integrates technology enhanced learning solutions through digital learning environments, digital media and resources, where DNS members find their new “virtual reality” and the new culture of learning.
4. How should learning and teaching change?

In order to adapt and reflect on the opportunities and risks which digital technology poses to educational and learning processes, HE institutions have to take the development challenges on board. While many steps have been taken already to evaluate new possibilities for learning and teaching, curriculum development is still one step behind. Today it is clear that digitalization is not a technological revolution in HE if it is not an innovation in learning design and organization of educational experiences.

The curriculum is expected to respond to the developments and changed contexts of a DNS. These are the features and the elements of the new pedagogical approach that would respond to the needs of DNS and are supported by OOL methodologies:

- Different learners’ characteristics, experiences, cultures, and learning abilities (Hood and Littlejohn, 2016). DNS is an example of the diversity of learners who represent lifelong learners networking in virtual space, connecting from their physical places, local economies, cultures and communities, sharing their individual and personal, as well as community experiences online within a dedicated network for formal and non-formal learning.
- Tate and Klein-Collins (2012) refer to increasing numbers of “non-traditional” learners or adults, sharing some of the traits such as having dependents, being a single parent, working full-time, being independent from parents or attending school part-time. One of the features of OOL is accessibility to those social groups who were prevented from participation due to constraints of time and socio-economic conditions. OOL has long been praised for providing access to all disadvantaged groups.
- The teacher-centred approach changes into a “personalized, small-group orientated, multi-dimensional model of teaching” (Sun, 2011). Active learning methods used in OOL, interactive learning through the use of digital learning resources, peer learning and peer reviewing, collaborative online activities and co-creation of knowledge illustrate both, the new attractive learning methods, and learner-centred learning design.
- OOL has the potential to attract more students with wide-ranging interests, ensuring more appealing learning opportunities (Meier, 2015). The new forms of OOL, including MOOCs, demonstrated how attractive flexible and self-directed learning. Student lifelong learning model should not be restricted to the traditional students, but ways should be opened for all DNS members to merge formal and non-formal OOL opportunities and receive recognition of their learning results.
- Hoadley (2012) suggests that for a better understanding of undergoing changes, teachers should find answers to the questions: what learning is; how learning should be designed; how knowledge can be organized; how learning is enabled in practice and how it can be assessed. These changes lead to advantages, such as smaller classroom size, better student–teacher interaction, ability to reuse open courses, lower costs and flexibility (Byrd and Mixon, 2012).
- Kovanović et al. (2018) approach curriculum transformation at its extreme, through the learners’ transition from knowledge-consumer to knowledge-provider. As already discussed, involvement of students in knowledge co-creation and sharing proves to have a very positive impact on student motivation and learning results improvement.
- The development of assessment and recognition procedures which are stressed by political decisions (Bologna Open Recognition Declaration, 2016) and research (Muñoz, Redecker, Vuorikari, and Punie, 2013; Witthaus et al., 2016). The importance of assessment and recognition at universities and the necessity of being on top of these developments is an increasingly important factor for competitiveness in a highly diverse and globalised education market.

Literature and good practice review argue that new learning industries formulate a multidimensional concept that allows transformation of educational practices and the nature of HE through new characteristics of OOL.

DNS wants to learn through global participation, community engagement, application of the flipped classroom, when students access content outside the class and spend class time discussing, analysing, and applying new information (St Clair, 2015). Therefore, it is important for HE institutions to appropriately consider how new practices and learning outcomes are contextualised. Discussions and clarification of options and models for recognition of OOL are still in progress (Muñoz et al., 2013).
The research shows that HE digitalisation is making fast progress. However, little evidence is available how well HE curricula today are aligned to meet the new challenges, and how that can be done. Therefore, an empirical qualitative study has been carried out to find how HE curriculum can respond to DNS needs, and what innovations are needed to empower learners through OOL HE curriculum.

5. Methodology of the empirical research

The research has been designed to address the extent of alignment of HE curricula towards the changing contexts of the emerging learning needs. For the purpose, a qualitative research strategy was chosen to study the complex phenomenon by helping to understand human experience and to reveal the subjective meaning and interpretation of instances of individual experiences without isolating them from the context (Creswell, 2014; Flick, 2009).

5.1 Data Collection and Analysis

Semi-structured interviews were used for data collection. Five open-ended questions were defined to clarify:

- characteristics of DNS;
- emerging ways of learning;
- changing university role to meet learning needs of DNS;
- the description of the transformation of the OOL curriculum; and, finally,
- the impact of transformation of the OOL curriculum upon the organization of the learning process.

The qualitative data were analysed by using the six-phased thematic analysis model documented by Braun and Clarke (2006) (see Figure 1).

Figure 1: The phases of thematic analysis (based on Braun and Clarke, 2006).

Thematic analysis is seen as one of the most flexible methods for qualitative data analysis as its model is not linear and does not require to be applied step-by-step. Rather, it is recursive, when the researcher can move from one phase to another without completing a prior phase (Clarke and Braun, 2013; Nowell, Norris, White, and Moules, 2017).

5.2 Research participants

Purposive sampling was applied for the selection of research participants, based on their relevance to the research question and ability to share expert knowledge on the need for the change of OOL in HE, considering emerging learning needs of DNS.

The following criteria were applied for the selection of research participants:

- experts involved in the activities of one of the biggest European or global professional associations in the area of OOL;
- experience of at least 10 years of working in the field of OOL, either implementing OOL in HE or working with OOL solutions for HE;
- experts representing different countries worldwide and working with DNS members (either creating OOL solutions or being involved in innovating non-formal and formal HE).

The data were collected by face-to-face and online interviews. All interviews were recorded, the majority of them in the English language, some in Lithuanian and then translated into English. There were no issues arising from the language versions nor interview mode (online or face-to-face). There were 13 interviews conducted with experts aged 28 to 60, working on a policy level, in international associations, HE and private companies, representing 8 countries. All experts were either creating OOL solutions for HE institutions or were involved in one or another way in non-formal and formal HE innovations that help to meet the learning needs of DNS. The experts were invited for the interview during the international events and volunteered for the interviews. The size of the whole sample of experts meeting the selection criteria is not known, but during the international conferences and seminars the selection criteria were announced to session participants and the ones who volunteered were invited for the interview. The characteristics of interviewees are presented in Table 1:

<table>
<thead>
<tr>
<th>Participant code</th>
<th>Gender</th>
<th>Experience of working in OOL (years)</th>
<th>Work position</th>
<th>Type of institution</th>
<th>Country</th>
</tr>
</thead>
<tbody>
<tr>
<td>I1</td>
<td>F</td>
<td>11</td>
<td>Researcher</td>
<td>University</td>
<td>Lithuania</td>
</tr>
<tr>
<td>I2</td>
<td>M</td>
<td>10</td>
<td>Researcher</td>
<td>University</td>
<td>Italy</td>
</tr>
<tr>
<td>I3</td>
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<tr>
<td>I4</td>
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</tr>
<tr>
<td>I5</td>
<td>M</td>
<td>12</td>
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<td>University</td>
<td>Hungary</td>
</tr>
<tr>
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<td>F</td>
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<td>Researcher</td>
<td>International foundation</td>
<td>Spain</td>
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<tr>
<td>I7</td>
<td>M</td>
<td>11</td>
<td>Researcher, practitioner, administrative staff</td>
<td>University</td>
<td>Germany</td>
</tr>
<tr>
<td>I8</td>
<td>M</td>
<td>18</td>
<td>Researcher, practitioner, administrative staff</td>
<td>University</td>
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</tr>
<tr>
<td>I9</td>
<td>M</td>
<td>12</td>
<td>Policy maker, researcher</td>
<td>Private company</td>
<td>Malta</td>
</tr>
<tr>
<td>I10</td>
<td>F</td>
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<td>I11</td>
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<tr>
<td>I12</td>
<td>F</td>
<td>11</td>
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<td>Private company</td>
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<tr>
<td>I13</td>
<td>M</td>
<td>10</td>
<td>Researcher, company owner</td>
<td>Private company</td>
<td>USA</td>
</tr>
</tbody>
</table>

The thirteen experts represent a wide geographical scope, in order to purposefully support the conceptual theoretical reference of timeless and spaceless DNS on the global reach.

5.3 Research ethics

This study is guided by the principle of interviewees’ volunteering consent to participate in the research (Flick, 2009). The analysis of the data has also been guided by the principle of impartiality, in order to see the data as they are, and aiming to disclose the transformation of open and online learning curricula in higher education without any preconditions.

5.4 Research limitations

There are some limitations that should be considered regarding this research. Firstly, the qualitative research strategy reflects subjective experiences of research participants, thus the research results cannot be generalized. Moreover, interviewees who were chosen based on purposive sampling may not reveal all the potential approaches towards the research question. Therefore, the thematic map may represent only a part of themes and sub-themes which are important for the research question. Finally, the fact that most of the interviewees and researchers themselves were non-native English speakers is also seen as an important limitation of the study.
6. Research results and analysis

The process of thematic analysis allowed the distinguishing of key elements that were evident in the data. Based on this, themes were defined as seen to be essential and summarizing research participants’ approaches. These themes have been named as “Constantly connected and learning online”, “Universities as knowledge-based hubs” and “Empowering learners through opening online higher education curriculum” (see Fig. 2).

![Thematic map on changing curriculum in HE.](image)

The research data demonstrate that all the elements of curriculum change in HE are interrelated.

6.1 Constantly connected and learning online

DNS refers to persons who are able to use technologies in their daily life and who are connected by technological means: smartphones, tablets or computers; people who browse the internet every day and read and/or comment on the news by using their phones or other technologies. To belong to DNS one needs to communicate or at least relate oneself to a certain digital community by being a member of a social network, by subscribing or reading and participating in online discussions on certain news pages or blogs, or by joining closed online group discussions, or at least following them.

DNS is quite a new phenomenon developed through the enhancement of reality by technological tools. We have their own lives and their own impact upon the society:

... it is smarter, it is more about being network connected (I13).

Our concern today is to find proper and good quality information. DNS members may and should be able to decide on the sources and the channels where information and the news come from, and they usually decide what version of the news or information they prefer:

... because we have too much information, and we have to be able to choose from this information” (I12).

The speedy dissemination of knowledge and information is one of the characteristics of DNS. There are no national or regional boarders in the network society, people connect with each other globally, and global network members can get access to the same knowledge immediately. Time differences are no longer important. Information flow and channels allow us to reflect on issues we would not have thought of before:
... it’s about interconnection of people, the exchange of knowledge, it’s not limited anymore to physical locations like an institution, it’s open. Because of that you don’t have any boundaries anymore, so the digital and network society has no boundaries anymore, that’s a major element of it. (I7)

DNS means no or less physical interaction, with virtual interaction dominant. Lots of connections, interactivity, innovative ways of sharing knowledge and skills in a group:

I think it’s all about sharing ideas, the really fundamental need of humans to interact and to share what they have achieved and to learn something new from others (I4).

New technological devices such as mobile phones, tablet computers, and social networks are becoming central for learning. Boundaries between formal, non-formal and informal learning are gradually weakening, everyone can choose and use a learning way that suits them. Moreover, learning happens everywhere in the open online environment:

Every time we connect to the online community, we learn. We sometimes don’t feel that we learn, but every new experience, every piece of knowledge that gives us input for new ideas and reflections, and changing any behaviour or thinking is a way of learning; and nowadays it is very easy to learn by participating in an online community, as people tend to share interesting, valuable pieces of information that influence our thinking and knowledge. (I10)

This data proves that OOL environments are suitable solutions for new ways of learning. HE curricula should be changed to integrate seamlessly informal and non-formal learning into formal OOL HE.

Since we are constantly online, whenever a disagreement during a dispute occurs, despite our physical whereabouts, it is very common for us to pick up a mobile device and to check information immediately. At the time we share, search for, or validate information, we naturally include our experience and communication into our learning.

These statements reconfirm the need for innovating pedagogies in formal education, allowing students to co-create knowledge and to share quality learning resources, as well as to receive immediate validation of information and interactivity.

Searching and sharing knowledge and information in smaller portions, making decisions and solutions much quicker, spending less time for the analysis of what is written or spoken become emerging ways of learning. We live in a faster society and world, and we, as individuals, have to minimize the acquisition of information, which is fragmented. In order to absorb all new things or new elements we need to take smaller portions of everything:

I see shorter and shorter modules and lessons in this digital world, which was not the case 10 years ago, the trainer society was quite reluctant to minimize the knowledge, so that is a kind of transformation, easy access, quick access for small chunks, small bits of learning. (I5)

Digital forms and new media formats have raised challenges for information scalability and presentation online. OOL reflects these challenges, thus sometimes it is “accused” of wide vs deep learning through reading, listening or watching. However, this topic needs much further analysis and is interrelated with cognitive characteristics of human beings, as well as with new pedagogy of online learning. We would rather not be corrupted by the new media forms by transferring their principles into chosen pedagogical approach but had better search for didactical solutions maintaining the principles of a pedagogical scenario and learning objectives, not generalising with the characteristics of the new media and information publishing formats:

This is only a different way of approaching knowledge. We are living in a society that allows you to go deep in one dimension or to stay on the top and have a wide perspective of all the feelings of the subjects and so on. I strongly believe that at the moment the knowledge of the learner stays maybe too much on the wide perspective and does not go into the deep perspective. (I2)

There is a tendency among DNS members to focus on limited topics and brief news. However, this may show characteristics of a more complex phenomenon: DNS members may prefer scrolling through wide horizontal
levels of information, instead of going into narrow, but deep, vertical levels, and they can demonstrate the
ability to see multidisciplinary connections that others have never seen before:

Today even myself, I’m not going so deep, I have lots of information and it's important that I
understand it and then just collect the pieces and build my knowledge upon them. So, I don’t go very
deep into each subject, but I’m just building based on more information than before. I think today the
youngsters are also doing it this way. (I3)

Online learners are diverse in their nature, needs, and preferences. There is a tendency to characterise them
as self-directed learners, as they manage to diagnose their own learning needs, to identify appropriate
resources for learning, and to choose appropriate learning strategies. However, others need some structured
help. Self-directed learners are highly motivated, and they themselves usually select and validate all the
information available. This fact has direct and huge impact towards the entire education system, and it
changes the level of knowledge exchange dramatically, because:

... now young people, living in the village, not having access and the possibility of going to university,
will now have the chance to gain knowledge and to build on the knowledge and be successful in life, so
that’s a very important element. (I7)

The trends and characteristics of OOL include self-directed and personally motivated learners, responsible for
their learning. This proves that education providers should revise their approach to curriculum development
and delivery, as future learning will all be online and open.

6.2 Universities as knowledge-based hubs

In DNS, the role of universities changes, as they need to fit into a new context in the education field, to
respond to technological innovations, to find out how to balance between tradition and openness. Universities
are still an effective place that brings together the creation of knowledge and teaching, creating a link between
research and teaching. “And so that means universities as knowledge transfer hubs, universities as team
leaders and professional networks, universities as research hubs” (I9).

On the one hand, universities strive to prepare people for a highly technologically advanced society, a
technologically advanced workplace; therefore, they are important actors in DNS, as well as promoters of
lifelong learning. On the other hand, universities are in great competition with other types of knowledge
providers; besides, some individuals still choose a university because of the diploma and certificates rather
than gaining knowledge. Moreover, a popular belief is that one can get the necessary knowledge from the
internet, from private providers, from open online courses:

... if this person has gained knowledge through the internet, through online courses, through MOOCs
provided by private institutions, companies don’t care anymore if they have no official certificates from
the university” (I7).

Indeed, companies have less focus on certificates, but stronger focus on skills. If universities do not respond to
the change, the market and society members will change faster than the former. More and more people will
start exploring alternative routes, which are much more diverse than the HE landscape. More flexible learning
possibilities are much more attractive to learners:

Definitely the idea of open learning is something that is revolutionary, more or less like the first radio
transmission because it changes completely and instantly the idea of learning. The idea of openness is
something that you can reuse .... we need to reprogram the university like they did it from the Bologna
process, it’s exactly the same. (I2)

OOL pedagogical approach is related with a change in a teachers’ role. Learning is more likely to happen when
a learner is engaged and active. The learning process needs to be organized in a way which makes it learner-
centred:

... it’s a question of the quality of the teaching that is actually being offered, how it is actually being
offered and what the students can actually make the most of. And also, in terms of how you package
that information, are we talking about the degree or mass qualifications... or is it some kind of lifelong learning. (I8)

Assessment and recognition of prior learning used in formal education must adapt to the emergence of much more diversified learning paths. The problem of the open learning is the recognition of learning results in the formal curricula, which you cannot do without paying the tribute to formal bureaucracy:

What I strongly believe is that now we are learners in everything that we are doing online, but at the same time we don’t have recognition of what we are learning during this time spent online, on Facebook, on YouTube, and so on. (I2)

The new systems of digital credentialisation and certification are in the process of development, but they need valid solutions in place. Other challenges addressed by OOL include recognition of learning by companies and the private sector:

We need something more like the Bologna process once again, to have something that could be recognized everywhere at organizational level and also the virtual mobility so structurally related, because as soon as you have a common framework, you will have the possibility of obtaining your knowledge and your formal recognition everywhere, independently of where you are and where you want to study. (I2)

6.3 Empowering learners through opening online higher education curriculum

Flexibility and openness is crucial for the OOL HE curriculum, as learning with no geographical or time boarders is an increasingly preferred form of learning, particularly for students who are employed, study part time, live in remote places or have fewer possibilities for accessing information and materials while traveling.

Obviously, we need to emphasise pedagogical and technological support for students. The pedagogical support may be provided by the teacher, while the necessity for technological support depends a lot on the students’ digital competence and information provided. There is a need to present students with suggestions on how to learn online. The possibility of asking for help should always be open. When changing curriculum to OOL, universities will become 24-hour institutions, offering 24-hour digital studies around different parts of the globe:

... and that’s how we get into this whole lifelong learning experience and that’s why I think it is so important, the way we can package up learning into smaller, more agile components that can actually be purchased by our students. (I8)

The needs of lifelong learners will be met by universities who will arrange their curriculum in smaller units and shorter programs, developing learning programs together with industry and DNS members. We need to think about how to structure the curriculum and the interactive learning process. Short exercises, short videos, immediate feedback on quizzes and tests, technology that supports learning - all these elements lead to re-thinking about how universities should organize teaching and learning process, and how the curriculum is structured in terms of competences and learning outcomes. If individuals are taking a course, a constant feedback during their studies should be provided, so they can make judgement of how well they are doing or how much there is to be done, and whether they are satisfied with their own progress:

What is obvious that learners... don’t want to sit for an hour and watch a lecture, then what you can do is take a curriculum and slice it into the learning achievements, learning outcomes, whatever you want to call them, and make it focused; it might be a lecture or more of an animation, but short... Then you have to really think about your teaching, then you have to think about how you organize your teaching, and how your curriculum is organized. (I13)

The structure of the curriculum can be very different: based on linear learning, what we usually do in our universities, or individualized learning, self-paced, or an entire study program modularly built by a student, and if an institution would be offering these as modules then the learners could have their own personal curriculum:
... so we have to begin to rethink the typical course environment and how we differentiate between courses and how they are structured; often very linear, or doing Google searches, completely unstructured and non-linear, ... I think it leads to new ways to think about individualized learning, self-paced learning, and it can be really interesting. (I7)

To sum it up, the thematic map on changing OOL curriculum in HE (see Fig. 2) highlights the features of DNS, the role of universities, which act as research and knowledge-based hubs, and changes in learning responding to the needs of DNS.

7. In conclusion

The results of the empirical part of this research reveal that technological innovations are used in the teaching process at universities, and the role of universities is in progress towards the change of their curricula to meet emerging ways of learning DNS, but there is much work ahead and a lot needs to be done to take important elements of change into practices. There exist examples of more flexible non-formal learning solutions for DNS, in particular with MOOC offers (Chuang and Ho, 2016), where millions of students are already studying online. More and more people start exploring alternative routes and have a much more diverse HE landscape to enjoy.

The challenge that universities face is based on the learning needs of DNS, such as constant online connection, a broad spectrum of interactivity, overwhelming amounts of information and innovative ways of sharing knowledge in groups with no time or geographical boundaries. Network and technology have become the central structural characteristics (Castells, 2014) of DNS, while digital innovations are a fundamental factor for social changes. Change of HE curriculum implies changes to organizational structures and policies of universities.

Individuals apply digital tools for learning in “timeless time” controlled by “space of flows” (Castells, 1996). They are equipped with internet connection and tend to learn in new places and with new tools. The pressure is on significantly faster acquisition of knowledge, which should be introduced in smaller portions to meet the challenge of living in a much faster society and the world. Members of DNS are more focused on wide rather than deep information acquisition and learning. These findings support the results of previous researches stating that with the appearance of different digital devices there appear new sources of information. The new approach offers new perspectives and opportunities for knowledge creation, sharing and innovations.

The research findings support the need to change the pedagogical approach from teacher-centred into a learner-centred, small-group orientated, multi-dimensional model of teaching where the structure can be very different, either based on linear learning or, on the contrary, completely unstructured, individualized, self-paced, modular, or even personal curriculum based on learning outcomes or competences.

The change of HE curriculum into OOL is related to the changes of a teacher’s role. The need for interactivity takes the central role in HE didactical change, to make it easier for individuals to share knowledge, experiences and perceptions of their interaction with the instructor, content, and other learners (Stone et al., 2016).

The empirical evidence of the research proves the need for universities to respond to existing challenges and to introduce technological and pedagogical innovations, design flexible and dynamic modes of learning, and to design a flexible curriculum divided into smaller units of credits, preferably in cooperation with industry and DNS members.

The research data confirm the need for OOL recognition. Assessment and recognition of prior learning in the formal curricula of universities should demonstrate an adaptation of much more diversified learning paths.

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Business Model of Learning Platforms in Sharing Economy

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Abstract: Current economy is driven by innovation and knowledge. Sharing economy is a new perspective on economics that impulses a new economy based on trust. In this article, the key components of global education business, based on the analysis of different types of business cases such as edX, Coursera, Udacity, Udemy, and Codecademy are established. For this research we carried out a systematic literature review based on different cases to highlight some of the main advantages of the models of global education services based on sharing economy, as a result, we found out that the main components of the learning platform business model in sharing economy are related to the online cash concept, shared resources, shared knowledge access, networking collaboration, analysis based on big data, joint consumption, rather than ownership while the government loses monopolies of knowledge. Our claim is that global education will be supported by a collaborative consumption model based on the online cash concept, shared resources, and shared knowledge access.

Keywords: MOOC platforms, business model innovation, share economy, open education, Business Model Canvas.

1. Introduction

The Cambridge English Dictionary defines ‘sharing economy’ as an economic system based on people sharing possessions and services, either for free or for payment, usually organized and mediated through the internet. Sharing economy is a perspective that drives a new economy based on trust, as part of a culture of sharing, rather than ownership (Aigrain, 2012; Ert, Fleischer and Magen, 2016). The concepts of ‘sharing’ and ‘economy’ have become increasingly co-joined to describe emergent means of enjoying, acquiring or exchanging goods, services, knowledge, and experiences together with others, often mediated with digital technologies. Indeed, some consultants and practitioners suggest this new model of Information and Communications Technology (ICT) mediated sharing represents a ‘third great economic revolution’ (Munger, 2016).

In addition, the technological innovations and connectivity expansion have led to a multi-directional development of new companies and business activities that have often over-flown into more traditional sectors and, therefore, those sectors have been redefined. Given the previous scenario, it is relevant to know how the change in global education is taking place, not only within the market, but within the global society (Brugnoni, Polzonetti and Sagratella, 2016).

Because of that, many believe that the sharing economy is an appealing alternative for consumers due to its economic benefits (i.e. low cost, new income opportunities), which have been considered important after the global economic trends (Hansen-Henten and Maria-Windekilde, 2016; Breidbach and Brodie, 2017; Wallenstein and Shelat, 2017b). The sharing economy has been presented as a new opportunity for doing business and for nurture new consumption attitudes (Wallenstein and Shelat, 2017a).

Therefore, participation in sharing economy is motivated by many factors such as sustainability, enjoyment of the activity as well as economic gains, also an attitude-behavior gap might exist; people perceive the activity positively and say good things about it, but this good attitude does not necessary translate into action (Hamari, Sjöklint and Ukkonen, 2016).
For this reason, the sharing economy can be defined as a socio-economic ecosystem that commonly uses information technologies to connect different stakeholders—individuals, companies, governments, and other, in order to make value by sharing their excess capacities for products and services (Hamari, Sjöklint and Ukkonen, 2016).

Additionally, sharing economy is gaining interest both in the management practice and academic sector alike. The main idea behind this phenomenon is that sharing products is more efficient than owning them individually (Eckhardt and Bardi, 2015). The most frequent reasons for joining sharing economy are ‘for learning’ and ‘to share knowledge and skills’; practitioners improve their own knowledge through teaching and overcome the sacrifices to share with others (Sützl, 2012). By the end of 2018, learning platforms crossed 101 million learners, over 900 universities around the world(235,976),(465,997) announced or launched 11,400 courses (Shah, 2019).

As we mentioned before, sharing economy seems to be recognized for increase assets utilization rather than ownership (Stephany, 2015); sharing economy implies a new culture of sharing goods and services (Davies et al., 2017). In case of learning platforms one important topic is defining the business model to participate in sharing economy market and which innovation strategies are used to generate competitive advantages.

In economic terms, the report from Global Market Insights, Inc. indicate that by 2025 the global online education market size is set to be over USD $300 billion (Bhutani and Bhardwaj, 2019). This projection is based on market growth in the coming years, due to increased demand for training and cost-effective learning techniques in the business and academic sectors.

In this context, a business model is a system of components (customer value, scope, pricing, revenue sources, connected activities, implementation, capabilities and sustainability) and relationships between these components (Afuah and Tucci, 2003). Furthermore, Methlie and Pedersen (2007) have defined a business model that consists of three dimensions:

1. Service Strategy which includes service value proposition, and market focus;
2. Governance Form which refers to the ways in which flows of information, resources and goods are controlled by the parties of the value-creating business network;
3. Revenue Model which includes revenue valuation and sharing.

The assertion is that a business model innovation involves not only an increase in customer benefit over the existing alternatives, but that organizational processes are designed or reengineered in order to deliver this benefit (Robertson, 2017). Then, a considerable proposition of business model innovation today is tied to the role of the Internet and connected technologies (Iansiti and Lakhani, 2014; Porter and Heppelmann, 2014) but this doesn’t necessarily represent the basis of business model innovation.

Likewise, education, training, and lifelong learning are critical to global society in order to advance as knowledge-based economies. Education systems worldwide are undergoing major upheavals and transformations; therefore, today more than ever, a new paradigm for this sector is necessary (Development Bank, 2014). Technological innovations also offer the solutions to drastically reduce the costs of educational resources, thanks to the implementation of new usage methods and new organizational models for the learning platforms (Brugnoni, Polzonetti and Sagratella, 2016).

Additionally, if knowledge is the key driver of modern economy, it is important to analyze how global education can be supported by a collaborative consumption model based on an online learning concept, shared resources and shared knowledge access (Cooke, 2001).

On the other hand, a business model that captures the key aspects of the company’s business should address four questions: what value propositions are being offered? who are the customers? how do operations have to work? and why is the business model financially interesting? (Blaschke et al., 2017).

Consequently, this research analyses the innovation business models in learning platforms operating within a sharing economy, to identify the key components of global education business. In order to do this, we assumed that learning platforms in sharing economy involve educational technologies, content and service provider, and academic, corporate and government end-use that cooperate, collaborate and interact to
create, deliver and receive value. Thus, in this context, we have established two research question research questions (RQ):

RQ1: What are the main components of the business model of learning platforms in the sharing economy?
RQ2: What are the components of the business model that make learning platforms different?

To achieve this, we studied different models that involve the global education market as part of the sharing economy model, conducting afterwards a systematic literature reviews to determine the components and their relationships and differences that can help us to solve our research questions.

2. Research methods and sample selection

One of our goals was to address the analysis of innovation in business models related to sharing economy and to identify the key components of global education business. We used Okoli’s methodology to guide the process of the literature review (Okoli, 2015).

Our first step was to design a research protocol, adapted to match our expected research outcomes. Secondly, we searched scientific databases Ebsco, Scopus - ScienceDirect and Google Scholar using the keywords ‘business model’ AND ‘sharing economy’ during the 2013-2018 period. During this stage, we collected a group of 48,627 scientific publications; 42 of Ebsco, 41,105 of Scopus - ScienceDirect and 7,480 of Google Scholar.

Then, we filtered the results with the keywords “learning” OR “education” OR ‘online course’ to select our collection of main studies related to our research questions. Our final group had 92 scientific publications; 14 in Science Direct and 78 for Google Scholar.

As a result of the literature review, the main research areas were identified that were related to learning platforms for higher education as an opportunity for participate in global education services (van Dijck and Poell, 2015; Kopnina, 2017; Escribano, 2018):

- Comparison of platforms learning in service and result terms to identification good practices and innovative strategies (Siedel, 2016; Robertson, 2019).
- Proposal conceptual frameworks for the construction of new courses as guide to new projects (Kjaer, 2014; Nguyen, 2017).
- Deploy technological innovations in platform infrastructure and end-use level to build competitive advantages (Worth, 2017; Zhang, 2017; Duy et al., 2018). Studies to determine the satisfaction of practitioners, teachers/instructors and learners (Worth, 2015).

For the analysis of the business models implemented by the learning platforms, articles with topics directly related to the research questions were included. We used the method of analysis of thematic content to grouped into categories to obtain information of business models in share economy (Stephany, 2015; Blaschke et al., 2017; Robertson, 2017; Sieber and Seager, 2017), main components in business model (Long, 2017; Voigt, Buliga and Michl, 2017) and learning platforms in share economy (Burd, Smith and Reisman, 2015; Daniel, Vázquez Cano and Gisbert, 2015; Epelboin, 2017).

After selecting the collection of studies, we decided to use the Osterwalder’s (2004) Business Model Canvas (BMC) to compare and define the study cases business models. BMC merging key elements in a single strategic field makes it possible to study in details enterprise’s work and to analyze the flows of income, expenditure and profit influenced by the most important external factors which mediate internal environment changes (Dudin et al., 2015). And, BMC is an excellent unit of analysis for studying and advancing common managerial and entrepreneurial approaches in business (Schaltegger, Hansen and Lüdeke-Freund, 2016). It helps to make sense of “doing business” (Trimi and Berbegal-Mirabent, 2012; Blank, 2013; Massa L. and Tucci C., 2013). The BMC contains nine structured elements of knowledge that represent the content (“what”) of doing business (Keane, Cormican and Sheahan, 2018). The dimensionality of the BMC is a key issue for both entrepreneurship and management research on the business model (Amit and Zott, 2001; Magretta, 2002; Morris, Schindehutte and Allen, 2005; Tikkanen et al., 2005).

A multiple and descriptive case study has been used as the main research method; and to select the case study, we created a list of learning platforms based on literature review, adding some information of the global
Amazon Alexa Ranking (Jayasekara, 2017). The criteria were to exclude platforms of our group that were not available in English, ‘aggregators’-function as a search engine and redirect to another platform-, open hosting sites, exclusively for corporate training and online extension of a single University.

Finally, we considered the number of learners reported in the stats of Digital Marketing Ramblings (Smith, 2019) for the learning platforms and choose the main platforms for this study. A brief description of these five platforms including Udemy, Coursera, edX, Codecademy and Udacity, is shown in Table 1.

**Table 1: Description of learning platform cases.**

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
<th>Founded</th>
<th>Vocation</th>
<th>Learners</th>
</tr>
</thead>
<tbody>
<tr>
<td>Udemy</td>
<td>An open marketplace through which anyone can create and take courses. It offers a large variety of topics from technology skills to entertainment</td>
<td>February 2010 by Eren Bali, Oktay Caglar, Gagan Biyani</td>
<td>For profit</td>
<td>30 million</td>
</tr>
<tr>
<td>Coursera</td>
<td>A platform that offers university-style courses provided by universities or organizations world-wide</td>
<td>April 2012 by Daphne Koller, Adrew Ng</td>
<td>For profit</td>
<td>40 million</td>
</tr>
<tr>
<td>edX</td>
<td>A platform that offers university-style courses and provides traditional instruction education</td>
<td>May 2012 by Anant Agarwal, Chris Terman, Piotr Mitros</td>
<td>Non profit</td>
<td>18 million</td>
</tr>
<tr>
<td>Codecademy</td>
<td>An educational company that teaches coding in different programming languages</td>
<td>August 2011 by Zach Sims, Ryan Babinski</td>
<td>Non profit</td>
<td>45 million</td>
</tr>
<tr>
<td>Udacity</td>
<td>A platform that mainly provides courses in the IT field to teach skills needed by employees</td>
<td>June 2011 by Sebastian Thrun, David Stavens, Mike Sokolsky</td>
<td>For profit</td>
<td>8 million</td>
</tr>
</tbody>
</table>

Source: Authors(2019) with data in (Long, 2017), (Voigt, Buliga and Michl, 2017) and (Smith, 2019).

Google Trends has been used as an analytical tool to visualize audience interests in learning platforms. Researchers studied the traffic trend of five cases included in the search for the last five years (Figure 1), the x axis corresponds to the analysis period while the y axis corresponds to audience traffic, where a value of 100 indicates the maximum value while 0 the lowest. From 2013 to 2018, Coursera had the highest audience traffic although it had a downward trend by the end of the period, while edX, Codecademy and Udacity were in a similar range. For the 2017-2018 period, Udemy increased its audience traffic becoming the most popular, while Coursera remained in the same range as edX, the case of Udacity presents an upward trend and Codecademy has the least level.

![Figure 1: Audience traffic trend of the five sample websites.](https://trends.google.com)
So, in order to determine the market segment to which each platform is related, the type of courses offered was considered. Some platforms target a horizontal market by offering courses across a wide variety of topics, while others focus on a vertical market by offering courses in a specific field. Whereas some platforms are more academic-oriented, other ones are supported by industry, therefore they are not restricted to academic (Long, 2017).

To compare learning platforms’ target markets, Table 2 classifies them into four blocks with two dimensions: horizontal versus vertical market, academic versus non-academic oriented.

### Table 2: Market segment of learning platforms.

<table>
<thead>
<tr>
<th>Market type</th>
<th>Market orientation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Academic-oriented</td>
</tr>
<tr>
<td>Vertical market</td>
<td>Coursera, edX</td>
</tr>
<tr>
<td>Horizontal market</td>
<td>Udemy</td>
</tr>
</tbody>
</table>


As a result, Coursera, edX and Udemy target a horizontal market by offering courses across a large variety of topics, while Udacity and Codecademy focus on a vertical market by offering courses in a specific field. While Coursera and edX are academic-oriented; Udacity, Codecademy and Udemy are non-academic oriented and supported by industry.

Innovation business models in a sharing economy were analysed through the prism of Osterwalder’s BMC to describe and evaluate the nine dimensions of a business model: customer segments, value proposition, customer channels, customer relationships, revenue streams, key resources, key activities, key partners, and cost structure.

Finally, we worked in pairs to construct the five BMC considering the theoretical concepts of the analysis of content of the scientific literature. We visited the websites of the learning platforms to collect data of interest. In addition, we registered as users of some courses offered to explore the contents, designs and interaction with the user to determine the components of the business model. Authors collaboratively defined the final version of each BMC.

### 3. Business model of sample cases

The following section analyses the components of the business model of five learning platforms after building a business model canvas for each one.

#### 3.1 Customer segment

According to Osterwalder (2010), it is important for the company to define its focused market in order to study in depth the specific needs of the target sector.

### Table 3: Customer segments of learning platforms.

<table>
<thead>
<tr>
<th>Customer segments</th>
<th>Learning platform</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>edX</td>
</tr>
<tr>
<td>University students</td>
<td>X</td>
</tr>
<tr>
<td>High school students</td>
<td>X</td>
</tr>
<tr>
<td>Career changers</td>
<td>X</td>
</tr>
<tr>
<td>Updated employees</td>
<td>X</td>
</tr>
<tr>
<td>Partner universities</td>
<td>X</td>
</tr>
<tr>
<td>Companies</td>
<td>X</td>
</tr>
<tr>
<td>Government and organizations</td>
<td></td>
</tr>
<tr>
<td>Instructors</td>
<td></td>
</tr>
</tbody>
</table>

Source: Authors (2019).
Table 3 shows the different types of customer segments to verify differences or coincidences. All platforms are available to university and high school students to complement their official courses; to career changers offering the experience or skills to land a new job in their desired field; and to updated employees to catch up on their professional and personal skills. Only edX and Coursera work with partner universities to publish their online courses for their students and all other users of the platforms. On the other hand, edX, Coursera and Udacity serve companies with personalized programs to update specific skills of their employees. Coursera provides their courses to government and organizations to update their staff on specific topics.

### 3.2 Value proposition

The role of entrepreneurs is to build new value propositions within an organization, while the role of managerial services is to implement entrepreneurial ideas and proposals (Demil and Lecocq, 2010). Value proposition refers to the way in which organizations create value for their customers and for each party engaged in service provision (Gao and Zhang, 2016).

As a result of the literature review, we determined some usual value proposals, contrasting them afterwards to find the similarities and differences between learning platforms, as shown in Table 4.

All of them offer professional online education, normally well-structured, by using traditional instructional methods such as presentations, assignments, and tests with a convenient and rigorous learning style that allows users to adjust their education according to their needs. Additionally, some of them focus on value proposition offering additional benefits such as quality courses, easy to access tools, great scale and economy.

#### Table 4: Value proposition of learning platforms.

<table>
<thead>
<tr>
<th>Value proposition</th>
<th>edX</th>
<th>Coursera</th>
<th>Udacity</th>
<th>Udemy</th>
<th>Codecademy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Professional online education</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Online university</td>
<td></td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Quality, access, scale and economic</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Job ready skills</td>
<td></td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Education in IT field only</td>
<td></td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Upgrade for employment</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Global marketplace</td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Blended learning</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Source: Authors (2019).

Coursera and edX offer online university courses and blended learning to combine academic oriented e-learning with face-to-face classes for enrolled students. Udacity, Udemy and Codecademy offer job skills education for those who need to obtain new opportunities in their work field, while Udacity and Udemy provide opportunities to upgrade employment skills. Udacity and Codecademy only offer IT education. Udemy was the most outstanding due to a wider variety of distinctive characteristics, besides, it is the only one that incorporates a global marketplace where students can build and sell their own courses and generate profits for themselves.

### 3.3 Channels

The channel describes how a company communicates with its customer segments reaching them to deliver its value proposition. All the cases analysed use their own web platform as a communication channel with their client segment using it to deliver the value proposal, as well as to create a link with them to facilitate their contents and materials per every course offered. All platforms use mobile applications to provide to their users the ability to access them from their mobile devices. Regarding this field, there are not any distinctive features, all platforms provide their services through the same channels.

### 3.4 Customer relationships

This area describes the types of relationships established by a company with specific customer segments. Table 5 describes the types of relationships established by every learning platform researched.
Table 5: Customer relationships of learning platforms.

<table>
<thead>
<tr>
<th>Customer relationships</th>
<th>Learning platform</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>edX</td>
</tr>
<tr>
<td>Self service via online platform</td>
<td>X</td>
</tr>
<tr>
<td>Community approach</td>
<td>X</td>
</tr>
<tr>
<td>Face-to-face interaction</td>
<td>X</td>
</tr>
<tr>
<td>Affiliation models</td>
<td>X</td>
</tr>
<tr>
<td>Personalized support</td>
<td></td>
</tr>
<tr>
<td>Mentorship</td>
<td></td>
</tr>
</tbody>
</table>

Source: Authors (2019).

Self service via an online platform that helps them to deliver their services to all users and the configuration of user groups through community outreach were common elements in all cases, both options are focused on the acquisition and retention of users. Coursera, edX and Udacity offer face-to-face interaction between users as well as personal interaction to answer their questions, relieve their anxiety or share their experiences; subsequently, the affiliation models of edX and Coursera allows some rewards to be awarded to learners to turn a short-term relationship into a long-term one. Only Udacity includes personalized support and mentorship to provide personal help to customers in order to solve their problems.

3.5 Revenue streams

The revenue models of learning platforms are still under development and new models are emerging every day. According to Long (Long, 2017) revenue streams are related to sales of courses or other products; services to provide a platform for organizations so their employees are able to take their own training programs; advertising fees directly or indirectly related to trademarks, brands or products involved in courses or final projects; enrollment fee to take unlimited courses for a period of time; and special programs, for example holding events and contests, or sharing students’ data with potential employers. Researchers coded the revenue sources for the five cases and then classified the sources into eight major categories, as shown in Table 6.

Table 6: Revenue streams of learning platforms.

<table>
<thead>
<tr>
<th>Revenue streams</th>
<th>Learning platform</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>edX</td>
</tr>
<tr>
<td>Course Sponsorship</td>
<td>X</td>
</tr>
<tr>
<td>Donation</td>
<td>X</td>
</tr>
<tr>
<td>Employee Training</td>
<td></td>
</tr>
<tr>
<td>Platform usage/service fee</td>
<td>X</td>
</tr>
<tr>
<td>Recruiting Program</td>
<td></td>
</tr>
<tr>
<td>Specializations</td>
<td>X</td>
</tr>
<tr>
<td>Tuition Fees</td>
<td></td>
</tr>
<tr>
<td>Verified Certificate</td>
<td>X</td>
</tr>
<tr>
<td>Degrees</td>
<td>X</td>
</tr>
</tbody>
</table>

Source: Authors (2019).

As it can be seen, Coursera, Udacity, Udemy and Codecademy sell employee training to companies and organizations. Coursera, Udacity and Codecademy generate profits through the recruiting program sharing students’ data with those who are looking for candidates for vacant positions. Udemy, Coursera and Codecademy charge students a small fee to take certain courses. Coursera, edX and Udacity develop specializations combining relevant courses and the capstone project in a package to sell it to students.

Udemy, Udacity, Coursera, and edX offer degrees to certify the knowledge acquired, students pass and pay for a group of courses configured to support the degree. Coursera and edX use course sponsorship charging companies and organizations to mention their brand or products in classes or use their banners to advertise them in videos. Codecademy and edX receive donations from companies, organizations and foundations. Likewise, both platforms have a purchase fee to use, support and service the platform when companies and
organizations offer their own courses. Finally, for the cases of edX and Coursera, once students have finished a class that is normally free, they can decide if they want a certificate by paying a small fee.

3.6 Key activities

Key activities are the activities that learning platforms need to do in order to deliver their value proposition to customers. Researchers coded the key activities for the five cases and then classified the sources into seven major categories, Table 7.

Table 7: Key activities of learning platforms.

<table>
<thead>
<tr>
<th>Revenue streams</th>
<th>Learning platform</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>edX</td>
</tr>
<tr>
<td>Financial sustainability</td>
<td>X</td>
</tr>
<tr>
<td>Continuous improvement</td>
<td>X</td>
</tr>
<tr>
<td>Converting course</td>
<td>X</td>
</tr>
<tr>
<td>Partner acquisition</td>
<td>X</td>
</tr>
<tr>
<td>Increasing courses</td>
<td>X</td>
</tr>
<tr>
<td>Updating courses</td>
<td>X</td>
</tr>
<tr>
<td>Personal code review</td>
<td>X</td>
</tr>
</tbody>
</table>

Source: Authors (2019).

Financial sustainability to operate and obtain more users and the continuous improvement in all process were common key activities of all learning platforms. Increasing the number of courses is relevant to Coursera, Udemy and Codecademy, because it gives them the possibility to rise the number of customers and obtain better revenues. EdX considers important to convert classroom training into online training to increase university courses availability. Coursera and edX see partner acquisition as a key activity to build bridges with universities worldwide strengthening their offer of professional online education. In the case of Udacity, updating courses is important to keep their content relevant according to employment needs, on the other hand, the function of the personal code review is important as well in order to provide this service to customers helping them to answer doubts and solve problems.

3.7 Key resources

Key resources describe the most important assets required to build your business. There are irreplaceable elements for the value proposition of learning platforms. Throughout the analysis, researchers identified four key resources for all study cases: platform design, instructional design, expert knowledge, and brand recognition.

Platform design is important because it is the main communication channel to bring value proposal to the desired customer segment. In this sense, the platform is configured to offer mobility and connectivity to consumers, it must be available to all devices at every moment. Usability and user experience must be guaranteed by the front-end, while scalability and security are the responsibility of platform’s back-end.

Instructional design has a crucial role in the systematic development of instructional specifications using learning and instructional theory to ensure the quality of instructions and creating learning experiences that learners can enjoy.

Expert knowledge is very important to ensure that courses offered are high quality and are constantly being updated in accordance with the value propositions of the learning platforms. Finally, brand recognition refers to the fact that a platform’s name should be recognized, associating it to quality and professional education.

3.8 Key partners

Key partners are the relationships established with other businesses or non-consumer entities. They are critical, so the learning platform can implement its key activities. During the analysis, researchers identified two groups of key resources for all study cases: universities and instructors.
Harvard University and Massachusetts Institute of Technology have created a partnership with edX to generate courses and share their brands. On the other side, Coursera is linked to the universities of Stanford, Princeton, Michigan and Pennsylvania with the same purpose. Udacity receives support from Stanford University, and universities from different parts of the world are key partners for edX and Coursera in order to expand its education offer to many countries.

The team of instructors is a vital partner for Udacity, Udemy and Codecademy, because they are in charge of designing, supporting and updating the courses offered to the customers.

3.9 Cost structure

Cost structure describes all the costs and expenses incurred by learning platforms: it not only indicates the total amount that they must spend, but also the format in which they are spent. The authors only have access to general fixed costs for the case studies.

For all cases, the cost of maintaining the platform is the main fixed cost that must be paid, including lodging, operation and maintenance. Regarding creation, updating and maintenance of the courses’ content, there is a content creation cost. On the other hand, marketing promotion activities have an associated cost as well. Finally, the management of the platform has administrative costs that must be considered in the cost structure.

4. Discussion

As a result of the analysis of five global education businesses, we agree that the main principles of the business models of learning platform are shared resources, access to shared knowledge, networked collaboration, and joint work instead of ownership.

Learning platforms are still being developed and new business models are reconfigured every day. However, it is relevant for researchers and practitioners to analyze the main components of learning platforms’ business models, in order to have a frame of reference for the services offered to the market.

Dimensionality of the BMC model allowed us to determine the characteristics of each case studied based on the examination of nine components that define its business model. This way it was possible to compare the components of the business model between the different cases studied.

In all the analysed cases, we defined the main components of the business models: customer segment, value proposition, communication channels, customer relationships, revenue streams, key activities, key resources, key partners, and cost structure.

Business models of learning platforms have four similar components that not allow to offer significant differences: communication channels, key resource, key partners, and cost structure.

In the case of communication channels, all of them use their own web platform and mobile applications to provide their users access to the courses offered, as well as to create a link. Key resources for all study cases are platform design, instructional design, expert knowledge, and brand recognition. We identified two groups of key partners: universities and instructors; they are non-consumer entities and critical to implement learning platforms. Cost structure include platform maintenance; courses creation, updating and maintenance; marketing and advertising; and administrative activities.

In other hand, business models of learning platforms have five components that they use to build their competitive advantage: customer segment, value proposition, customer relationships, revenue streams, and key activities.

Learning platforms have their own customer segment that defines its target sector and focused market. We found similarities and differences in the way each platform creates value for their customers and for each party engaged in service provision. Every platform establishes different types of relationships with their specific customer segments. Revenue streams are still under development and new models are emerging, every case studied has different revenue sources regarding the market segment and types of courses offered.
Key activities that the learning platform needs to do in order to deliver its value proposition to customers are important to compete by being different and attract more learners. The main innovations for business models of learning platforms relate to value propositions, customer relationships, revenue streams, and key activities. For these business model components, the platform can design and deploy innovative strategies in terms of technology, service and content provider or focused end-user to build competitive advantages and differentiate from others.

In the university sphere, sharing economy offers the following key features: inclusion of non-academic sectors in learning platforms through a particular value proposition for a specific customer sector; professors share their knowledge and time in the open market and students easily access it.

The approach of learning platforms poses a challenge for college education that needs to change quickly. The cases studied allow us to consider an immediate alternative: to offer certain courses online which do not demand instruction and face-to-face discussion. And perhaps, this alternative represents lower costs for students and universities. Likewise, the use of learning platforms offers educational institutions the possibility to join forces to teach common courses. This will help them to optimize teaching resources, but they need to accept these credits.

5. Conclusions, limitations and future directions

This article explores the business models of learning platforms and determines the main components according to the BMC: customer segment, value proposition, communication channels, customer relationships, revenue streams, key activities, key resources, key partners, and cost structure.

As a result of the analysis, value proposition, customer relationships, revenue streams, and key activities can help to build a difference between learning platforms oriented to diverse customer segments, and they can focus on the selected market. In this case, the platform can decide what component will serve as basis of its competitive advantage.

Communication channels, key resources, key partners, and cost structure are very similar between platforms and do not allow to build a direct competitive advantage. One exception could be the quality and social recognition of key partners that can really make a difference between platforms.

The results of the research are limited to a sample of five cases, future research can expand sample size and explore the profitability model to combine the benefits of open education and higher education.

Two big trends dominated the learning platforms scene in 2018. First of all, paying customers (and revenues) are increasing. Secondly, more degrees are being offered through learning platforms. Both trends will allow us to explore new ways of revenue streams, instructional design innovation for new degrees, and technological innovations for communication channels and customer relationships; all of this focused on creating and defending competitive advantages.

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