

Students' and Instructor's Perspective on the use of Blackboard Platform for Delivering an Engineering Course

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Abstract: The use of Information Technology (IT) has been growing over the years in various human endeavours. It has also been adopted in education sector for teaching and learning. Various studies have been conducted to assess the effectiveness and acceptance of e-learning strategy by students. In particular, the current research is an attempt to obtain students' and instructor's perspective on the use of Blackboard software. The technology is a course management system used in a blended learning mode to deliver a third year mechanical engineering course at the University of Botswana (UB). In terms of students' views, the study covered a period of nine years and the questionnaire survey was administered to each succeeding cohort of students. Whereas in terms of the instructor's perspective the motivation and the challenges faced during the years of use of the platform were described. Results indicate that students were generally comfortable with the use of Blackboard as they highly embraced it. Students indicate that their performance improved and communication with instructor was enhanced significantly. The respondents also recommended that Blackboard should be used in other courses in their programme of study. The instructor considered the time factor the most vital challenge related to the use of the platform. However, despite the challenges the application of the learning platform and the development of its material was a positive experience for the instructor and well received by the students.

Keywords: Information Communication Technology, e-learning, Course Management Systems, Students Perspective, Instructor Perspective

1. Introduction

Information Technology (IT) has become part of human activity in social, economic and industrial enterprises, and education is no exception. Information technology significantly impacts learning among university students as they use it in their program courses. Information technology is widely used by engineering professionals, engineering educators and engineering researchers and they use it on a daily basis in their professional practice. As such, there is no technological barrier for engineering lecturers to employ technology for course delivery.

Today, education uses learning management systems (LMS) which are specially designed platforms to facilitate distance learning (Wael and Morsi, 2005). Such platforms are also used for delivery and tracking of blended learning, i.e. a combination of traditional (face-to-face) and on-line resources. E-learning however is not a simple application of IT in education but a case of expanding learning possibilities and a new frontier in education. In order for e-learning courses to promote value, creating processes both for learners and teachers requires enormous effort and commitment (Uziak and Oladiran, 2012). The complexity of learning, as a cognitive and knowledge oriented process, makes the establishment of effective e-learning platform using IT more difficult. Actually, e-learning challenges the way teaching is done. It requires much more effort for equivalent or improved learning outcomes in comparison to traditional learning; it requires joint efforts from lecturers and students.

2. Learning systems

Learning Management Systems (LMS) are an increasingly important part of academic systems in higher education. They are used in many forms of e-learning from courses introducing minimal element of Web facilitation to full online courses.

There are several course management systems, such as Blackboard, Blackboard Vista (formerly WebCT), Desire2Learn, Questionmark Perception, I-Assessor Moodle. All of them promote teaching and learning activities in a 'seamless environment' (Burrell-Ihlow, 2009; Ullman and Rabinowitz, 2004). They combine functions; distribute information to learners; enable communication with the students via discussions, announcements, email, real-time chat sessions, and an interactive whiteboard; enable on-line assessment (evaluation of the students by means of quizzes and assignments); promote student self-evaluation through self-tests and progress tracking; tracking of students' use of the learning materials; and facilitate course administration. These virtual environments enable learners to collaborate on projects and share information (Heo, 2009; Lansari, Tubaishat and Al-Rawi, 2010). They basically provide "all-in-one" software packages which enable several functions apart from providing students with course materials.

Course management systems are also used for delivery and tracking in blended learning, i.e. a combination of traditional (face-to-face) and on-line resources. The aim of those different modes of delivery is to complement each other and create the most efficient and effective learning environment. Bath and Bourke (2010) argue that blended learning achieves better student experiences and outcomes, and more efficient teaching and course management practices.

Despite the type and sophistication of learning platforms used, it is still the instructor who plays the most important role if the students are to learn effectively, retain the knowledge and practice the skills imbibed during the process. The platform must be accepted by students in order for them to feel comfortable in using it and not being threatened by the level of difficulty or complexity.

3. Blackboard

Blackboard is one of the premier on-line LMS. It is a flexible "all-in-one" system, which has been selected as appropriate for student learning for the following reasons (Bradford et al., 2006-2007; Watson and Watson, 2007).

- It is a good medium for communication and exchange of information.
- It provides good peer support and peer coaching – contributes to enhancing peer learning.
- It is used as a tool that facilitates student - centred and student – led learning.
- It promotes lifelong learning and active engagement concepts.
- It exposes students to modern technology and
- It provides additional resources to teaching and learning.

Blackboard has proven to be a successful LMS. Despite occasional statements about instructors' facing difficulties in the system due to low background knowledge in technology (Zaki and El Zawaidy, 2014) it is user friendly and easy to use (Lin, Persada and Nadlifatin, 2014). Blackboard is especially useful in terms of accessibility of unit materials (Heirdsfield et al., 2011). Students also value the connections made with other students although learners indicated that they needed more interactive and communicative functions and activities (Liaw, 2008).

Evident indicates that instructors mainly use Blackboard as a tool for enhancement purposes, rather than an advanced level that requires transformation of teaching and learning methods and tasks (Nkonki and Ntlabathi, 2016). It also supports the view that instructors could use learning management systems more creatively and consistently as part of their pedagogy (Heirdsfield et al., 2011).

Blackboard technology was introduced at the University of Botswana (UB) in 2002. The rationale was to expand access to academic programmes and to enrich the quality of instruction. Originally, WebCT and Blackboard were considered to be the right LMS in the UB context mainly due to its flexibility, and ease of installation and use. The features which were most relevant for selecting Blackboard included the following:

- an easy way to manage and to put course content on-line
- access control (password protection)
- tracking of student progress
- grade maintenance and distribution as a method to keep assessment on-line

4. Context

Data was collected over a period of nine academic years from 2007/08 to 2015/16 from the students registered for a course of Mechanics of Machines offered in Year 3, semester 2 of the BEng Mechanical Engineering programme at the University of Botswana. The course was delivered using a blended mode consisting of the traditional method of lectures, tutorials and labs (with the application of PowerPoint for lecture delivery) as well as Blackboard, which was used for all elements of teaching including provision of teaching material and communication with students. It was also used by the students to submit all (apart from tests) elements of the continuous assessment (assignments, projects, lab reports).

The Blackboard material for students was grouped in topics as per lecture delivered. The material for each lecture included lecture notes, PowerPoint Presentation (in pdf format), summary, examples with solutions, a list of problems (with answers but not solutions) and self-test (in the form of multiple choice questions). In the majority of topics extra material was provided such as video clips from software on performance or behaviour of engineering materials. Access to the lecture material was monitored on a weekly basis. The Blackboard material was constantly developed, updated and improved.

The results presented show students and instructor perspective towards use of LMS as a technology enhancing learning and teaching tool. Data was gathered for a period of 9 years and were concerned with students' general use of IT, application, comfort and time spent, and learning experience with LMS.

During all 9 years the course was taught by one instructor who started as a complete novice in the use of any LMS. The instructor received less than an hour of training and no assistance in the any element of preparing or placing material on the Blackboard. The instructor perspective demonstrates a personal experience in the application of the technology in terms of meeting general objectives of its application and challenges faced.

The original inspiration to start using the Blackboard was one of curiosity on the part of the instructor and the attempt was treated as an experiment. Although the 'rumors' heard on the academic grapevine about the convenience of the platform in administrating a course was also a motivation. There was also a hope that the interaction between the students and the instructor would become more open. At first, the general attitude of the students attending the course was not well received with the students hardly asking any questions or expressing their opinions or wishes. The instructor never considered it as a special problem related to his particular teaching approach or his personality. In general, the students at UB, or at least Faculty of Engineering and Technology, are not very active participants in the classes or even less vigorous in seeking help of the instructor outside of the class.

The original administration of the course involved document and resource delivery to the students. That mainly included the course syllabus, teaching plan and assessment plan. The resources covered the pdf versions of the lectures and tutorial sheets. There was never an intention to replace the face to face delivery mode but rather to augment it with extra resources. The blended method was largely unknown to the instructor at the beginning of the experiment. The course however developed with years gradually covering more features available in the platform (Table 1).

Table 1: Course Development

Year 1	Year 2	Year 3	Year 4	Year 5	Years 6-9
<ul style="list-style-type: none"> • Course Information • Course Material (Lectures & Tutorial Sheets) 	<ul style="list-style-type: none"> • Announcements • Online Calendar • Discussion Forum 	<ul style="list-style-type: none"> • Video Clips • Links to online resources • Mail Communication 	<ul style="list-style-type: none"> • Online Submission of Assessment Elements • Posting of Marks 	<ul style="list-style-type: none"> • Assessment Elements Created using the Platform (Assignments & Essay Questions) 	<ul style="list-style-type: none"> • Self-Assessment Elements (Tests, Quizzes, Question Pools) • Surveys

The first year was used to ask the students opinions on the application of LMS. The students' views were sought regularly through the years and the application of the system gradually went beyond simple administration of the course.

Discussion forums however, never became very popular between the students. They may have exchanged ideas and opinions between themselves using other media but they certainly preferred to use Blackboard mail to communicate with the instructor. That naturally led to the application of Blackboard in providing students with announcements regarding the course. Although, it constitutes the management part of the LMS application, it was not originally used mainly due to the concern of students' access to the system from outside the campus. It proved to be no problem and, together with the online calendar indicating salient dates for the course, the announcement gradually turned out to be one of the fundamental uses of the platform.

The elements of the Blackboard (Table 1), such as course administration (posting the teaching and assessment plans, announcements, and online calendar), course content material (with lectures, tutorial sheets and links to extra online sources including video clips enabling visualization of some difficult topics) and mail direct communication between the students and the instructor were fully operational and developed by the end of the third year of the implementation of the platform.

The development of the course was triggered by problems related to the students' submission of some elements of continuous assessment. Normally, students would submit their project reports, lab reports and assignments by putting hard copies into the instructor's mail box (pigeon hole). That was always a contentious issue due to possible meddling with such submissions as there was free access to instructor's mail box. Some students complained about other students removing and/or copying their submission, and there was always some discussion about keeping the deadline. The submission via Blackboard removed such problems. It also enabled individualized feedback in the form of the comments provided to the students with confidence.

Additional benefit of requesting students to submit their work in the electronic form was the idea that their submission should constitute one file combined of text, figures/photos, graphs, drawings etc. It was noticed that the hard copy submission was most of the time a mélange made by smart photocopying to enclose graphic elements into the text. The electronic submission forced the students to embed graphic elements into the word processed text. The free hand sketches or other hand drawn graphics (such as velocity and acceleration diagrams for instance) had to be scanned and included in the text file. Basically, the submission required student work to look like a professional engineering report.

Although students were encouraged to submit their work in the non-editable form (like a pdf format) some reports were always submitted as text file which allowed to look at the formatting. That was an eye opener in some cases indicating the inability of students to properly edit the text. The use of the spacebar (instead of tab or instead of center the text), end of the line key, end of the page and other fundamental editing functions, in addition to more complex feature like referencing or table of content etc., was in most of the cases unacceptable for engineering students. Although, marking did not include the editing part of the submission, comments were passed to the students.

The marking of electronically submitted elements of continuous assessment naturally extended to actually creating assessment elements in the platform with due dates, late submissions indicator and finally posting marks for the students. Although students appreciated the transparency in which the created assessment requested them to submit the assignments and the reminders associated with them, they expressed reservations with impersonal treatment of the submissions and especially maintaining due dates and, more significantly, cut off dates. The old form of submission via the mail box always created 'natural' flexibility with the deadlines. Technical issues, especially in the first few years of using the Blackboard platform, undeniably created obstacles in smooth use of the system. That was a concern of students especially with the deadlines for submission, however such hindrances were always resolved by the instructor extending the submission period if the system was not functioning properly during the deadline.

Publishing the marks for submitted assessments only unsurprisingly extended to announcing marks for other elements of assessment such as tests and quizzes. That proved to be very popular among students and less enjoyable for the instructor. That was due to a general and fundamental glitch or lack of technical adjustment as the general Academic Students Administration System (ASAS) (and even previously used ITS system) were

not linked to Blackboard. That is a serious problem adding enormous time demand on instructors who wanted to keep students' marks up to date on both systems, as that can only be done manually.

The final step in the developing of the course material was online quizzes which were introduced in the last 4 years. They were intended at students' self-assessment and were never used as actual elements of continuous assessment for the course. Those multiple choice assessment tools became very popular among students despite the fact that multiple choice questions were never used in tests or final exams.

5. Methodology

As mentioned before, the results presented in this paper are based on nine years' surveys carried out on the application of Blackboard technology in one course (Mechanics of Machines) offered in Year 3, semester 2 of BEng Mechanical Engineering programme at the University of Botswana. The questionnaire was administrated at the end of the course in academic years from 2007/08 to 2015/16. In total, 275 students (out of 281 students registered for the course, i.e. response rate of 98%) completed the questionnaire in the years under study. The number of students changed between the minimum of 15 to a maximum of 46 through the years with the average size of the class of 31 students (Table 2).

Table 2: Number of Students Registered for the Course

Year	Academic Year	Number of Students
1	2007/08	40
2	2008/09	39
3	2009/10	22
4	2010/11	15
5	2011/12	23
6	2012/13	23
7	2013/14	24
8	2014/15	43
9	2015/16	46
		Total: 275 & Average: 31

A structured questionnaire with 45 items was designed and administered at the end of each semester. The principal research question was to establish the engineering students' opinions about the use of Blackboard in the learning process. The questionnaire covered issues such as Blackboard as a learning tool, its efficiency and effectiveness, and Blackboard as a tool for interaction between the students themselves and also between students and the instructor. There were also preliminary questions regarding students' general use of IT and its application in learning. Additional questions covered students' preference in course delivery. The questions were converted into statements and the questionnaire was created using Likert items seeking students' evaluation. The whole questionnaire was thoroughly discussed within the research group and also with several colleagues who were asked to make a critical review.

As with any self-reported survey, it is not possible to verify if the students completed the questionnaire honestly and accurately. The honesty issue was not addressed directly but the questionnaire was anonymous hence the responses did not influence the final marks that students obtained in the course. The students were also briefed on the purpose of the survey and how it could improve the use of Blackboard. Pre-testing of the questionnaire was carried out to identify and remove any ambiguities in the statements and also to ensure that respondents understood the purpose of the study.

6. Results

6.1 General use of IT

The first point which the survey tried to clarify was the general use of IT and whether it is used for learning. In that respect the students were asked what type of IT they use in the learning process. As expected, internet dominated the scene, with 90% of the students using it for learning (Figure 1). There was also a very high percentage for e-mail, which, from discussions with the students, was used for communication with fellow students and with instructors. There was a relatively low use of intranet and this did not really increase through the years. That is despite the fact the learning platform and general students' administrative system was available via the University's intranet. The reasonable explanation is that the students did not understand the term intranet. There was not much difference in use of IT throughout the years. However, there was a

surprising dip in all applications during academic years 2013/14 and 2014/15, which cannot be due to technical issues related to availability of the technology for students in the Faculty. The other IT applications used by students included Facebook, Twitter, What’s up, etc.

A majority of students used internet for information search related to the learning either ‘Very Often’ or ‘Often’ (Figure 2). Although the results varied between years they remained constantly affirmative on the use of internet over time.

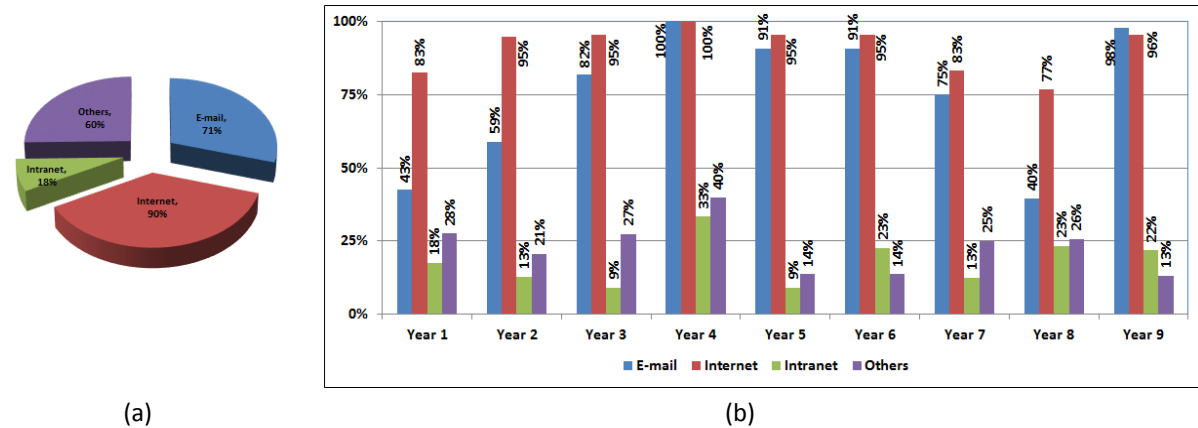


Figure 1: General use of information technology

Students were satisfied with their skills on using the internet; they professed to be skilled (69%), comfortable (74%) and efficient (68%) in searching for information on-line (Figure 3a). Figure 3b shows that the majority of students confirmed that on-line searching helped them to do assignments quickly and efficiently (57%) and that in general it improves their quality of work (59%). However, in both of the above aspects there were also a lot of neutral answers (36% and 32%, respectively).

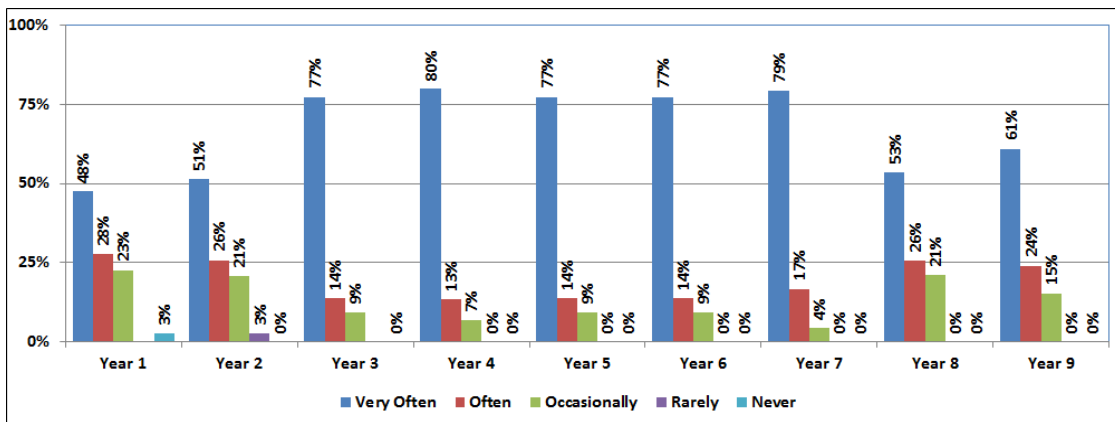


Figure 2: Respondents use of the Internet search for information

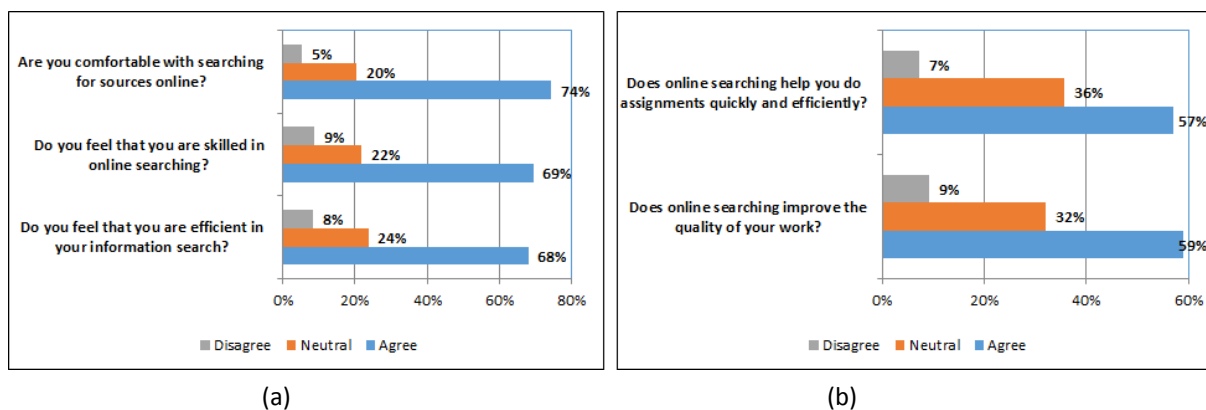


Figure 3: Application and comfort of using the Internet

6.2 Application of Blackboard

Almost immediately after the first few weeks using LMS it became apparent that the communication part of the software was extremely useful. It started to work as a real platform for interaction, mainly between the instructor and the students. Students became more active in asking questions, especially on the open boards where they did not need to post their names. However, even direct communication with the students enhanced. The students started asking particular questions regarding topics covered showing some interest going beyond the prescribed syllabus. That was mainly manifested in request to some internet links, video clips and other material related to the course. Those requests gave the direction for the development of the material to be posted on the Blackboard.

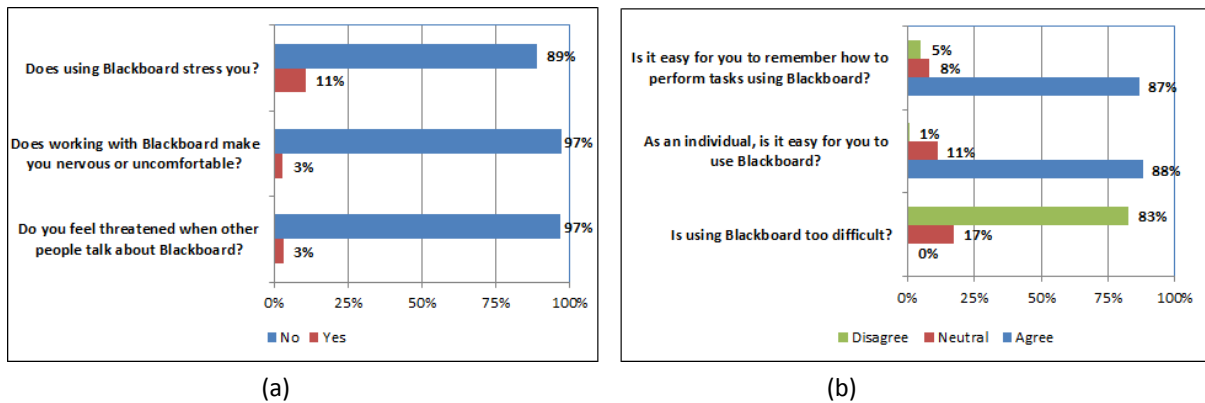


Figure 4: Blackboard application and comfort

As indicated in Figure 4a, students were generally comfortable with Blackboard as a learning tool; they did not feel any stress related to using it (89%), it did not make them nervous (97%) and they did not feel threatened when other people talked about that technology (97%). They were also pleased with the general ease of use of the platform (Figure 4b)

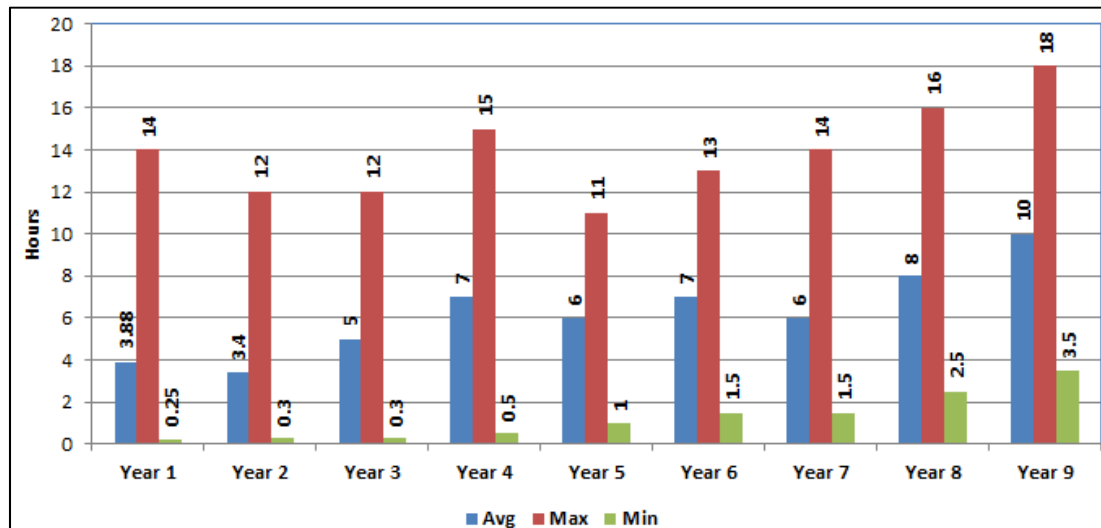


Figure 5: Time spent on using Blackboard

Time which students spent using the Blackboard increased steadily over the last 4 years of the research, reaching an average of 10 hrs/week, and maximum of 18 hrs/week (Figure 5).

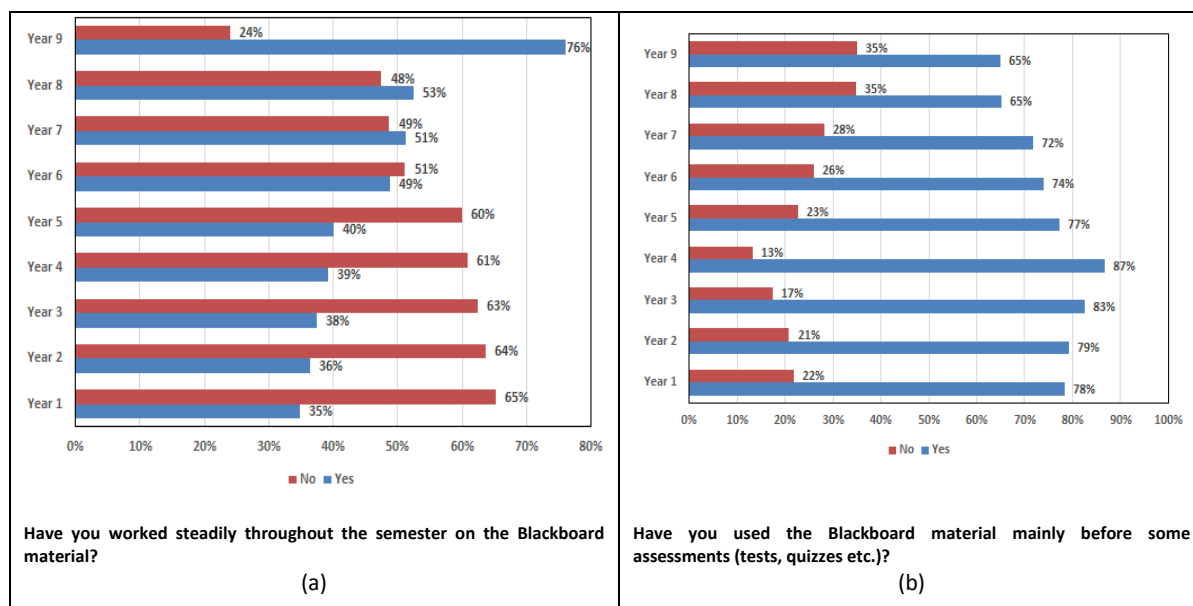


Figure 6: Use of Blackboard

Students admitted that they did not always work through the teaching material regularly throughout the semester but rather before assessment such as tests or quizzes (Figure 6). However, the percentage of students who worked systematically steadily increased from 35% to 76% through the years (Figure 6a). There were a large number of students, who used the material available on Blackboard mainly before assessments (Figure 6b). It is difficult to see any correlation between those changes and the course development (Table 1). The change in working systematically throughout the semester may be attributed to students’ prior experience.

6.3 Blackboard as a learning tool

The students thought that the use of Blackboard provides them with a positive learning experience (76%) giving them a sense of being in charge of their learning (87%) – Figure 7a. Answers also clearly indicated that Blackboard improved students’ quality of studies (81%) and was useful in the learning process (90%). The platform also gave students the ability to organize themselves better (84%), to make best use of their time (65%) and to accomplish assignments quicker and more efficiently (84%) – Figure 7b.

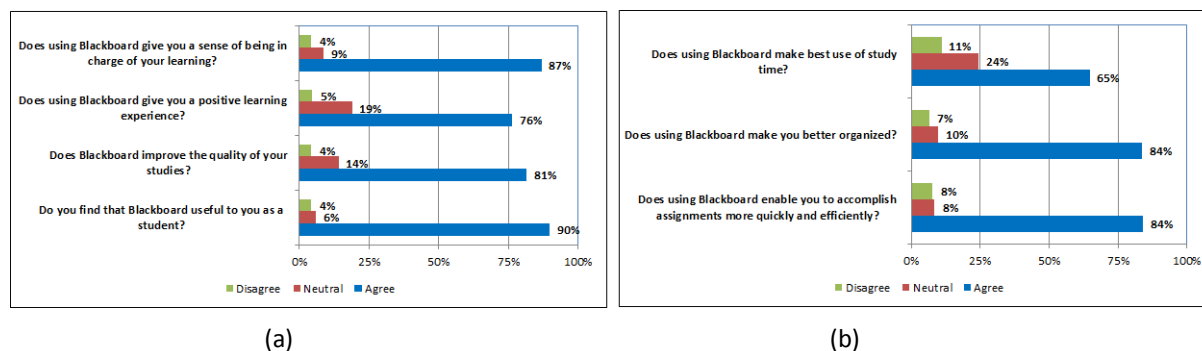


Figure 7: Learning experiences of using Blackboard

Figures 8 show students responses on the effectiveness of using Blackboard. For example, they positively rated it in managing class activities (81%). Blackboard helped to present the course content in an organized way (79%), whereas 87.5% of students appreciated its effectiveness in terms of transferring the information from the syllabus, timetable etc. The platform increased the communication between the students and the lecturer (79%) and; from discussions with students this was mainly due to students receiving individual notification and the possibility of always easily checking the relevant deadlines on the Blackboard.

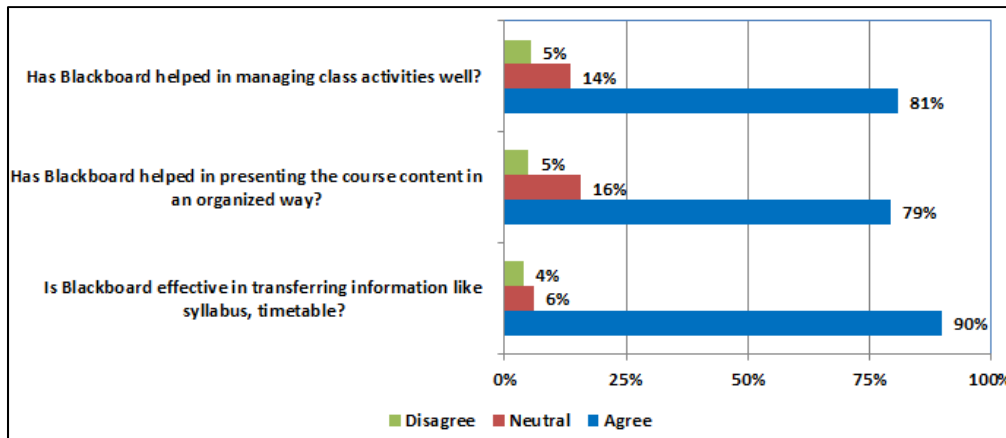


Figure 8: Blackboard as a learning tool

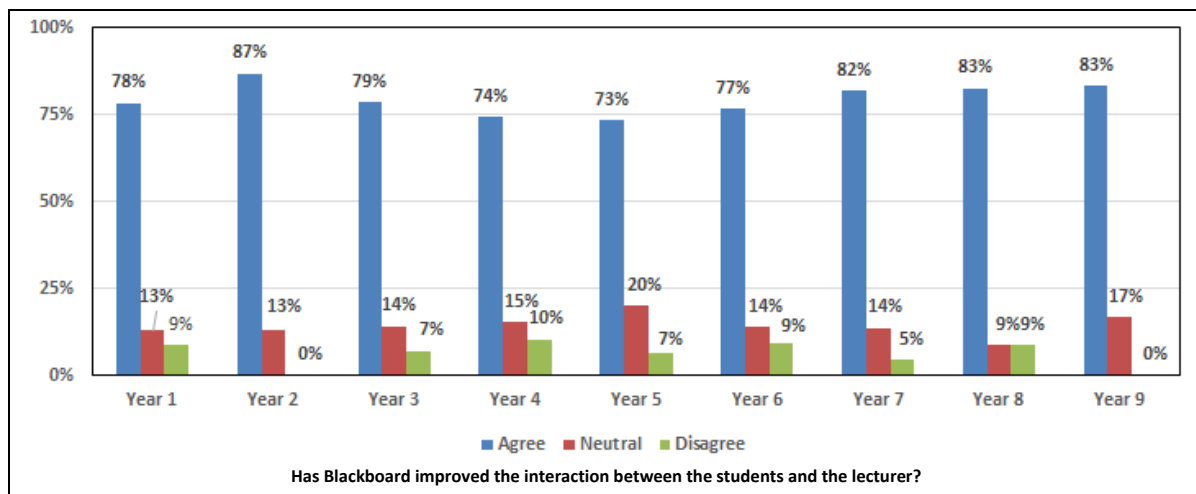


Figure 9: Interaction between students and instructor

One of the questions in the survey requested students to assess whether the learning platform improved the interaction with the instructor. The students' observation on that aspect was always positive (Figure 9), however it is worth noting that the percentage of negative answers reduced in the last two years. The introduction of the mail communication in year three did not have much effect on the students' opinion. However, the use of the online calendar, discussion forum and providing announcements about the course in year 2 made a big impact.

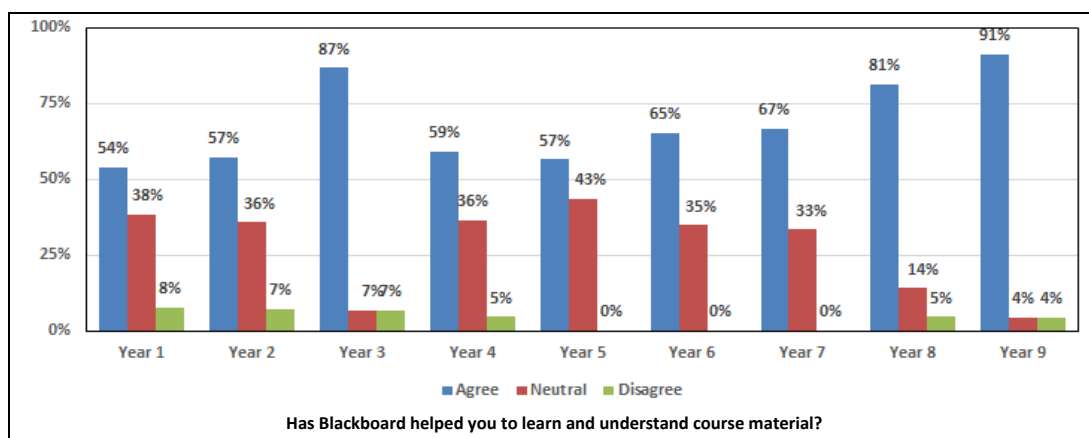


Figure 10: Facilitation of learning and understanding of course material

Blackboard was very useful in facilitating learning and understanding of the course material. The students' assessment increased steadily in the first years of use of the platform taking a substantial dip in the fifth year

and recovering gradually reaching the highest level of 91% in the last year (Figure 10). The sudden decline in the fifth year could be attributed to the introduction of elements of assessment created using the platform (Table 1). Although, not really related to the facilitation, introduction of unusual assessment may have negative impact on students' learning. The introduction of video clips and links to online resources in year three significantly improved students' opinion.

Similar trend, although with smaller decline in the fifth year, was observed in Blackboard as a tool to help in explaining difficult concepts (Figure 11). The students' opinion recovered massively in the last two years. Again, a big improvement in that aspect of the application of the platform was observed in the second year after introduction of video clips and links to online resources.

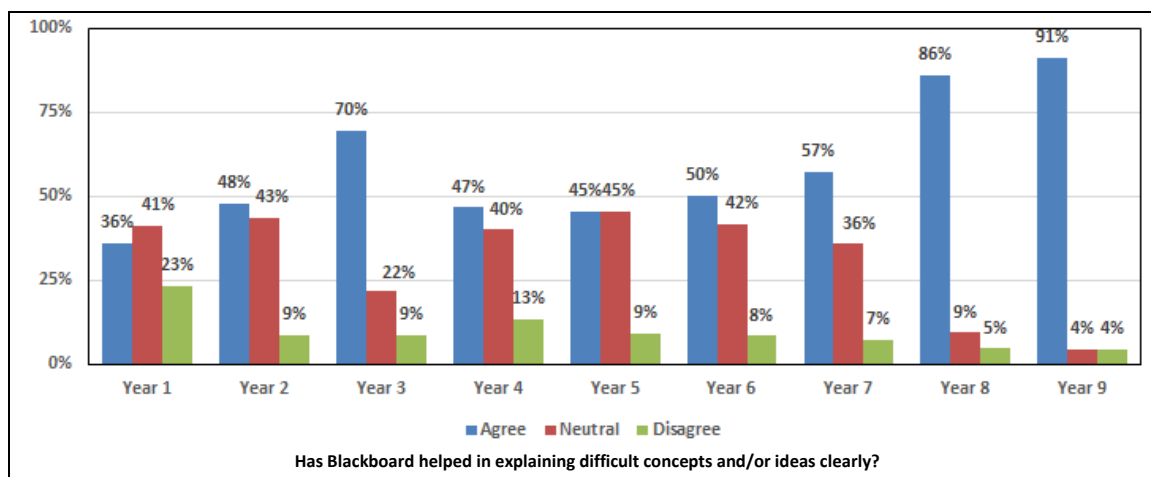


Figure 11: Assistance in explaining difficult concepts

In terms of generating interest in the course, one again the visual aids and information about online resources in year two made an impact on students' views (Figure 12). The fifth year observed again a decline.

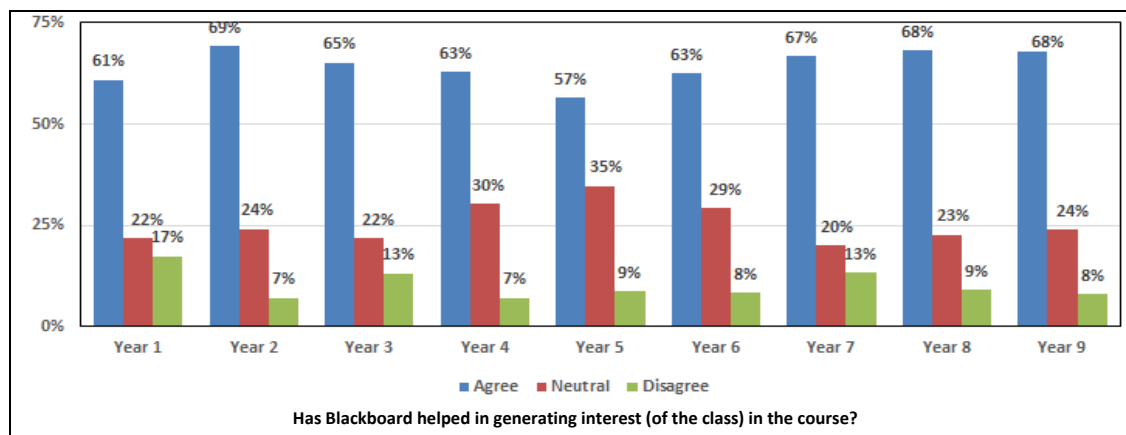


Figure 12: Generating interest in the course

Students considered Blackboard as helpful in supporting delivery of the course material (65%) giving them more than only a lecture (84%) and students wanted more courses to be delivered with the use of the learning platform (84%) – Figure 13a. Students however showed slight confusion in terms of their preferences in the course delivery; as shown in Figure 13b, the same percentage of students wanted the courses to be delivered in blended method and in traditional way (84%).

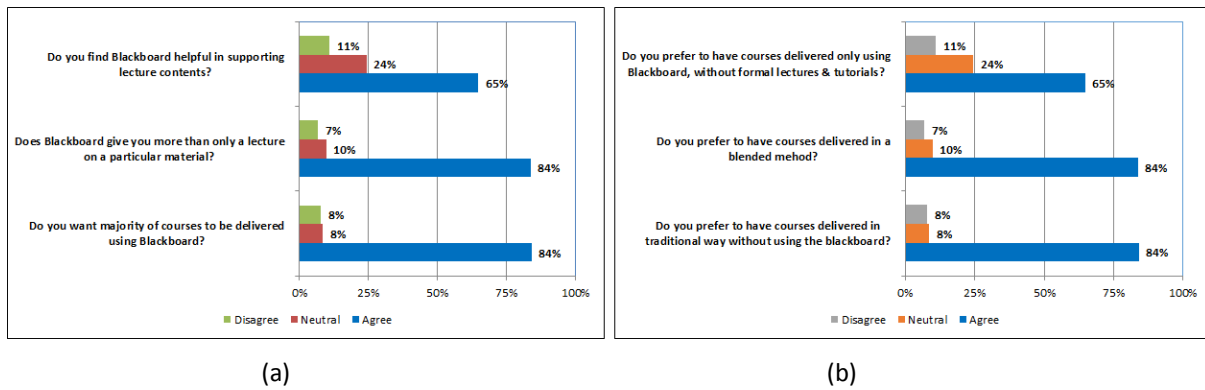


Figure 13: Blackboard as a support for delivery of lectures

Students had no doubt regarding the overall effectiveness of Blackboard; a great majority assess it as high or very high (Excellent – 19%, Good – 28% and Above Average – 40%) – Figure 14a. They viewed it highly in its role as being a new challenge (65%), broadening their horizon (84%) and also, fortunately or not, influencing their class attendance (84%) – Figure 14b.

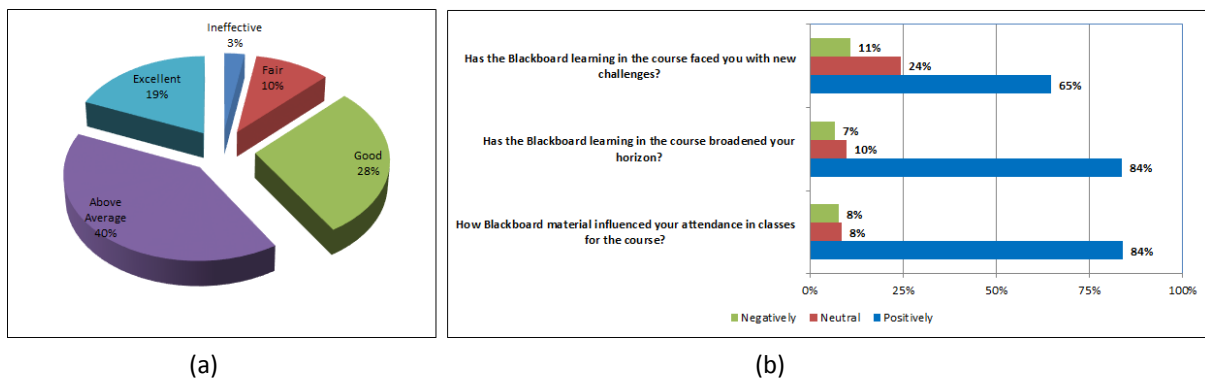


Figure 14: Overall effectiveness of Blackboard

7. Instructor’s Perspective

Despite the general aim to change the university system from teaching to learning, in terms of the preparation of the learning platform, the instructor remains the main actor on the stage. Instructor’s motivation, attitude, acceptance, experience, innovation are the main issues related to the success of the use of the learning platform. Such issues have been studied and reported upon by several authors (Woods, Baker and Hopper, 2004; Almarashdeh, et al., 2011; Alshammari, Ali and Rosli, 2016). The current study extends on the practical experiences of the instructor over the extended period of 9 years when using the learning platform.

7.1 Meeting the Objectives

The sole objective of the introduction of the LMS in the course was to improve the course administration, and improve the communication between the instructor and the students. The results exceeded the expectations. In fact, the communication which was the minor objective gradually became the major one, with great success acknowledged by both students and the instructor.

The use of the platform helped others, typical for such course objectives, for example, imparting students with knowledge about motion and forces, or enable students to apply fundamental principles of mechanics to machines, engines, linkages. However, quite unexpectedly was the objective of improvement in the use of computer technology. It has to be admitted that the computer skills improved were not of the highest level, though still important and useful for engineers.

Although it would be difficult to claim that obtaining feedback on the course is a valid objective, though receiving such feedback from the students is a valid and important element in the process of improving the course and teaching. The feedback obtained was not only anonymous, covering both course content and course delivery, but was also constant and continuous. That allowed the instructor to actually react to the

feedback, more or less, in live time, a feature not necessarily available in typical and loved by administration students' assessment of staff and course, done normally sometime at the end of the semester.

What can be considered as a disappointment in terms of objectives was a failure to improve communication between the students. Student-to-student interaction, apart from the one forced by the instructor by giving groups projects of assignments, was not visibly improved. As far as the instructor can assess there was no community of learners created in the course.

7.2 Challenges Faced

The challenges can be classified depending in a few categories depending on the issues and subjects.

Students' Readiness and Willingness

It appeared from the start of the using the platform that there is no barrier in students' readiness to use the technology. As also reported by students (Figure 4) there was no problem with navigating through the course material or achieving what the students wanted to accomplish. They were also happy to use the platform with several possible reasons. The fundamental reason may be a pragmatic one related to the fact that students had access to all material related to the course in one place. Even if they missed a lecture or tutorial, the material was easily available at any time. Content was prepared as for lectures, that means in portions or segments which were manageable from the time perspective but also showing the natural flow of logical progression in the course material. The content was presented not only in the form of written text but also some visual elements and/or links to external sources and access to latest materials.

Traditional, hard-core engineering courses, normally follow the usual way of delivery with only classroom face-to-face contact. The application of the LMS in the course gave students some extra appeal to keep them attracted to the course and its material.

Instructor's Readiness and Willingness

The course instructor, although originally not familiar with any learning platform, was well conversant with computer technology. He had years of experience in use of old mainframe computers, personal computers and also programming in different languages. It can be probably assumed that he had more than average level of computing skills.

Despite his years of experience in a traditional learning system, the instructor's attitude towards application of technology in teaching was very positive. He wanted to try something new, not only to attract students to the course and its content, but also to improve the general attitude of students who informally, and quite reluctantly, admitted the jealousy towards electrical and computer engineering students always using computers in their classes. The improvement in communication with the students was also a major factor. The interaction with students both inside the classroom as well as outside was not fulfilling the instructor's desire of more interactive style.

Organization Factors

Despite no formal motivators employed by the University of Botswana the organization did provide the students and staff with WebCT/Blackboard platform for general use. The instructors were encouraged to apply the technology which, however, did not translate, at least in the infant stages of the application of the platform, into enough training or support. Despite the 'encouragement' there was no push from the organization to make any changes, adjustments or alignments of the curricula with introduced technology. A missing element in the early stages was lack of instructional design specialists and trained assistants.

Technology Factors

Technology alignment, system quality and service support may be a major hindrance to the employment of any learning technology. Unfortunately, that was also the case, at least originally, with the use of WebCT/Blackboard at UB. The network failures, internet breakdowns, general unreliability of the access to the system, and also the countrywide power failures and interruptions, although may be typical for an African country, were indeed the major problems, both for students and the instructor. Students' complaints were mainly related to the problems with on-time submission of assessment elements. They actually almost never complaint about problems with access to the Blackboard material claiming that could be done anytime. Instructor's frustrations had many sides. The breakdowns in the access to the platform, whatever the reason

may be, was especially painful when happened during the process of adding the material or, even more dramatic, when marking the assignments or entering the marks.

The students' grading system constitutes even now a serious problem still unresolved. Until now, the Blackboard is not linked to the student record system. Both, previously used Integrated Tertiary Software (ITS), and currently used Academic Students Administration System (ASAS), were not linked to the database of Blackboard. That creates a lot of trouble and requires a lot of time consuming actions. It extends not only to the need to double entering of marks (into Blackboard and separately into student record system) but also to simple registering students into the platform. It has to be done, more or less manually, by platform administrators on the basis of a list of registered students for the course which has to be downloaded by the instructor and sent by e-mail. Any change in the registration records is not reflected in the Blackboard and has to be adjusted. With students adding and dropping the courses, late registration (also due to sponsorship problems) lack of automatic synchronization of Blackboard with the ASAS is a vital obstruction.

Time Factor

The potential benefit of using the learning platform in blended delivery of the course is cost-effectiveness, adaptation to changing circumstances, timely content, open-access at any time, and quick feedback from the students. However, for an instructor the so called 'cost-effectiveness' depends mainly on his own time devoted to the preparation of the material, course administration, assessment, and communication with the students. In the organization where it is expected that the course development will be done by the academic staff in its own time with little institutional help or resources, it is only the intrinsic motive and personal need of the staff which may inspire them to use learning platform.

The original idea that the platform would be useful if course administration proved to be the correct one and actually did not require any extra time, once learned how to put files into the system. As mentioned above, the secondary motive of improving communication with the students upheld as well but created a demand on the instructor's time. The demand on the communication with students was 'self-inflicted' and therefore, to some extent, welcomed. Also, several questions and requests from students were similar not really creating a backlog.

However, the time spent on the preparation of the material was seriously challenging. As the course material was to augment the material delivered it normally consisted of the lecture delivered in class plus some extra and at least somewhat different to the one presented in the classroom. The most time consuming element of the course were tests. They were multiple-choice tests introduced for the self-assessment of students. Since such tests were never used in the course they had to be created from scratch, which involved also some pre-testing.

In general, although the instructor did not keep tabs on the time spent it can be said that the time demand on the Blackboard experience was certainly at least triple in comparison to preparation for traditionally delivered class.

Keeping with the pace

One of the fundamental challenges in using the LMS platform for the instructor is keeping up with the pace of the course. The 'course' includes all the demands from students and the demands from the course itself, i.e. the need, create new material, to update the material, to introduce new features to keep students' attention and to make the fabric of the course useful and attractive. The preparation of the on-line tests was not only the most time consuming and demanding elements of the course but it was also the most demanding to keep it at high enough level and at the same time not to discourage the users. The survey administered did not ask about that feature of the platform, as it was introduced as the last one, however from the discussions with students and their on-line input it appears that they highly valued that form of self-testing.

8. Conclusions

The paper presented the students and the instructors' experiences on the application of Blackboard as the learning management system. In terms of students' views, the study surveyed a cohort of third year mechanical engineering students to obtain insight of the general use of information technology for learning

and their perceptions about the use of Blackboard platform, whereas the instructor presented challenges faced during the years of use of the platform.

Students reported high use of general application of IT, 90% used internet for some elements of learning. Over 70% of students also used e-mail as a way of communication with fellow students and also with instructors. There was not much difference in the use of IT throughout the years.

In terms of application of Blackboard, results from the study were consistent with previous research findings for courses other than engineering discipline (Goolkasian, Wallendael and Gaultney, 2003; Warren and Holloman, 2005; Yip, 2004). Therefore, it seems that students in general did indeed possess positive attitudes toward the use of e-learning software like Blackboard. The students in the current study were very open to the new technology. They considered it as a useful but still only additional tool in the delivery of courses. They reported that course material placed on Blackboard was a valuable supplement to traditional classroom lecture approaches.

Positive attitudes towards Blackboard were also demonstrated in students' responses to questions about their general viewpoint toward the new technology. Students highlighted the effectiveness of Blackboard in managing class activities (81%), in terms of transferring the information from the syllabus, timetable etc. (87.5%) and also helped to present the course content in an organized way (79%).

Time spent using the Blackboard increased through the years of study. That increase can be contributed to gradual development of the course in terms on features available for the students. Students were forced to use the platform as the submission of assessment elements and the assessment itself was increasingly moving towards online. The time spent was also more regular, as students increased systematic work on the material through the semester, although they still admitted to use it more often before assessments.

There was a correlation between students' opinion on some aspects of the use of technology and the development in the course material/features. The learning platform improved the communication between the students and instructor. However, it was not the mail but rather use of online calendar, discussion forum and providing announcements about the course online. Blackboard was also considered by students to be a great help in understanding course material, explaining difficult concepts and generating interest in the course. The introduction of video clips and links to online resources in year three significantly improved students' opinion in the above aspect of application of the technology. However, there was a considerable drop in all of the above aspects in the fifth year of the application. Although, there may have been other reasons for such tendency it can be attributed to the introduction of assessment elements created using the platform. An unusual assessment may have negative impact on students' learning, although the situation improved in the following years reaching the highest values at the end of the period.

Students were well aware of the advantages of using e-learning platform, which provided more material which could be accessed at any time and could be studied at one's own pace. They were of the opinion that blended approach and the use of the learning platform should be adopted in other courses. Surprisingly, students did not express a clear preference on the mode of course delivery.

Overall, it can be concluded that students embraced the use of Blackboard as it provides additional material in course delivery.

The original instructor's motivation for the introduction of the learning platform in administration of the course was discussed showing the gradual development of the course. The platform was not only to help in the course administration but also improve the unsatisfactory communication with the students. It proved that the results exceeded the expectations. In fact, the communication which was the minor objective gradually became the major one, with great success acknowledged by both students and the instructor. However, the communication between the students, as visible by the instructor, was only limited to interactions related to groups' assessments within the course.

There was no problem in terms of both students and instructor readiness and willingness in application of the platform. Students considered it as a welcome novelty and the instructor voluntarily entered the challenge anticipating learning and teaching benefits. There was no technology barrier for any user despite almost no

training in use of the platform. The only challenges in terms of technology were related to frequent network and power failure. The organizational challenges were mainly the lack of instructional design specialists and trained assistants. The major obstacle in terms of technology was lack of the link between the platform and the student record system, which created a lot of trouble with students' lists and recording of their marks.

The instructor considered the time factor the most vital challenge related to the use of the platform. The basic use of the platform for the course administration did not require any extra time. However, the time spent on the preparation of the material was seriously demanding. The further development of the course involved even more time required for the preparation of certain features (for instance on-line tests) and time required to update the material, communicate with students, introduction of more attractive elements to keep students engaged.

Despite the challenges, the application of the learning platform and the development of its material was a positive experience for the instructor and well received by the students.

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Going on Safari: The Design and Development of an Early Years Literacy iPad Application to Support Letter-Sound Learning

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Abstract: This paper explores the design, development and evaluation of an early childhood literacy iPad application, focusing on the English Alphabet, called 'A to Z Safari' trialled in Australian classrooms. A to Z Safari was designed to assist students in the early years of schooling with learning the alphabet and building on their knowledge of letter-sounds. This paper details the process that led to the design and development of A to Z Safari and evaluates the success of the application (also known as 'app'), using the Technology Acceptance Model (TAM), from a classroom trial in 2015. Quantitative data from the app statistics gathered on student use, and qualitative interviews with classroom teachers explores how students and teachers received A to Z Safari. It was found that the design of A to Z Safari exhibited ease of use and usefulness for the target cohort in regards to gameplay and teacher support, however a number of updates need to be made to the app's functionality to satisfy future, larger scale use. Suggestions for those designing similar apps for use in classroom environments have been provided.

Keywords: Games, literacy, digital application, design, phonics, iPad

1. Introduction

Digital devices are common both in-class and out-of-class time across Australian elementary schools with many young learners preferring the digital format (Lynch and Redpath, 2012, Stern, 2014, Flewitt et al., 2014). When implemented effectively, digital devices can provide a highly stimulating, motivational and engaging environment for students, with apps designed to support children's literacy demonstrating positive outcomes (Reid and Ostashevski, 2011, Flewitt et al., 2014). Developing and promoting digital literacies in the early years of schooling has continued to gather interest as smart phones and tablets become pervasive in both the home and school. When considering an early-years multimodal app, designed to support the learning of letter-sound associations, a review of the Apple AppStore showed a number of relevant apps; in particular Oz Phonics (DSP Learning Pty Ltd, 2012) and Montessori (Edoki Academy, 2014). With such a plethora of apps to choose from, it is more than availability alone that will determine whether a particular app will be selected and used by teachers and parents. Two important factors that determine the selection of an app for use in classrooms are whether the app will be effective in assisting users to achieve their learning outcomes, while facilitating high levels of engagement at the same time (Furió et al., 2013, Lynch and Redpath, 2012). This critical intersection requires solid foundations in educational theory and game design to offer an experience that can satisfy the need of both students and teachers. In an effort to push the boundaries of early childhood literacy educational techniques, we developed the app A to Z Safari to provide an educationally sound, game based learning experience for 5 to 7 year old children to learn the English alphabet. The aim of our research was to evaluate both the learning and usability outcomes of A to Z Safari from a small trial intervention conducted within an Australian elementary school. In addition, this research explores the design and development of A to Z Safari to demonstrate how usability was considered at every stage. Further research that presents the learning outcomes from students' use of A to Z Safari can be found in Nicholas et al. (2017).

2. Computer based literacy applications for early years of schooling

Digital devices allow users to engage with and create texts using more than one mode of communication, whether it be through sound, visuals, movement and/or layout. According to Kress and Leeuwen (2001), users of multimodal texts are facilitated to engage in meaning making via the four domains through which the text is created (Figure 1).

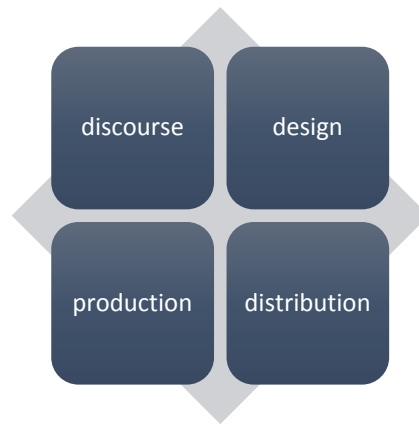


Figure 1: Kress and Van Leeuwen's (2001) four domains - the multimodal text

Though all four domains are interrelated and critical, the 'discourse' domain is the quadrant that most directly influences the design, production and distribution/promotion of a multimodal app that seeks to support users to acquire new knowledge. Kress and Leeuwen (2001) define discourse as "socially constructed knowledge of (some aspect of) reality". Supporters of socio-constructivist theories postulate that knowledge is socially constructed through interactions with others, which in turn have been influenced by an accumulation of social actions over time (Dewey, 1938). Interacting with the multimodal texts found within an educational app created by a team of 'others', is an avenue through which users can engage in the social construction of knowledge.

When creating a multimodal text such as an educational phonics app, Kress and Leeuwen's (2001) description of the discourse domain suggests that it is critical that the most accepted and/or sound discourse be associated with the presentation of letter-sounds (Kress and Leeuwen, 2001). The educational discourse that informed the design of A to Z Safari was drawn from two disciplines: research into the development of reading skills, and that of memory retention. The importance of learning letter-sound associations in the early stages of a child's reading development informed our choice to focus on letter-sound associations for our app's design (Australian Government, 2005, Burgess and Lonigan, 1998, Melby-Lervåg et al., 2012, National Early Literacy Panel, 2008, National Reading Panel, 2000, Rieben and Perfetti, 2013, Perfetti et al., 1987, Pfof et al., 2013, Stanovich, 1986). Dual coding theory (Kuo and Hooper, 2004, Sadoski and Paivio, 2013, Paivio and Csapo, 1973) informed our choice to use both illustrations and language to facilitate the learning of letter-sound associations when designing our app. Dual coding theory shows that memory retention is more effective when a learner uses different types of information concurrently, to facilitate recall. This theory contends that target content is more readily stored in memory and retrievable when images and language are used together, rather than relying on one source of information to aid recall on its own

Our focus on dual coding theory was further enhanced by research that has found that images are more effective in aiding the recall of letter-sound associations when the connection between the image and target memory is more concrete. For example when the letter 's' is superimposed over an illustration of a snake that was crafted to take on the shape of the letter 's', this highlights that the initial sound in the word 'snake' makes the sound associated with the letter symbol 's' (Agramonte and Belfiore, 2002, de Graaff et al., 2007, de Graaff et al., 2009, Dilorenzo et al., 2011, Ehri et al., 1984, Fulk et al., 1997, Hooegeveen et al., 1989, Manalo et al., 2013, Sener and Belfiore, 2005, Shmidman and Ehri, 2010). This was further supported by research into memory 'interference', a theory that contends that other memories can interrupt the successful retrieval of sought after memories (Kline, 1921, Danker et al., 2011, Van Dyke and Johns, 2012, Rutledge-Taylor et al., 2014) To minimise interference, more concrete, chain-type mnemonics are needed to lead the learner to the sought after memory (Bellezza, 1981, Levin, 1993). This was illustrated above, where the shape of the snake was crafted to take on the form of the letter 's', so that the learner is not led to associate a snake with the letter 'l' for example, given that a snake can resemble the letter 'l' when laid out straight. Such communion of image and language would ensure that an app designed to facilitate learning based on the conclusions above will have positive outcomes for its users. The combination of image and language has been illustrated in Nicholas et al. (2017) which tested literacy theories used in A to Z Safari's design.

In addition to the educational theories outlined above and detailed in Nicholas et al. (2017) the functional design of A to Z Safari also required careful consideration of design characteristics (affordances) so as to appeal to the target audience.

3. Design affordances and development considerations of digital applications for early school years

Modern tablets and smartphones are becoming increasingly powerful in terms of their processing, memory, and storage capabilities, allowing for sophisticated delivery of a range of digital content (e.g. games, news, and social media). When students use a tablet, they interact with the device through a series of taps, swipes, and pinch-zooms. A review of relevant literature informed the ways in which an app can be best integrated into the classroom environment, as well as providing an effective platform for delivery of the learning material. It has been recommended that the following be considered when designing an app for the early school years:

1. **Interface interaction-based recommendations:** Minimization of interface distractors or creation of what Stern (2014) argued as 'an interface economy'. When constructing a system of feedback that supports different interaction needs, an app needs clear, immediate and rewarding feedback in both visual, aural and oral forms for young learners (Flewitt et al., 2014, Reid and Ostashewski, 2011). Continued motivation should allow students to 'undo' or 'retry' attempts (Flewitt et al., 2014). Furthermore, removal of social media content and complicated controls allows the app and the learner to focus on the primary content.
2. **Subject/Content-based recommendations:** Apps used for learning should include visual and interactive elements that are enjoyed by students. To facilitate an engaging and interactive learning experience, video, images and sound elements should be provided, relevant to the target audience (Stern, 2014). Furthermore, Stern (2014) argued that an app should provide a clear integration of resources that assist learning (for example a glossary). In the classroom, devices should not be considered as personal, but rather reflective of use in the classroom situation. Reid and Ostashewski (2011) echo this on a larger scale acknowledging that digital device use in the classroom can result in many management issues. Central to digital device use, however in particular with younger target audiences is the provision of a safe and secure environment particularly in regards to Internet use and access (Mifsud, 2002, Henderson and Yeow, 2012, Livingstone and Smith, 2014).
3. **Understanding/Learning-based recommendations:** Flewitt (2014) asserted that an app has the potential to support independent learning, concentration, enriched communication and creative collaboration. The evaluation of early-school language apps as completed by the Department of Education and Training (2016) demonstrates a number of ways in which kindergarten and early school age children can have their learning supported while using apps. Learning recommendations include the provision of aural, visual and oral media assets to support varying learning methods as well as personalized learning pathways that offers individualized support of student activities. They also recommend that apps should also support students to develop a variety of foundational skills.
4. **Language/Literacy-based recommendations:** In addition to the above, the Department of Education and Training (2016) outlined a number of ways in which kindergarten and early school children can have their literacy needs supported while using apps. Literacy recommendations include the use of play based learning to support early language learning and using repetition for students to develop their literacy skills through oral and aural means.

Across all recommendations, multimedia is promoted as a key component through which to deliver content via apps, providing a detailed audio and visually interactive experience for users. However, consideration must be given to the type of multimedia being presented, what mode/s will be used (e.g. audio, visual), and how the various modes are combined to convey content. The targeted hardware (Apple iPad) presents constraints for presentation of multimedia (Furió et al., 2013), which need to be considered during design.

In addition to the above recommendations, factors such as usefulness and ease of use should also be taken into consideration when designing technology interventions for the classroom. The Technology Acceptance Model (TAM) considers mediating factors of usefulness and ease of use in relation to system characteristics and the probability of system use. Usefulness is defined as the degree to which a person believes that using a particular system would be useful to enhance his or her job performance (Davis et al., 1989). Ease of use is defined as the degree to which a person believes that using a particular system would be easy to use and/or

free of effort (Davis et al., 1989). The above design recommendations and TAM evaluation metrics were considered during development of A to Z Safari.

4. Design of early childhood literacy application A to Z Safari

A to Z Safari was designed and developed in 2014 to support young children to learn the 26 most common letter-sound associations of the English alphabet. The app also provides teachers with a tool that can support the review and assessment of student learning. A small team comprising of two programmers, a games designer, two graphic artists and two educational consultants worked within an informed research and development framework to ensure a quality and rigorous implementation. The development of a theoretical framework based upon research into children’s early reading development and research into factors that aid or hinder the recall of target memories informed app design (Nicholas et al., 2017). In addition, age of intended audience (i.e. 5 to 7 years olds) and intended context (independent classroom use) was considered during the app’s design (Reid and Ostashewski, 2011, Watlington, 2011), which included design considerations that would be suitable for display and use on a small screen (Stern, 2014). In addition to the research and development framework, numerous considerations were also taken into account in regards to the hardware requirements needed to deliver the app via our target device, Apple iPads.

A to Z Safari was designed to guide students through self-directed tasks that would support the learning of letter-sound associations. In the design of A to Z Safari, the intention was to create an app that could be used independently by young children in the classroom so that teachers might be free to devote their time to tasks that encourage students to engage in higher order thinking processes. The decision to create an app was informed by the potential that software programs can support independent, self-paced learning of content knowledge that is closed in nature i.e. answers can only be correct or incorrect (Jones, 2009, Kirriemuir and McFarlane, 2006, Busch et al., 2015, Marchetti and Valente, 2015).

In the design of A to Z Safari, images were created in the shape (form-taking) of the letter that they were to be associated with (e.g. a flamingo in the shape of the letter ‘f’, see Figure 2), so that a more concrete link could be forged between corresponding illustrations, letter-sounds and letter symbols, reflective of research into dual coding theory (see section 2). The form-taking designs shown in Figure 2 intentionally deviated from more traditional alphabet picture cues (e.g. using an image of a flamingo in a more natural pose as a reminder that the first sound in the word ‘flamingo’ is to be associated with the letter symbol ‘f’), which is commonly used in classrooms to assist students to learn and recall letter-sound associations. Our form-taking design was chosen to reflect the theory that creating more concrete links between images and letters, by presenting illustrations (e.g. of animals) in a form-taking shape, can better assist students to remember the associated letter symbol over traditional alphabet picture cues. Figure 2 shows the alphabet chart used in A to Z Safari (Nicholas et al., 2017).

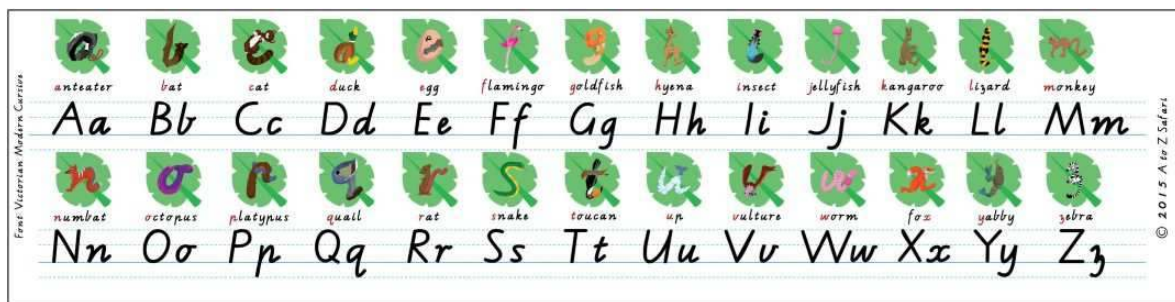


Figure 2: Alphabet Chart of A to Z Safari

The Apple iPad (generation 2 or higher) was chosen to house the A to Z Safari app due to its widespread use in Australian primary schools (Etherington, 2013, Apple Press Info, 2013). The widespread use implies that our intended audience, primary school aged children, would be already familiar with Apple iPads, an important consideration to the adoption of a new technology in the classroom (Lynch and Redpath, 2012). The development environment for the iPad is also well supported with a mature, well-established development toolset along with easy access to well-established communities of support. During development and subsequent testing of A to Z Safari, the development team used Xcode 5, targeting iOS 8, the iPad 2, and the iPad Mini 2.

To facilitate interaction with the form-taking illustrations designed for A to Z Safari (Figure 2), the app offered users two categories of games: match (Figure 3) and memory (Figure 4). Within each category, users could select from five levels that allowed them to interact with the letter 'leaf' tiles (Figure 2) in different ways. Table 1 describes each level, available within both game categories, in A to Z Safari. Within each level, users were presented with activities that were associated with all 26 letters that queried their competency.

Table 1: Description of A to Z Safari Game Levels

Level	Match and memory game description
Level 1	Users are presented with spoken words (for example 'cat'), required to partner with letter tiles.
Level 2	Users are presented with spoken letter-sounds (for example /s/), required to partner with letter tiles.
Level 3	Users are presented with written letters, required to partner with letter tiles (Figure 3)
Level 4	Users are presented with spoken letter-sounds (for example /s/), required to partner with letter symbols written in plain font (not letter tiles)
Level 5	Users are presented written letters, in a different font than previously used, required to partner with letters written in plain font (not letter tiles)

A to Z Safari also consisted of a welcome screen (Figure 5) and a teacher/administration area (Figures 6 and 7) where the classroom teacher can setup a class list and begin or end 'assessment sessions' to enabled the gathering of user statistics (see section 4.1). The assessment sessions support the match games.



Figure 3: Example of a Match game in A to Z Safari



Figure 4: Example of a Memory game in A to Z Safari

When approaching the design of A to Z Safari it was important to build a visually appealing, flexible, yet easy to use app framework based on interaction, content, learning and literacy recommendations. In A to Z Safari, 'interface economy' (Stern, 2014) was established via a combination of audio and visual elements that prompt the user to explore the games. To ensure a clear introduction to the content the landing screen was purposefully designed with bright colours and large buttons to allow players to engage with the games. With each interaction, A to Z Safari rewards users with positive audio feedback and details their progress via appropriate visual feedback. Influenced by Flewitt et al. (2014), A to Z Safari encouraged players to 'try again' if they cannot provide the correct answer, minimising negative feedback to maintain player motivation.

4.1 Data analytics

A to Z Safari allowed classroom teachers to enter the name, age, and gender of each student within their classroom, stored behind a password protected 'teacher' area. User statistics were stored in one device (normally the teacher's) and not shared across other devices. A database was required to store these user statistics, with SQLite 3 chosen due to being lightweight, and able to run natively within any iOS app as it is included within the iOS API. As advised by Stern (2014) and Reid and Ostahewski (2001), to provide a high level of security and to constrain data management issues, only the teacher area had the ability to email user statistics to an outside source. Once the teacher had logged a student's details in the app the teacher could give the device to the child in this 'assessment' mode to play the match game. While in assessment mode, students could complete up to five levels of the match game to test their letter-sound competency. During each level A to Z Safari tracks students' progress on: number of questions played, letters assessed, number of incorrect answers, number of correct answers, which letters were selected in error, and more.



Figure 6: Example of the teacher administration section of A to Z Safari

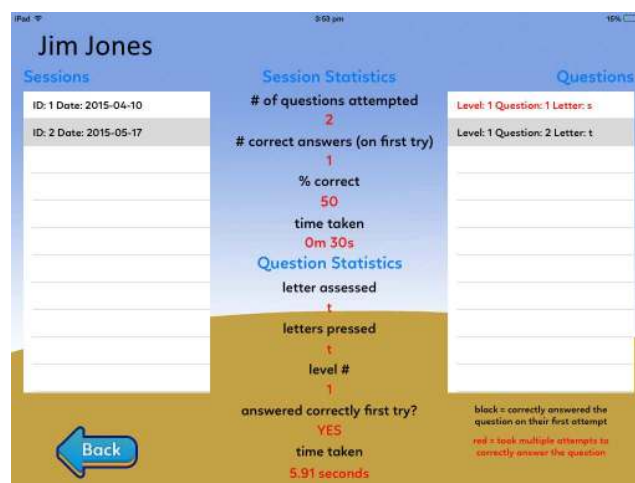


Figure 7: Example of the statistics section of A to Z Safari

The statistics were then available for teachers to measure the effectiveness that the specially designed alphabet lettering may have had on the learning outcomes of the children in their class.

5. Rollout of A to Z Safari

A to Z Safari was used in two Foundation classes (the first year of elementary schooling in Australia) in the second term of a four term year in 2015. The classroom teachers were instructed by the researchers to introduce the app to the children in a small group setting, referred to by the teachers as a 'guided reading' session. Here, small groups of four children were given their own device and guided through the use of the app in the first week of implementation. The teachers ensured that every child in the class (n=32) took part in a guided reading session in the first week of the term. Over the next nine weeks of term the children were directed to engage with A to Z Safari independently of their teacher, in a small group setting for 20 minutes at some stage during their reading sessions. The four iPads in each classroom were rostered to particular groups of children each week, ensuring that each child in each classroom was given time to use the app for 20 minutes once a week for 9 weeks in total. In the 20-minute session each week, each child had access to their own tablet device but were often seen sharing a device and collaborating as they engaged with the games in free play mode (without being logged into assessment mode by a teacher as described in section 4.1). The two teachers who made use of the app were asked before the trial began when they could conceivably see themselves making use of the teacher area and the assessment mode of the app. Both teachers agreed to use it only once towards the end of the term, to inform mid-year student reporting to parents. Data gathered shows that this is indeed when the teacher area was used and user statistics were stored on the devices.

6. Methodology

To evaluate the design and development of A to Z Safari a mixed method was used. As this research is presenting an initial evaluation of the design and development of A to Z Safari, an exploratory mixed method supports the development of further, more rigorous techniques that may contribute to more robust empirical evaluations (Gelo et al., 2008). Quantitative data from 10 consenting students who used A to Z Safari, and qualitative data from semi-structured interviews with two teachers involved in the rollout of A to Z Safari, detail use, as well as exploring ease of use and usefulness of the mobile app. For the results of the usefulness of the app in terms of the learning outcomes achieved, please see (Nicholas et al., 2017). Quantitative data was drawn directly from the user statistics (Figure 7), gathered through use of A to Z Safari. The data shows students' progress when using the app based on: number of questions played, letters assessed, number of incorrect answers, number of correct answers, which letters were selected in error, and more. Each teacher interview was coded using thematic qualitative techniques.

Using the Technology Acceptance Model (TAM) (Davis et al., 1989), we evaluated A to Z Safari in terms of usefulness and ease of use when implemented in the classroom. Usefulness and ease of use are crucial for A to Z Safari to be used by students and teachers in the classroom. This evaluation was informed by data generated from semi-structured interviews with teachers. Questions included: From your perspective did you find the teacher area, as included in the app, easy to use? and Overall was this software useful to your classroom experience? While this research did not complete empirical evaluation using TAM factors, the model is beneficial to guide preliminary evaluation and to support further design and development efforts of A to Z Safari. Ethical approval was sought from relevant institutional ethics committees to interview staff and to utilise consenting students' usage data.

6.1 Research questions

The aim of this research was to present the design and development of A to Z Safari, and evaluate the usability of the app. To achieve this aim, this paper addressed the following research questions:

1. What does the data analytics reveal about student use of A to Z Safari while on trial in an Australia elementary school?
2. What is the perceived usefulness and ease of use of A to Z Safari by teachers involved in a trial in an Australian elementary school?

7. Results and discussion

7.1 Use of A to Z Safari by students

To address the first research question, regarding the data analytics on student use of A to Z Safari, user statistics were analyzed using quantitative techniques. A summary of student data from one game-play session, across five levels within the match game (refer Table 1 for level definitions), is shown in Figures 8 and 9. When engaging in each of the five levels of A to Z Safari, Figure 8 shows the average correct answer percentage for all students ($n = 10$). The correct answers percentage (y-axis) refers to student attempts who correctly selected the correct letter on their first try.

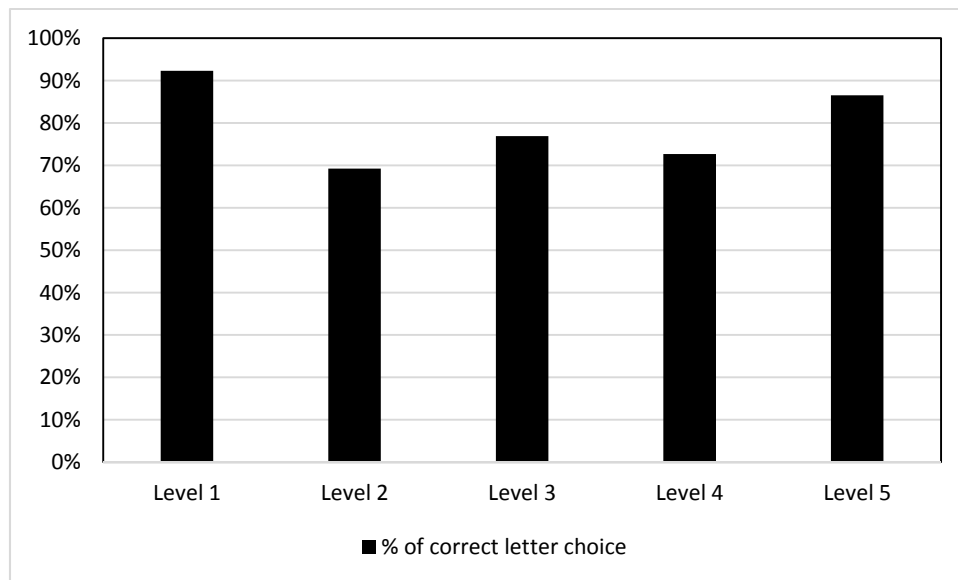


Figure 8: Average correct letter choice made by students

The results in Figure 8 show that across all five levels students achieved above 60% accuracy when identifying the correct letter choice in their first attempt. In addition to the information in Figure 8, further analysis of student data uncovered that the lowest scoring letters across all students ($n = 10$) across the five levels were: K, P, Q, U, V. Figure 9 shows the average time, in seconds, for all students ($n = 10$) when engaging with A to Z Safari across the five levels.

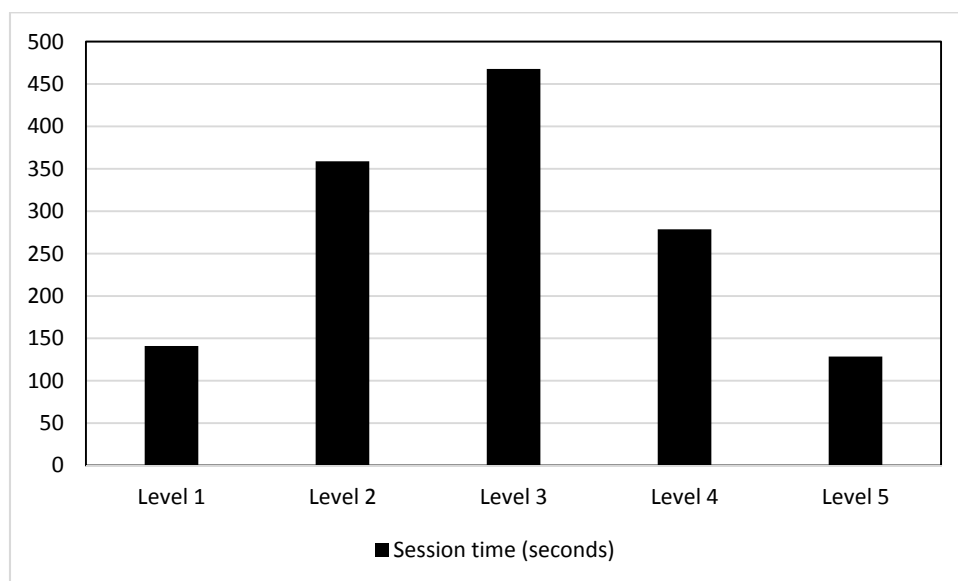


Figure 9: Average session time by students when assessed by A to Z Safari

The results in Figure 9 show that level three (matching images to letters) had the longest session duration on average, with 465 seconds recorded. Time taken for students to complete levels can be an indicator of difficulty in identification of letter-sound association. In addition to the information shown in Figures 8 and 9, data on the number of times students asked for a repeat of the question instructions (or re-ask count) was also recorded by A to Z Safari. The students did not request any repeat instructions in levels three (matching images to letters) and five (working with different font styles). Level four (matching font letters to spoken sounds) demonstrated a high re-ask count with on average 20 re-asks, level two showing on average 14 re-asks (matching pictures to spoken sounds), and level one (matching images to spoken words (the name of the image)) showing three. Time taken to complete a level, when reviewed in light of the 're-ask' count, demonstrates that students would ask for a repeat of question instructions only when the task involved listening (such as identify the letter based upon the sound). When A to Z Safari requires students to listen carefully to projected sounds of letters, this could be an issue in noisy classroom. Our investigation also revealed a lack of opportunity to provide students with the ability to review letter-sound associations outside of gameplay. A to Z Safari provided no resources, such as a dictionary or glossary, as suggested by Stern (2014).

7.2 Teacher evaluation of A to Z Safari

To address research question two, regarding the usefulness and ease of use of A to Z Safari by teachers, teacher interview data was analysed using qualitative thematic analysis techniques. Two teacher interviews were available for analysis. The following describes the themes uncovered during analysis supported by direct quotes from teachers. Two initial themes of ease of use and perceived usefulness seeded qualitative analysis, with further themes identified through a process of iterative dual researcher analysis. In terms of ease of use of A to Z Safari, themes included: ease of use of the games (Figures 4 and 5) and the teacher area (Figures 6 and 7). Usefulness themes included: overall usefulness for letter competency and usefulness of the teacher area.

7.3 Ease of use of the games in A to Z Safari

The games provided students with two ways to interact with the alphabet chart (Figure 2). Both teachers reported that initially they were somewhat confused on how to play each game, commenting specifically on the memory game. One teacher commented:

"Teacher one and I had a chat because we were confused about it at the start... Once we understood it was a memory game we knew what to do, but on first sight we were a little bit confused ... I think it was the randomness that we found a bit confusing." – Teacher Two

This is further reiterated by additional teacher comments:

"It was slow in the early stages as we had to talk to the kids about what those animals were and get them to recognise them." – Teacher One

After an initial period of learning, the teachers reported that both students and staff had increased ease of use in regards to the games and how to play. Importantly, the teachers commented on the fact that instructions on how to play were easily accessible:

"The elephant [see Figure 4] was useful instruction to help guide the kids". – Teacher Two

Clear tutorials are therefore required for both teachers and students to provide ease of use.

7.4 Ease of use of the teacher area

During data collection, it was uncovered that teachers had trouble with successfully exporting students' data from A to Z Safari. While the teachers managed the classroom by allocating one tablet to assess each student, teachers had difficulties understanding how to link A to Z Safari to an email account. Therefore, teachers could only review the information on the iPad, but could not export it as a spreadsheet to be used on their desktop machines. However, despite misunderstanding how to successfully export the data, many positive comments regarding the statistics were captured in the teacher interviews. Teachers commented that set-up of the teacher area was 'straight-forward' and found the data that was captured during assessment easy to follow.

One teacher commented:

“The instructions in the teacher area were useful. You could always go back and check, and you could have a look before giving it to the kids”.

One teacher commented on the autonomy the assessment component of the teacher area provided for their classroom:

“I did like how the assessment at the end, didn’t require any teacher time. You could just give them the app, as they were used to seeing it, and you could do an independent assessment. A lot of assessments get put off for that reason. The [other] kids are going crazy while you’re trying to do it”. – Teacher One

It was noted however, that when the teacher section of A to Z Safari was first introduced, the teachers were asked when they could realistically foresee themselves making use of the function. Both teachers declared that they could only see themselves using the independent assessment area once over the 10 weeks of the trial, coinciding with their mandatory report writing. Consideration of Davis et al. (1989) who defines ease of use as the degree to which a person believes that using a particular system would be free of effort, this calls into question the perceived ease of use of the teacher area. Or perhaps it is a question of usefulness rather than ease of use. We were able to rule out the possibility that the data that was generated was difficult to interpret as one of the teachers commented:

“The way the data was presented, once you had tested them, was easy to follow.” – Teacher Two

7.5 Overall usefulness of A to Z Safari on letter competency

The teachers used A to Z Safari in many ways in the classroom and found that the app assisted their job performance. One of the teachers suggested that the app added to the everyday teaching and learning practices in the classroom contributing to the success of the teacher’s program by providing ‘novelty’ and a new way of learning that seemed to facilitate motivation and engagement. When asked if use of the app contributed to their students’ learning of letter-sound mapping, Teacher One responded with:

“Absolutely, yes. Particularly when you are working with students who are picking up things at home, picking up things from listening, picking up things they do at home and then there is the ones who don’t do any of that. Who don’t tune in on the floor. I think those are the ones who really benefit from this because it is a novelty, they know how to use it, and it really helped the lower fraction stay on task a little bit more and learn some sounds.”

The ability to learn more than one letter-sound combination while using the app was also highlighted:

“It saves a lot of teaching time with letter-sounds, because it is a big thing, you can’t teach all 26 [letters] in one hit. You can still take a guided reading group [while other children are using the app].”
– Teacher Two

These comments suggest that while there was a ‘saving’ of planning and preparation time once the children were familiar with its use, it cannot be assumed that this will happen from the outset or quickly with all children. Time needs to be invested when the app is first introduced, with some students perhaps needing more time than others, to fully realise its usefulness otherwise its usefulness may be compromised.

Overall, the teachers commented that A to Z Safari was useful in supporting their classroom programs however some limitations were noted. One teacher commented on the requirement for students to critically think about their answers/input when using the app, rather than allowing the digital device to facilitate forced feedback:

“We did have to have a big talk, and I guess this happens with all apps, in that the kids had to think about the answer and not just guess or look for the correct sound. There was a bit of tutoring at the start.” – Teacher One

The need to steer students away from ‘guessing’ when using A to Z Safari, is an important consideration and impacts upon the longer-term usefulness to assist children to learn common letter-sound associations. For example, Teacher One commented that students had issues with certain letters in A to Z Safari:

“...for UP they would go ‘bird’. But as we got through our weeks and our letter-sounds and they were learning more they got better. With /u/ or UP they were expecting an animal or bird, and not an action.” – Teacher One

The ‘up’, /u/ (see Figure 2) connection may have been a design issue rather than one associated with the time taken for students to learn new vocabulary. Given that all image/sound connections were related to animal sounds, this deviation for the letter ‘u’, linking the word ‘up’ to the image used, may have contributed to the difficulties some students had in learning the connection between word, image and letter-sound in this instance. As identified in section 7.1 the letters K, P, Q, U, and V all scored lowest across the five levels of match games. Images such as ‘vulture’ /v/ were observed by teachers to be difficult for students to identify, perhaps due to the students not being very familiar with the animal, which is something to take into account in future designs of the app. Additionally, teachers further commented that students sometimes had difficulty hearing sounds projected from the iPad, which impacted on situations where matching sounds to a picture were required.

7.6 Usefulness of teacher area

Both teachers saw value in the teacher area as a way to keep track of students’ progress with letter-sound competency. Some issues occurred concerning accessing the data (as covered under 7.4 Ease of Use of teacher area), however overall the integration of data analytics was deemed useful to assist the teacher in their job performance:

“The data was useful, I found it very specific as it goes through each round. So I had to think about what was that round, was it knowing the picture, was it knowing the sound? For the stronger kids I found it the most useful.” – Teacher One

Furthermore, teacher comments indicated that they perceived the teacher area would be useful in assisting to write student reports. This suggests that teachers saw this function as summative rather than an ongoing formative assessment that could inform their planning for teaching and learning. Teacher Two commented on data analysis features that would be useful:

“So a summary, per student, to show where they struggle. For example, they struggle with the /q/ sound. At the moment it is based on session, which I had to go through. The session data is useful I wouldn’t get rid of that, but when it comes to report writing time the summary data would be really useful.” – Teacher Two

This was reiterated by Teacher One who also suggested that summaries would have been useful, indicating that she did not make use of the data to inform her daily teaching, using it instead to inform the writing of her mandatory student reports:

“It would be nice if it popped up on the page with a percentage, I have looked at the individuals but it would be good to look at the class.” – Teacher One

These comments highlight possible issues with usefulness of the app to inform changes to daily teaching practice, and provides suggestions on changes that could improve usefulness such as easy to access collated user and cohort statistics. Despite drawbacks with the way in which A to Z Safari presented data to the teachers during the trial, Teacher Two commented that she still found the data that was generated to be useful, commenting:

“For the stronger kids I found it the most useful. What was confusing them? Was it the sound? Were they confusing a letter with another letter?”. – Teacher Two

Overall, the teacher area requires a number of improvement in usefulness and ease of use in future versions of A to Z Safari. To improve usefulness and allow the teachers to integrate assessment feedback into their weekly

teaching, data analytics need to provide multiple and customisable views. Both teachers commented on the need for quick and easy feedback within the app from both the macro (class) level as well as micro (student) level. While data export features remain, it is the ability for quick feedback that could be better integrated into A to Z Safari to improve classroom integration.

8. Conclusion and future work

The evaluation of A to Z Safari, based on user statistics and teacher interviews, demonstrated ease of use and usability of the app. Further, the evaluation helped to understand how the research based approach impacted upon the design and development of A to Z Safari. Usefulness and ease of use of TAM, used to evaluate A to Z Safari, proved effective to determine usability and inform app updates. While this paper does not address the educational outcomes of student use of A to Z Safari, the results show support for the unique presentation of letter-sound associations (Nicholas et al., 2017).

Overall, the results in this paper suggest that A to Z Safari provided a usable and educational app for learning letter-sound associations. However evaluation uncovered a number of ways in which both the usability and educational components could be improved for future use. Improvements included: updating content design for certain letter tiles (for example 'U'), consideration of projected sounds while in a classroom environment, ability to review letter-sound combinations outside of gameplay, clear student and teacher tutorials to assist first time users, and improvements to the teacher area to provide quicker and customisable access to visualisation of data on both a macro (class) and micro (student) level.

When designing an educational app for young children, recommendations in regards to content, interaction and learning should be strongly considered through all stages of development. This research uncovered the importance of observing use of apps in the classroom environment to determine what modes of communication (e.g. aural, visual,) are best suited to support learning. In addition our work asserted a need for data capturing facilities to be 'designed into the background' to support learning analytics (Reid and Ostaszewski, 2011). This is critical, as the use of digital applications in the classroom will be determined not merely on accessibility, but by their adoption by those who intend to use these tools to facilitate learning: both principals (headmasters) and classroom teachers (De Grove et al., 2012, Flewitt et al., 2014, Reid and Ostaszewski, 2011).

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Familiarity with Technology among First-Year Students in Rwandan Tertiary Education

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Abstract: The more the students get experienced with technologies, the more the need for tertiary education systems to adopt innovative pedagogical strategies for accommodating different learning needs. Depending on students' prior experience with computer-based tools, they may have different degrees of familiarity with new technologies. At University of Rwanda (UR), for example, the familiarity and experience with technology for incoming students is not clearly known. Universities need to understand this phenomenon for efficient education planning and management. Therefore, this study aims to understand the degree of familiarity with technology for first-year students at the University of Rwanda. Accessibility, ownership, usage and previous computer-based training are used in this study' conceptual framework as factors that determine the degree of familiarity with technology. Firstly, results indicate that the majority of participants are not familiar with technology and never had any previous exposure to eLearning systems. Secondly, regarding the digital tools, while smartphones are the most accessed, owned and used tools by respondents, they rarely or never used them for learning activities. Thirdly, findings portrayed a heterogeneous technology experience with a substantial variation of access, use, ownership and previous training on new technologies among the sample. Strategies for improving experience and confidence with technology, for first-year students, are recommended for this institution. This will prepare new students for early technology uptake and readiness while empowering them to develop appropriate competencies and skills for the digital age. Further studies in the area of experience with technology are also proposed.

Keywords: familiarity with technology, net generation, tertiary education, digital tools, digital skills, first-year students

1. Introduction

Students' familiarity and experience of technology are different among first-year degree candidates in tertiary education due to several reasons (Kvavik 2005; Kennedy, Judd, Churchward, Gray and Krause 2008; Hargittai 2010; Thinyane 2010). Some factors of differences in ICT skills among students may include but not limited to early exposure to computers and other digital devices (Kennedy et al. 2008), the types of schools frequented before being admitted to universities, students' attitudes towards computers, students' degree of computer anxiety (Sun, Tsai, Finger, Chen and Yeh 2008), and the level of teachers' ICT competencies in previously attended primary and high schools.

Due to the advances in technology, computing became ubiquitous and today's young generation's life is embraced by the digital culture and environment with a remarkable increase in using computers and smartphones for different purposes. Scholars such as (Kennedy et al. 2008; Jones, Ramanau, Cross and Healing 2010) argue that the current generation of students are digital natives, though their skills are at different levels. The types of computer-based activities that students used to perform, contribute to the diversity of their skills. The same authors uphold that, since their childhood, these students were spending their most time using computers, mobile phones, and other available digital tools. By levels of experience with technology amongst students, this is described by the frequency of accessing and using digital devices. That means while students who were always using technology are strongly experienced, others who rarely got such an exposure have little or no experience with technology at all (Kvavik 2005; Oblinger and Oblinger 2005b; Kennedy et al. 2008; Bennet and Maton 2010; Thinyane 2010). Therefore, what can be noticed from the above literature is that it is broadly assumed that there is a diversity in technology experience among first-year students at universities.

From the education perspective, various e-learning platforms are being integrated to assist in education delivery (Hosein, Ramanau and Jones 2010). Hence, due to this trend, it has become a prerequisite to have a

certain degree of digital skills for learners and teachers in order to cope within the new learning environments (Ananiadou and Claro 2009; Hosein et al. 2010; Claro et al. 2012).

A particular level of familiarity with the current technology has a strong impact on students' attitude toward the use of new ICT tools available at universities (Kennedy et al. 2008; Mahmood 2009). Therefore, it is becoming more crucial for educators to know the level of incoming students' digital skills. This knowledge forms the base for informing policy-makers and the university planners to accommodate new students' learning needs by acquiring appropriate ICT infrastructure and providing a proper technical support to not only learners but also the faculty and administrators.

However, research on students' familiarity with technologies for first-year university students is still scarce especially in Rwanda and the East African region. This study aims to understand the level of familiarity with technology by first-year students in higher education considering the case of the University of Rwanda.

2. Study background

Today, universities around the world are called to consider learners' categories of experience with technology when attempting to integrate information and communication technology (ICT) in pedagogical activities. A study by (Querios and de Villiers 2016) anticipated that universities, in developing countries particularly, should consider their students' perceptions, attitudes and situations before shifting to online learning. This means that there is a need to pave the way to accommodate both computer-savvy and underprivileged learners with low digital literacy in university policies.

As students are considered as the core stakeholders in the current advocated active learning or student-centered teaching approach (Richardson and Newby 2006; Beetham and Sharpe 2013), it is crucial to get a rich picture of their previous ICT experiences. Hence, universities' pedagogy and curricula must be systematically revised to meet different learning preferences (Oblinger and Oblinger 2005b; Owston 2007). In this regard, the knowledge about incoming students' experience with technology is paramount for faculty, administrators, and other educational stakeholders.

Most scholars that explored first-year students' familiarity and experience with technologies, focused on developed countries (Kennedy et al. 2008; Nagler and Ebner 2009; Hosein et al. 2010; Jones et al. 2010; Margaryan, Littlejohn and Vojt 2011; Ng 2012). In general, findings from these scholars reveal that although many students from the sampled countries are tech-savvy, their preferences and experience with technology are highly heterogeneous. This considerable variation is linked to the patterns of ownership, accessibility, and use of computer-based tools and Internet during students early age. Another study conducted in America by (Kvavik 2005) depicted also that, although the surveyed sample of students self-reported the highest levels of computer skills, their level of IT competency in support of learning and problem solving was found very low. This author recommended a change in the curricula so that necessary digital skills for learners to cope with the current technology can be acquired during their early exposure to the university's learning environment.

Some other few studies in Sub-Saharan Africa attempted to study on students' use of ICT for learning purposes (Arif 2001; Ajiboye and Tella 2007; Czerniewicz and Brown 2009) and others for technology acceptance towards learning management systems (Abdel-Wahab 2008; Tagoe 2012). Nevertheless, their focus was not on IT experience of first-year university students. Another study that was interested in this category of students was conducted by (Thinyane 2010) to understand South African first-year students' use and experience with technology. This study portrayed a considerable variation in accessing and using technology before enrolling at university and mobile phones as the vastly accessible and mostly used digital tools. However, this study sample was only composed of South African students and thus, it is difficult to generalize these findings to many other developing countries in Africa, because the latter do not share the same technology trend with South African education systems.

Reading from the above literature, one can realize that there is a universal assumption that the current incoming students at a university have had a great exposure to digital tools. Unfortunately, this may not be the case especially in developing countries such as Rwanda. Although there are some government initiatives to introduce computers in primary and secondary schools in Rwanda, there has been no equal distribution in both public and private schools. Additionally, due to limited financial resources, only a small number students

can afford to buy smartphones and personal computers. Those are some of the reasons it could be assumed that several Rwandan incoming students get access to computers for the first time when they join the university. Thus, this has to be empirically validated.

Broadly, higher education systems from around the world are aspired by the integration of technology in the classroom (Kennedy et al. 2008; Thinyane 2010). Thus, this has to be aligned with the diversity of students' familiarity with technology and their digital skills. Particularly in Rwanda, understanding the incoming students' mixture of information literacy levels can enable the hosting universities to reduce the existing digital divide among students.

Noting that few empirical research has been done in Sub-Saharan Africa and probably none attempted to investigate the access and use of technology for incoming students at universities in Rwanda, a typical study can be important to provide a frame of reference in modernizing pedagogy through the integration of appropriate information technologies at this university or similar contexts. This study aim has been to empirically understand the familiarity with technology for first-year students at UR with the following research questions: (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?

3. Familiarity with Technology: A Conceptual Framework

Today, teaching and learning are going either blended or fully digital. Familiarity with today's advances in technology has become a requirement for students in the current higher education settings. The degree of familiarity can be determined by the extent to which students are competent and able to use a range of existing digital tools and web-based platforms to perform different computer-based activities (Kennedy et al. 2008; Ng 2012). People become digitally literate when they have acquired a particular degree of the knowledge, attitudes, and skills that enable them to use the Internet and the associated set of technologies. Also, called digital natives are individuals who can easily understand the digital media and can manage digital information or work easily in a digital environment. As tertiary education systems are going digital, this implies that new students should be able to use different digital media tools and online learning management systems, search for online information, process digital data and be able to critically analyse data in a digital environment.

The concepts of familiarity with technology, digital competence, digital proficiency, technology confidence, digital ability and digital literacy are used interchangeably when measuring and assessing individual knowledge in regard to new technologies (Martin and Madigan 2006; Calvani, Cartelli, Fini and Ranieri 2009; Sefton-Green, Nixon and Erstad 2009; Ferrari, Punie and Redecker 2012; Littlejohn, Beetham and McGill 2012). A report by (Ferrari 2012) from the European Commission presented an inclusive definition of digital competence after reviewing a range of related frameworks and concepts. He then summarizes that:

..... Digital Competence is the set of knowledge, skills, attitudes (thus including abilities, strategies, values, and awareness) that are required when using ICT and digital media to perform tasks; solve problems; communicate; manage information; collaborate; create and share content; and build knowledge effectively, efficiently, appropriately, critically, creatively, autonomously, flexibly, ethically, reflectively for work, leisure, participation, learning, socializing, consuming, and empowerment. (Ferrari 2012, p. 43)

The overall consideration of these concepts is related to values, knowledge, and skills that determine an individual's experience or proficiency in a particular technology. Although most of the current incoming students at universities are commonly described as tech-savvy, internet-savvy or computer-savvy (Combes 2006; Bennet and Maton 2010), there is still no guarantee that they all have adequate skills to cope with the current digital learning environment (Kennedy et al. 2008; Helsper and Eynon 2010). In this study, students' familiarity with technology refers to the degree of experience and ability to use digital tools. These tools include but not limited to smartphones, computers, and tablets. The ability to use these digital tools and applications for manipulating digital information is also considered as an indicator of familiarity with technology. Thus, students with ownership, access, use and ability to efficiently deal with digital information can then be described as the Net Generation learners (Dorman 2000; Oblinger and Oblinger 2005a; Barnes,

Marateo and Ferris 2007). Other scholars such as (Tapscott 1998; Prensky 2006; Bennet and Maton 2010) describe them as socially inclusive learners. Therefore, by reviewing the above literature, a conceptual framework, to analyse students' familiarity and experience of technology, has been proposed as illustrated in figure 1.

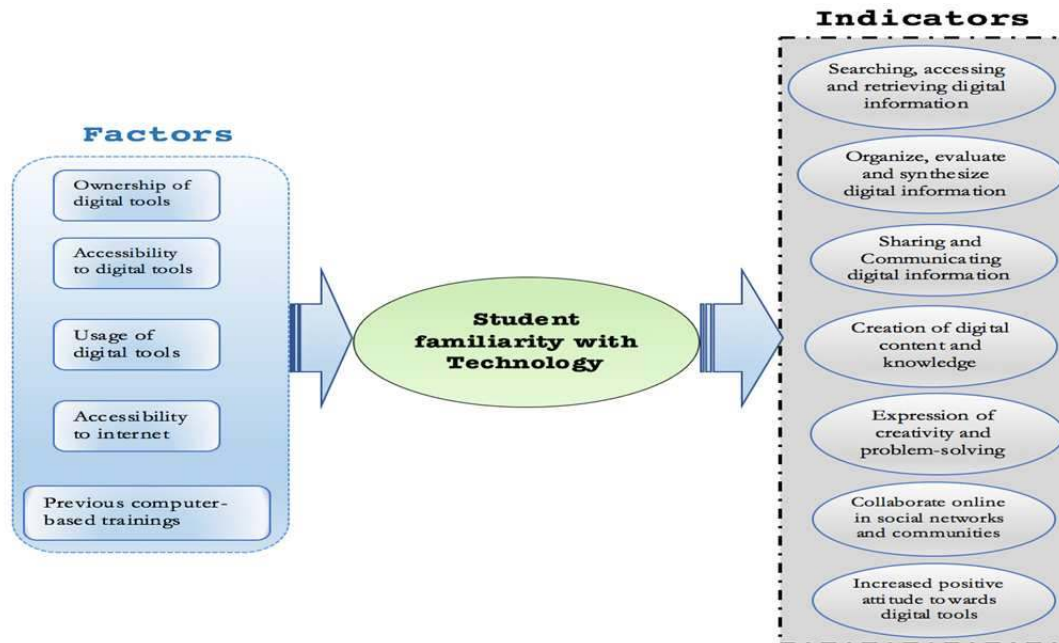


Figure 1: A conceptual framework for student familiarity with technologies

The development of this analysis framework considered the existing literature related to digital natives and tech-savvy learners. This includes but is not limited to ICT competencies, digital skills, digital literacy, ICT proficiency, ubiquitous computing and experience with technology (Tapscott 1998; Oblinger and Oblinger 2005a; Kennedy et al. 2008; Ng 2012; Santos, Azevedo and Pedro 2013). This framework is first used to map some factors that affect familiarity with technologies for today's first-year students in tertiary educational institutions, irrespective of their study programs. In addition, some indicators for technology familiarity and experience are also proposed as a basis for analysing students' digital skills.

The framework is composed of two main clusters namely factors and competencies or indicators. The most identified relevant factors of student's familiarity with technology in the explored literature include ownership, accessibility and usage of digital tools, access and use of the Internet or web-based technologies; and previous computer-based training. These components are also considered as prerequisite and primary triggers for an individual to be familiar with a particular technology.

The second category includes various effects of being acquainted with technology. In other words, it encompasses a set of tech-savvy students' competencies (Oblinger and Oblinger 2005a; Feiertag and Berge 2008). These include capabilities to collaborate in online social networks and communities, to search, access and retrieve digital information, to organize, evaluate and synthesize digital information, to communicate or report information using digital tools, to create digital content and express creative knowledge and problem-solving skills using digital tools. More specifically, both factors and indicators that are used to conceptualize the framework are mostly related to the early exposure to technology by students before enrolling in higher education programmes. Both factors and indicators of the framework served as the basis to formulate the research questionnaire that was used in this study.

4. Research Method

4.1 Instrument and procedure

Due to the study limited time and the types of data to collect, a survey was used as a research strategy (Denscombe 2010) to gather factual information from students. With this strategy, web-based and paper-based questionnaires, with a mix of closed and open-ended questions (Denscombe 2010; Cohen, Manion and Morrison 2013) were developed and distributed to the sample of first-year students. Based on the survey instruments used by (Kennedy et al. 2008) and (Thinyane 2010), a questionnaire was developed to evaluate the degree of ownership, access use and previous experience with technology for first-year students. This instrument was composed of three main sections: participants' demographic information; ownership, access and use of computing tools and the Internet; and the level of confidence with technology and previous computer-based training to acquire digital skills.

An authorization for conducting this study was obtained from the Directorate of research and postgraduate studies at the university, prior to the administration of the questionnaire. Prior to distributing the questionnaire, it was tested and validated by four instructors with strong experience in educational technology and eLearning systems. Additionally, two lecturers with expertise in computer and systems sciences also reviewed it. All their comments and suggestions were highly considered in designing the final version of the questionnaire. Accordingly, the System Administrator at university assisted in creating and validating the web-based questionnaire version.

The data were collected during registration and orientation periods from September to October 2015. The online version of the questionnaire was created and its link was embedded in the university's online registration platform. Students were directed to the questionnaire link after the registration process is completed. Using two research assistants, paper-based questionnaires were also administered face-to-face to students via the academic registrar's offices at each college. In addition, with the assistance of Class representatives and Heads of Departments, the same questionnaire was distributed in classes of first-year students. Prior to launching the questionnaire, all participants were clearly informed through an introductory letter, that the participation in the research was voluntary and that the collected information will be kept confidential.

The collected valid data were analysed using two computer-based statistical packages (Muijs 2010). First, both paper-based and online data were entered in SPSS, a quantitative analysis software, before being analysed for determining the frequencies of students' ownership, access and use of technology; and their level of digital skills. Secondly, for data visualization, tables and figures were created using Microsoft Excel. This visualization was important to highlight the disparities and similarities of students' familiarity factors and indicators of their digital skills level as illustrated in the conceptual framework used for this study (See figure 1).

4.2 Participants

This study is limited to first-year students at University of Rwanda for the academic year 2015-2016. In total, a random sample of 576 students completed successfully the questionnaire used in this research. While 286 used the online questionnaire, 290 used a paper-based questionnaire. Among the total sample, 381 (66.14%) are males while 195 (33.85%) are females. The majority of participants' age is between 18 and 25 years old, which is equivalent to 526 students (91.3%). Students who participated in this study were from different previous study backgrounds. This information is presented in Table 1 in line with their secondary school majors.

Table 1: *Students' major categories*

	N/A	Non-STEM	STEM	TVET	Education	Total
Numbers	8	233	287	28	20	576
Percentage	1.4	40.5	49.8	4.9	3.5	100

As it can be observed from the Table 1, students that composed the sample for this study represented four main secondary school majors. The latter include (STEM) Science, Technology, Engineering and Medicine (40.5%), Non-STEM (49.8%), (TVET) Technical and Vocational Education Training (4.9%) and Education (3.5%). All the six colleges of the University of Rwanda are represented in the sample with the following proportions: College of Business and Economics (30.90%), College of Education (19.27%), College of Science and Technology (18.75%), College of Medicine and Health Sciences (12.33%), College of Agriculture and Veterinary Medicine (10.76%) and College of Arts and Social Sciences (7.99%). Figure 2 illustrates this distribution.

Distribution of respondents by college (in percentage)

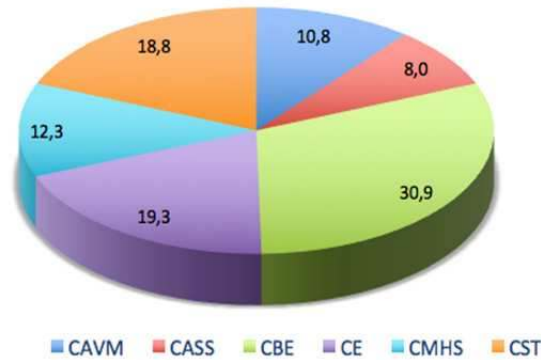


Figure 2: Respondents by college

5. Results

5.1 Access to digital tools

In line with the theoretical framework adopted for this study, respondents were asked to report about their access to a range of mostly available digital tools and the Internet. A unipolar rating scale was used from “Unlimited Access” to “No Access”. Those who have missing data for this variable of accessibility, were classified as “Not Sure”. In order to facilitate data interpretation for an easier understanding, respondents who reported having limited and very limited access to the proposed digital tools and Internet are categorized as “Limited Access”. Those who reported that they have no access and not sure are also combined to form one single category called “No Access”.

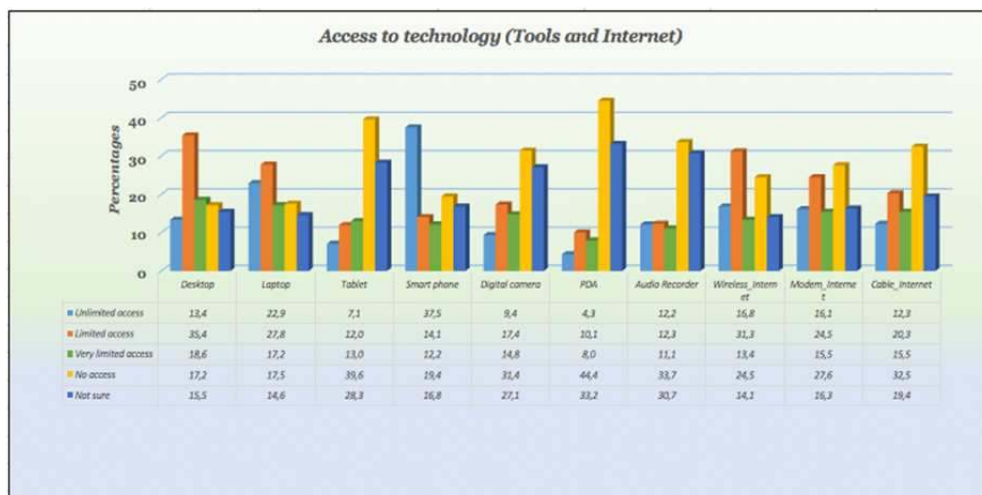


Figure 3: Students’ accessibility to technology

As it can be observed from Figure 3, the degree of access to both digital tools and the Internet is proportionally low among respondents. This is explained by the fact that the majority of respondents have a limited access (54%) and no access (32.7%) on desktop computers. The same situation is observed on laptop computers as (45%) of respondents have a limited access and (32.1%) have completely no access. Further analysis shows

also a high proportion of students with limited access (25% and 32.2%) and no access (67.9% and 58.5%) to tablet and digital Camera respectively. Not surprisingly, results indicate a slight increase of students with unlimited access (37.5%) to smartphones but still, the same data show that the remaining subsets have a limited or no access to mobile phones with a total of (62.5%) of respondents. Another observed trend is that smartphones are the highly accessed tools when compared with other proposed tools. In the same Figure 3, data indicate that the majority of respondents in this study do not have access to PDA (77.6%) and Audio Recorder (64.41%) respectively.

Nevertheless, on the accessibility to the Internet, related data indicate a similar trend as for digital tools in regard to the proposed types of the Internet access. For the wireless network, while 44.7% of respondents have a limited access and 38.6% with no access at all, only 16.8 % of the sample reported having unlimited access. Adding to that, only 12.3% of students reported having access to cable network while the rest of the sample have either limited (35.8%) or no access (51.9%) correspondingly. For the Internet modem, only 16.1% of respondents reported having unrestricted access while the majority of them have a very restricted (39.8%) or no access (43.92%) to this type of Internet network. Overall, the statistics reported in Figure 3 portray a significant heterogeneity among respondents' access to technology and a substantial number of students with limited or no access to the proposed digital tools and Internet.

5.2 Ownership of digital tools

In this study, respondents were also asked about which tools they own. Seven commonly computer-based tools that are especially used by students for different learning activities. The findings are presented in Figure 4.



Figure 4: Ownership of Digital tools

As illustrated in Figure 4, smartphones are the most owned digital tools by 41.32% of respondents although still, a large proportion of them do not own this gadget (58.7%). Additional analysis shows that, while only 26.2% of respondents have their own laptops, the remaining six proposed digital tools are slightly owned by less than 10% of students who participated in this study.

5.3 Frequency of using digital tools

The access and ownership of digital tools and Internet do not necessarily mean that an individual is familiar with technology. Thus, the level of using these tools has a huge impact on the degree of familiarity with a range of technologies. This study was also interested in understanding how frequent students have been using digital tools. Participants were asked to rank their frequency of using digital tools as follow: Always, Sometimes, Often, Rarely and Never. Figure 5 presents the results of students' frequency of using the seven proposed digital tools in this study.

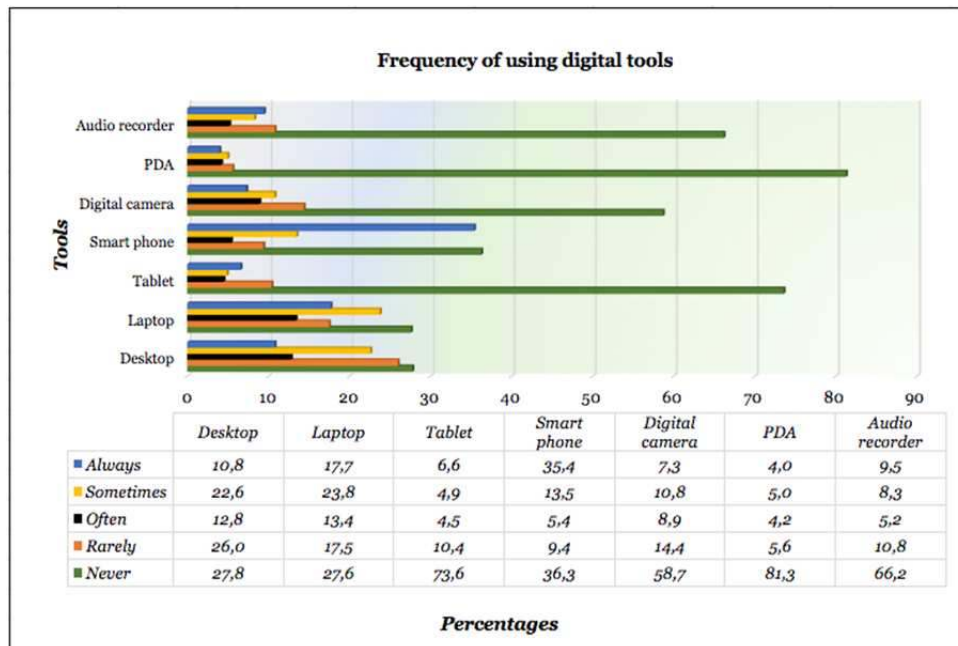


Figure 5: Frequency of using digital tools

As it can be seen from Figure 5, smartphones are the most frequently used tools by 35.4% of the surveyed students although this number is still not substantial. The same data show a slight number of students who frequently used desktops (10.8%) and laptops (17.7%). While respondents rarely (26%) or never (27.8%) used desktop computers, the same trend is also observed for laptop computers which were also rarely or never used by (17.5%) and (27.6%) correspondingly. Other tools such as tablets, audio recorders, digital cameras and PDAs record a very low frequency of usage which is less than 10% of study participants.

To sum up on this section, one can realize that the proportion of respondents who rarely or never used each of the proposed tools surpassed greatly the one for those who have been moderately and highly using these tools. Although not to a desirable degree, smartphones and laptops are reportedly the most frequently used tools by respondents.

5.4 Students' activities using computer-based technologies

This study was also interested to know what students do with the proposed digital tools. Hence, participants were asked to indicate how often and which activities they performed offline using computing tools. The results are presented in Figure 6.

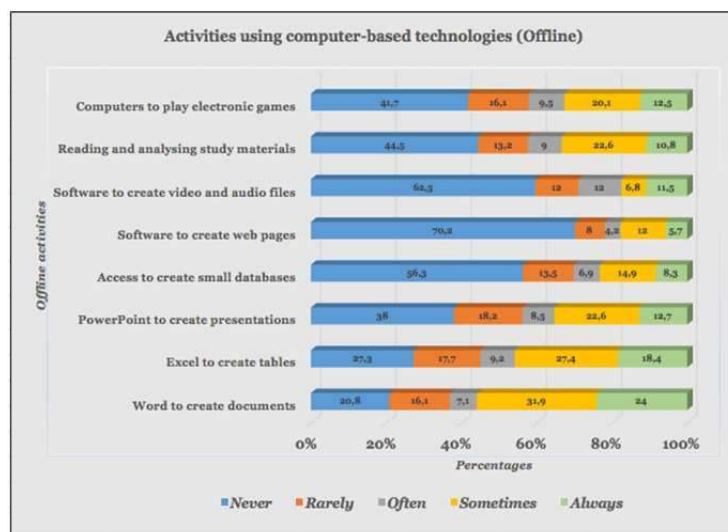


Figure 6: Activities using computer-based technologies

As visualized in Figure 6, the figures indicate that a small proportion of participants used the basic digital tools. For example, only 24% created documents most regularly using Microsoft word while Excel and PowerPoint tools were also used by (18.4%) and (12.7%) respectively to create tables and presentations. In addition, only (8.3%) used Access package to create small databases. For other proposed activities, the majority of students who participated in this study never created web pages (70.2%) and videos or audio files (62.5%). More alarming is that a substantial number of respondents (44.5%) never used computers for reading and analysing course materials.

5.5 Students' activities using mobile-based technologies

Having considered mobile phones as the important tools to increase familiarity and experience with technology, students' activities using a smartphone were further investigated. Participants were asked to indicate the activities they perform using smartphones. The findings for this section are presented in Figure 7.

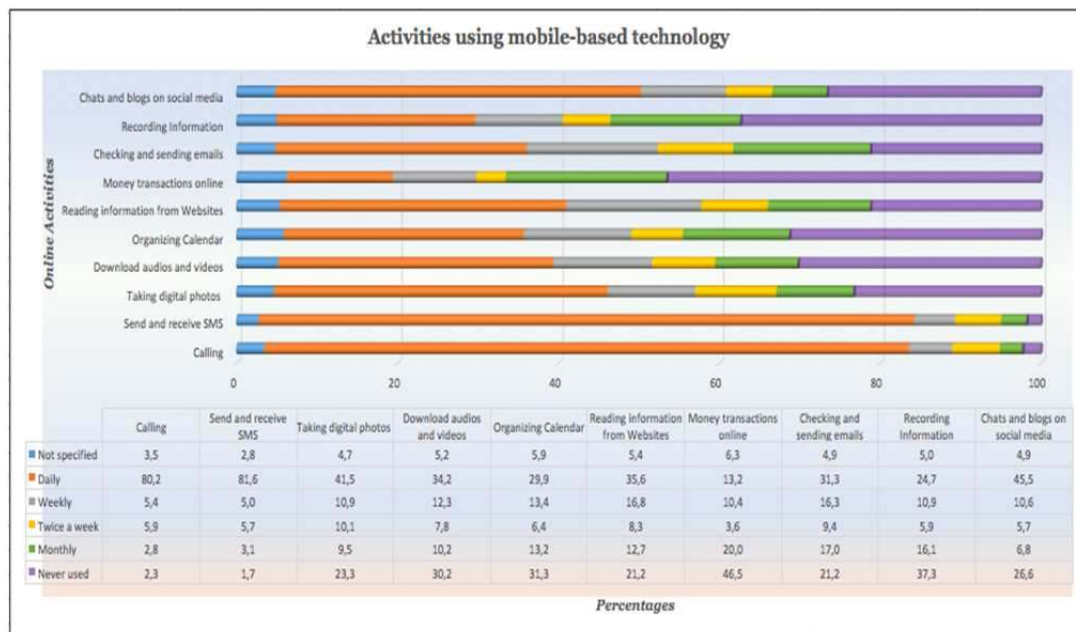


Figure 7: Activities using mobile-based technologies

As illustrated in Figure 7, the results indicate that respondents use mostly their smartphones for calling (80.2%) and texting messages (81.6%) on a daily basis. A substantial proportion of participants have been also using their phones daily for chatting and blogging (45.5%) and taking pictures (41.5%). On the other side, the data indicate that some important features offered by today's current technologies are still not yet used by respondents. For example, respondents never used their smartphones for online money transactions (46.5%), recording information (37.3%), organizing calendars (31.3%) and download audio/video files (30.2%). Another significant proportion (21.2%) of participants never used their mobiles phones to access and read information on websites, and exchanging emails.

5.6 Students' activities using web-based technologies

Like mobile-based technologies, using online-based tools has also an impact on the familiarity with technologies. For this reason, this study went further to describe the activities performed by students using web-based tools. The results are visualized in Figure 8.

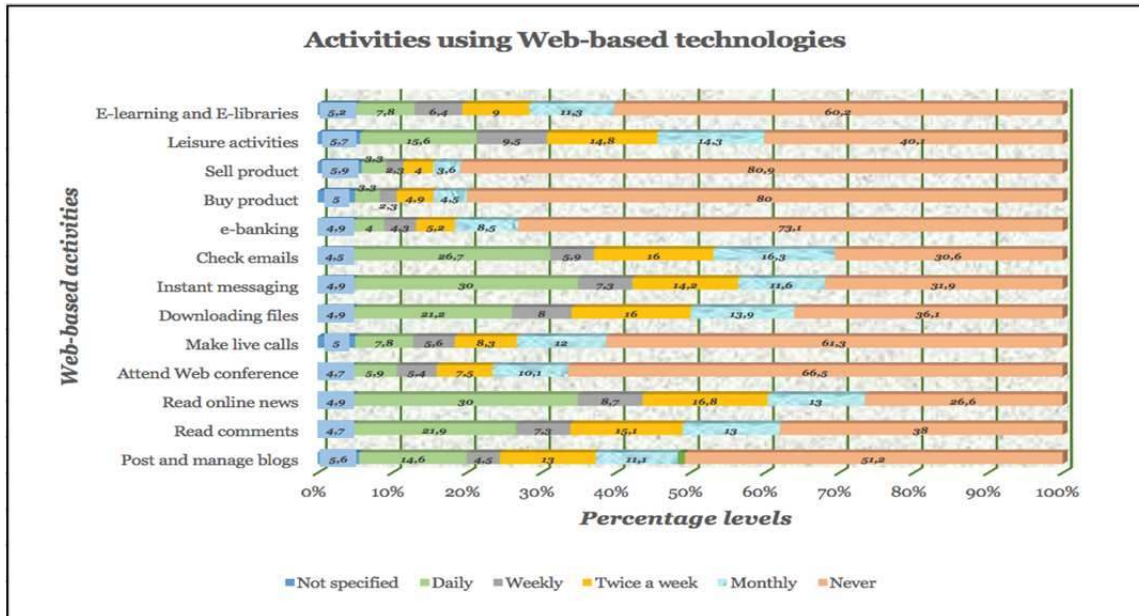


Figure 8: Activities using web-based technologies

As illustrated in Figure 8, more than 60% of students reported that they never used the web tools to attend online conferences and to make live calls. More to highlight is that a substantial proportion of respondents (60.2%) never used eLearning systems and E-libraries before registering at the University of Rwanda. Only a small subset of respondents (30%) used web-based tools to read online news (30%), send instant messages and to read and receive emails (26.7%) at least on a daily basis. But on the other hand, the majority of the sample reported having neither buy or sell products online (80.9% and 80%) and making online banking (73.1%). Overall, the figures in this section indicate that participants are not frequently involved in online web-based activities.

5.7 Students' self-confidence on the use of computer-based tools

Participants were asked to express their level of confidence vis-à-vis a range of nine digital tools. Figure 9 presents the results of respondents' self-reported degree of confidence which are ranked in scales from strongly confidence to no confidence.

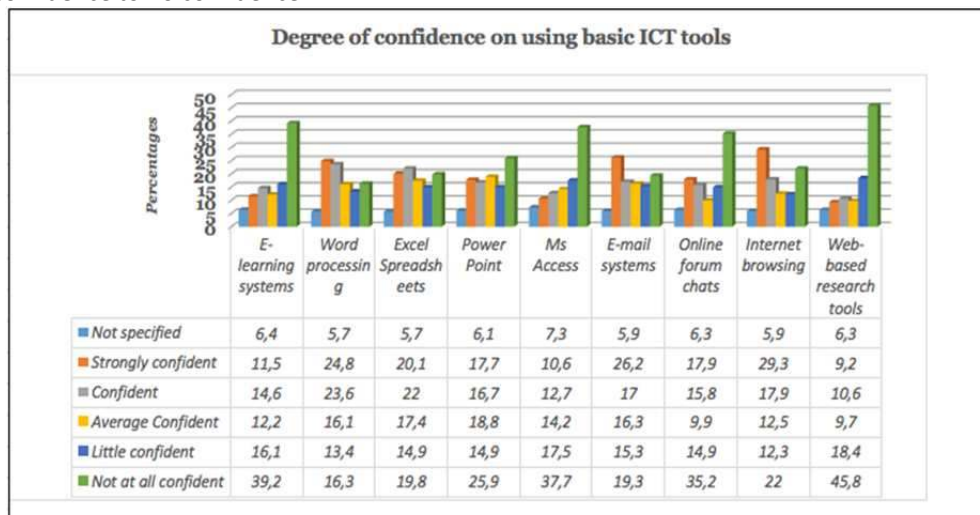


Figure 9: Degree of confidence on using computer-based technologies

As illustrated in Figure 9, many respondents reported that they have little or no confidence at all in using web-based research tools (64.2%) and eLearning systems (55.3%). While Internet has become an important tool for teaching and learning in universities, it is surprising to know from data in Figure 9 that only a small proportion of respondents are confident with eLearning systems (26.1%) and web-based research tools (19.8%).

In a general view, the data about first-year students' confidence in using computer-based tools are not significantly substantial at least for the considered sample, while most of the proposed range of digital tools are much used for learning in higher education.

5.8 Previous computer training

Having been previously offered some training, either on basics or advanced computer applications contribute enormously to an individual's degree of familiarity and confidence with technologies. This study went further to investigate this factor from respondents. Results for this section are clustered in colleges for which students have been registering in.

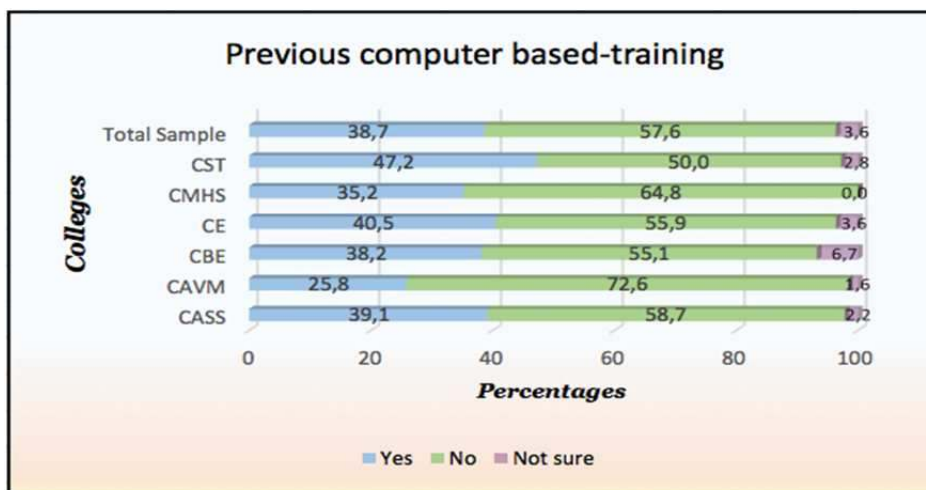


Figure 10: Previous computer-based training

As illustrated in Figure 10, the majority (57.6%) of the first-year students considered in this study never got any training on computer applications. When you observe these data by college, the figures of those who never got a training continue to be considerably higher, more especially for the College of Agriculture and Veterinary Medicine (72.6%) and the College of Medicine and Health Sciences (64.8%) respectively. This means that a considerable number of first-year students at this university do not have adequate digital skills and competencies as proposed by the conceptual framework used for this study.

5.9 Previous experience with E-learning systems

Another interest of this study was to assess the first-year students' previous experience with an online learning environment. Respondents were asked to rate the degree of difficulty or stress-free for some eLearning systems that they previously used. To analyse this experience, students have been clustered in their respective majors at secondary schools. The findings regarding this question are presented in Figure 11.

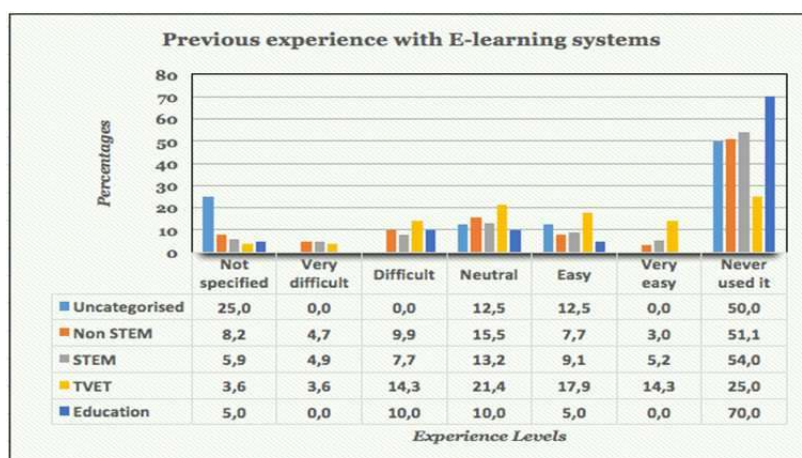


Figure 11: Students prior experience with eLearning systems

As illustrated in Figure 10, it indicated that a substantial proportion of respondents from education (70%) and STEM (54%) never used eLearning systems for educational purpose. Therefore, for those subsets, it is not possible to know their experience with the online learning environment as they never had such an exposure.

The findings show also that students with difficulties in using eLearning platforms are relatively higher than those who found it easy across all secondary school majors. But in the overall, the variation among the surveyed sample on how difficult and easy they find using eLearning platforms is relatively small. This means that the figures are less than and close to 20% for all students' major categories.

6. Discussion

As described in the introduction and background of this paper, the knowledge about students' familiarity with technology in Rwanda and similar contexts was still limited. Thus, this study revealed empirically the level of first-year university students' experience with technology and the extent to which they can use ICT for learning purposes. According to the conceptual framework used for this study (Figure 1) accessibility, ownership, usage and previous experience with digital tools and Internet were used as four main factors that can determine the degree of an individual's familiarity with a particular technology. By taking into consideration the statistical data presented in Section 5, important findings in line with these factors are observable.

Starting with technology access, the findings presented in Figure 3 indicate that a substantial number of first-year students had a limited or even no access to a number of digital tools such as desktops, laptops, tablets, and smartphones. The same situation was also noticed for students with limited or no access to the Internet. Therefore, with these findings, differences in access to technology among the first-year students are noticed from at least the investigated sample. By investigating the ownership of digital tools, it was also revealed (See Figure 4) that the majority of first-year students at University of Rwanda do not own any of the proposed digital tools. Hence, this study coincides with the scholars such as (Thinyane 2010) and (Kennedy et al. 2008) who concluded that there is a diversity among first-year students' degree of technology access in their respective study samples.

These findings can serve as a basis for developing a policy and mechanisms for "Bring Your Own Device" program. This is also in line with the work of (Afreen 2014) who portrayed that owned devices are much used at universities for educational purposes by students. This is also a program which is hugely supported by the Government of Rwanda.

Regarding the use of technology, while the results indicate that some students are somehow at a slightly increased level of using digital tools and Internet (See Figure 6), it is important to note that even most activities they perform are not related to the learning purposes (See Figure 6 and 8). Therefore, the results of this study concur with the assumption of (Van Dijk and Hacker 2003) about the appearance of "usage gap" between individuals who use digital tools and Internet for education purpose on one hand, and those who use them just for entertainment. As discussed in the previous section, the majority of surveyed students have rarely or never used computer-based tools for online learning (See Figure 6 and 8), reading and analysing study materials (See Figure 6), and web-based research tools (See Figure 9). This overlap with the work of (Kvavik 2005) who also claimed that the high levels of access and use of computing tools, and the students' digital skills do not certainly translate into their preferences of using technology for educational activities.

To understand the students' experience with technology, we, first of all, analysed their previous computer-based training. Results show that still the majority of surveyed students for each college (See Figure 10) never had any ICT related training. However, this entails that their level of digital skills and competencies, as proposed by the conceptual framework used for this study, is problematic. Secondly, to highlight more on this, further analysis of their self-reported degree of confidence show also that their level of experience with technology is low, as portrayed by a substantial number of students (See Figure 9) who reported that they have very little or no confidence for a number of technologies.

After that, by investigating the students' previous experience with eLearning systems, results indicated also that the majority of the sample (See Figure 11) never had any previous experience with online learning platforms. Thus, the students' previous little exposure to eLearning based-tools brings us to hypothesize that their level of knowledge towards these tools, as one of the indicators of familiarity with technology (See Figure

1), is very low. That is because the more you use a particular tool, the more you become familiar with it and this has not been the case for at least the sample used in this study.

In general, the overall results denote a lack of a uniformity for the surveyed students in terms of digital capability and a significant variation in student's degree of familiarity and experience with the current technology. This is explained by the fact that there is a substantial variation in their levels of performing different activities online. Therefore, although not at the same level, first-year student's heterogeneity has been observed in access, use, ownership and previous experience with technology. In contrast, while a study conducted by (Kennedy et al. 2008; Jones et al. 2010; Thinyane 2010) revealed that it is a little minority of their sample that does not substantially use technology, instead in this current study, it is the majority of first-year students that rarely or never used technology.

Therefore, there is a high ratio of digital divide among incoming first-year students in Rwandan higher education with regard to ownership, access, and use of digital tools and Internet. This situation may be seen from geographical and social-economic dimensions as also revealed by (Hindman 2000; Warschauer 2004; Ching, Basham and Jang 2005). While the universal assumption in the literature conveys that the current students are denoted as "Net Generation or Dot.Coms" (Barnes et al. 2007; Shaw and Fairhurst 2008), this study results contrast this perception at least for the first-year students in Rwandan tertiary education context and probably the similar milieus across the world. Although the surveyed students in this study are born in the digital era (after 1980) when the Internet and World Wide Web was thriving (Tapscott 1998), the results for this study indicated that their degree of computer-based technologies does not qualify them as tech-savvies. Therefore, this study agrees with other scholars such as (Kennedy et al. 2008; Jones et al. 2010; Thinyane 2010) who claimed that the Prensky's concept of digital natives or net-generation students could not be universally generalized. Undoubtedly, referring to this study results, it is realized that adhering to the Net Generation students, does not necessarily imply that someone has adequate knowledge for using available digital technologies for learning purposes in the current digitalized tertiary education context.

7. Conclusion

This study aimed to understand the degree of familiarity with technologies for the new incoming students at the University of Rwanda. Factors of previous experience, ownership, access to and use of technology were used as determinants of familiarity with technology.

The study revealed that the majority of incoming first-year students at University of Rwanda are not tech-savvy and they are at different levels of technology readiness. This means that only very few incoming students at the University of Rwanda can search and retrieve digital information, evaluate and synthesize soft data, and share and collaborate in a digital learning environment of the current higher education systems. With their low degree of accessibility, ownership, usage and previous experience with technology (as indicated by the study results), it can be difficult for them to use a range of digital tools. This slight or lack of exposure to computer-based tools by the surveyed sample can predict that the degree of using available online learning resources at UR by first-year students is more likely to be undesirable.

Therefore, this is an early warning to teachers and educational planners in Rwandan tertiary education to revisit the institutional curriculum in order to accommodate these students' needs, especially for better learning in a digital environment. More especially, course designs should be aligned with this lack of homogeneity in students' familiarity with technology in order to effectively accommodate their differences. There is a need for change in curriculum reform in order to take into consideration the diversities of the Net Generation students (Beyers 2009) at University of Rwanda and similar contexts in the region. While this university continues to shift the majority of courses/modules from traditional to the online learning environment, this study can serve as a reference for improving first-year students' digital literacy and meeting their learning preferences.

Finally, in order for those new students to cope within the current university's digital learning environment, the university has a big challenge to bridge the gap among them by increasing access to computer labs and Internet. Although the Government of Rwanda has initiated the laptop ownership project by all new university students, this study shows that access and ownership of these tools are not the only factors to assess student's familiarity with technology. Instead, teaching approaches that involve the integration of computer-supported

collaborative learning activities (Stahl, Anderson and Suthers 2006; Owston 2007) should be put in place at the early stages for first-year students classes. That means, teaching with technology at UR should be aligned with first year students' degree of access to, ownership and experience with digital tools. For example, in order to increase their familiarity with technology, students have to be introduced to a range of available educational technologies, such as online learning forums and blogs, electronic libraries and other online learning management systems, at the early start of their university course activities. This alignment will allow students to develop digital high order thinking skills that enable them to process computer-based information and easily collaborate online.

As results indicated an increased proportion of access, ownership, and use of smartphones, compared to other tools, the university should emphasize designing courses that are also compatible with mobile phones, provided that there is increased, free Internet access for students at the campus. The same recommendation of introducing mobile based-learning technology was also put out by (Thinyane 2010).

In this study, the continuing university students were not considered and thus, further research should follow this category chronologically to evaluate their technology uptake by the time they will have completed their study programmes. Other studies could go further to investigate the university teachers' degree of familiarity and experiences with a range of common educational technologies that support teaching and learning activities by considering the University of Rwanda or comparing them with other universities in the region.

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A Literature Review of the Factors Influencing E-Learning and Blended Learning in Relation to Learning Outcome, Student Satisfaction and Engagement

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Abstract: In higher education, e-learning is gaining more and more impact, especially in the format of blended learning, and this new kind of traditional teaching and learning can be practiced in many ways. Several studies have compared face-to-face teaching to online learning and/or blended learning in order to try to define which of the formats provides, e.g., the highest learning outcome, creates the most satisfied students or has the highest rate of course completion. However, these studies often show that teaching and learning are influenced by more than teaching format alone. Many factors play significant roles, and this literature review will look further into some of them.

The review has a special interest in professional bachelor education and teacher training, and it focusses on factors that influence learning experiences in e-learning, online learning and blended learning. Thus, the research question of the review is as follows: Which factors are found to influence e-learning and blended learning in relation to learning outcome, student satisfaction and engagement in collaboration in higher education and particularly in professional education?

The findings from the research papers included in the review show that among the many factors some seem to dominate more: educator presence in online settings, interactions between students, teachers and content, and designed connections between online and offline activities as well as between campus-related and practice-related activities. The article thus points in the direction of some significant factors, but it also discusses and questions the relevance of research focusing on comparisons between individual formats of e-learning, online learning, blended learning or "traditional" face-to-face teaching and learning. Teaching and learning are complex and are influenced by more than just the teaching format. The review is based on systematic database searches conducted in January 2017, and it includes 44 peer reviewed articles and papers published between 2014 and 2017.

Keywords: e-learning, online learning, blended learning, hybrid learning, learning outcome, student satisfaction, collaboration

1. Introduction

In the literature reviewed, a great number of studies have aimed at determining whether computer-mediated education in the form of e-learning, blended learning or hybrid learning is better than traditional face-to-face teaching in relation to, for instance, learning outcome and student satisfaction. Researchers, educators and educational decision makers alike are eager to find out which format leads to the best results for their students and the educational institutions. However, as we shall see below, comparative studies of educational formats show different results, which might indicate that factors other than the format alone influence learning outcome, satisfaction, student retention et cetera.

In this review of the literature on e-learning, we present and discuss definitions of e-learning, hybrid learning and blended learning, and we review the literature comparing different online teaching formats with traditional on-campus/face-to-face teaching. With this point of departure, we explore which factors affect students' learning experiences in different online formats in higher education, with particular emphasis on professional education and teacher training. The review serves to show that some factors are more prominent than others, and these factors, including spaces, learning community and student identity, course design and the educator's role, are further discussed.

1.1 Methods

The literature search on which the present review is based (Bryman, 2012; Creswell, 2013; Machi & McEvoy, 2016), serves the purpose of identifying papers that may contribute to answering the following research

question: which factors are found to influence e-learning and blended learning in relation to learning outcome, student satisfaction and engagement in collaboration in higher education and particularly in professional education? A systematic search in the Educational Resource Information Center (ERIC) and ProQuest databases was carried out in January 2017, using the search keywords ["e-learning" OR "online learning" OR "blended learning" OR "hybrid learning"] AND ["innovation" OR "teacher education" OR "learning outcome" OR "collaboration" OR "satisfaction"]. To ensure that the latest findings are presented in the review, the systematic search was restricted to articles published between 2014-2017.

The database searches generated a total of 135 articles. The authors read the full articles, discussed how to categorize them and, eventually, 93 articles were selected as relevant and grouped into 13 major categories that affect e-learning and blended learning in higher education. The 13 categories were further reduced to five categories based on an estimate of which categories were most dominant, i.e. the categories that involved the highest number of hits. Thus, the review draws on a total of 44 articles and addresses the following categories: spaces, learning community and student identity, course design and educator roles. More papers are published in 2015 (20 papers) than in 2016 (13 papers) and 2014 (11 papers), but all categories are discussed throughout the period.

Below, we present the results from our reading and analysis of the articles included in the review by starting out with a discussion of the selected comparison studies on online, blended and face-to-face (F2F) formats.

1.2 Comparison studies on online, blended and F2F formats

Several studies (e.g., Bernard et al., 2014; Chigeza and Halbert, 2014; González-Gómez et al., 2016; Israel, 2015; Northey et al., 2015; Ryan et al., 2016; Southard, Meddaug and Harris, 2015) have compared F2F teaching to online learning and/or blended learning in order to try to define which of the formats provides, e.g., the highest learning outcome, creates the most satisfied students or has the highest rate of course completion. In the following, we make an introductory review of recent comparative studies of the three formats mentioned. The main focus will be on summing up the results developed by these studies and discussing some of the limitations said to accrue to comparative studies of teaching formats. In the literature reviewed, it is often shown that teaching and learning are influenced by more than teaching format alone as many other factors play significant roles.

Before embarking on our comparative review of the three different teaching and learning formats, we will begin by clarifying how each of them is definable according to studies of the different formats. Although there has not been complete agreement among researchers about the precise definition or meaning of the term 'blended learning' in particular (Bernard et al., 2014; Chigeza and Halbert, 2014), consensus has still built up around a sense of fairly clear distinctions between the three formats. Definitional questions do not, however, seem to haunt the terms 'face-to-face learning' and 'online learning' in the same way as they do 'blended learning' in the articles reviewed. Their meaning appears to be more or less agreed upon.

For instance, the F2F learning format is characterized as "traditional" by many of the authors, referring to the fact that this is the format with the longest history of the three formats and in relation to which online and blended learning represent a modern or innovative intervention (e.g., Chigeza and Halbert, 2014; Adams, Randall and Traustadóttir, 2015; Pellas and Kazandis, 2015; González-Gómez et al., 2016). Generally, its meaning derives from an understanding of an instructional format that involves a physical classroom and the synchronous physical presence of all participants (i.e., teachers and students). One study emphasizes that even in-class use of computers and educational technology does not affect the definition of the F2F format so as to change it into blended learning (Bernard et al., 2014).

Online learning is commonly defined in contradistinction to F2F learning (e.g., Ryan et al., 2016). Its most prominent feature is the absence of the physical classroom, which is replaced by the use of web-based technologies offering opportunities for out-of-class learning independent of time, place and pace (Bernard et al., 2014; Chigeza and Halbert, 2014; Northey et al., 2015; Israel, 2015; Potter, 2015). Ryan et al. (2016) point out that "in the context of higher education, the phrase *online learning* is often interpreted as referencing courses that are offered completely online; [...]" (p. 286). Typically, the online learning setting is launched through so-called learning management systems (LMS) or virtual learning environments (VLE) such as Moodle and Blackboard (Pellas and Kazanidis, 2015).

The terms blended learning and hybrid learning sometimes seem to be used interchangeably (Ryan et al., 2016). According to Bernard et al. (2014), who builds on Graham's definition (2005), blended learning can be defined as "the combination of instruction from two historically separate models of teaching and learning: traditional F2F learning systems and distributed learning systems" (p. 91). In some cases, blended learning is seen as the more effective counterpart to the other two formats used separately (Pellas and Kazandis, 2015; González-Gómez et al., 2016) insofar as it is, e.g., characterized as F2F and online learning being "optimally integrated" (Israel, 2015) or combining their "benefits" (Adams, Randall and Traustadóttir, 2015). Moreover, several studies seem to agree that blended learning is definable according to the relative time spent on respectively online and F2F instruction in courses. Thus, at least 50 percent of total course time dedicated to F2F instruction appears to be the lower limits of in-class components in the blended learning format (Bernard et al., 2014).

Many studies compare the effect on students' learning outcome generated by respectively F2F teaching and/or blended learning. In Bernard et al.'s (2014) meta-study of blended learning in higher education, students in blended programs have turned out to achieve slightly better than students following traditional classroom instruction programs. Similar findings have been made by other studies – e.g., Israel (2015), Northey et al. (2015), Southard, Meddaug and Harris (2015), González-Gómez et al. (2016) and Ryan et al. (2016).

What leads to a better learning outcome among students in online and blended learning programs is, however, a question that is not answered in the same way by all the studies mentioned. Bernard et al. (2014) conclude that the element of technology integration in blended learning courses seems to lead to very low, though significant improvement in student achievement – particularly when technology yields cognitive support (e.g., simulations) or facilitates student interaction (i.e., with other students, content and teachers). In González-Gómez et al.'s study (2016), it is the adoption of a flipped classroom model of blended learning in a general science course that results in higher grades among teacher training students when compared with those achieved by students following a traditional classroom setting. Though no specific predictor is mentioned by Israel (2015) or Potter (2015), the former still observes modest positive impacts on students' learning outcome resulting from the adoption of the blended format, while the latter records grades "significantly higher in the hybrid option than for the traditional face-to-face format" (p. 7).

Despite widespread agreement that the blended learning format produces better learning achievement among students, other studies have shown the exact opposite. In a comparative study by Adams, Randall and Traustadóttir (2015) the overall finding is that university students following a hybrid introductory course in microbiology were less successful than their peers following the same course in a F2F version. Less interaction with the material or a sense of isolation arising from less class attendance are counted among potential reasons for the hybrid students' lower success. Similar findings are mentioned in Powers et al.'s study (2016) of students' performance in respectively hybrid and traditional sections of an introductory psychology course where a significant decrease in exam grades throughout the semester was observed for students in the hybrid section. A suggested reason for this negative difference in achievement for students following the hybrid program is that these students had to deal with difficult concepts independently and without sufficient explicit F2F teaching. In contrast, another study reaches the opposite conclusion and points to similar circumstances as a way of explaining. In fact, a better academic outcome for students in a blended education program is precisely attributed to the opportunities given to them for working independently through participation in student-centered asynchronous collaborative learning activities supported by Web 2.0 media such as Facebook (Northey et al., 2015).

On the whole, our review of studies comparing F2F teaching to online and/or blended learning reveals that no inherent features of any of the three teaching formats produce either better or poorer learning outcomes for students. Rather, what leads to either is not the format itself, but is circumstantial and context-dependent. What one study counts as inhibiting for students' learning, another finds conducive to it (cf. Powers et al., 2016; Northey et al., 2015). Therefore, as, for instance, Ryan et al. (2016) conclude in their comparative study of community college students in traditional classroom-based and blended courses, "[...] blended learning opportunities are carefully designed to capitalise on both technological advances and multidisciplinary knowledge about academic content, as well as learning and instruction" (Ryan et al., 2016, p. 296). In other words, student learning in online and blended courses appears not "[...] to arise from technology alone but from the combined influence of implementation, context, and learner characteristics as these factors interact with technology (Ryan et al., 2016, p. 296).

Thus, below we explore the first of our contextual categories which has emerged as one of the factors that significantly influence e-learning and blended learning in higher education, i.e. the category of spaces, learning community and student identity.

2. Spaces, learning community and student identity

In this part of this review, we look into teaching and learning environments, student identity and learning communities, putting particular emphasis on the aspects highlighted by the reviewed literature to be of specific importance for professional education students' learning experience in online and blended programs. Several studies have noted that the online element of blended learning education has important implications for students' experience of the learning setting (c.f. Saghafi, Franz and Crowther, 2014), the learning community and their own learner identity (Baxter and Haycock, 2014).

Some research emphasizes the extent to which the absence of the F2F environment in asynchronous online teaching reduces the possibility of in-person interaction between students and instructors (Saghafi, Franz and Crowther, 2014) despite the importance that is still attached to F2F communication in students' learning experience (Tambouris, Zotou and Tarabanis, 2014; Israel, 2015; Bolsen et al., 2016). Nonetheless, the same and other research has pointed to the advantages that the online teaching environment offers – e.g. in terms of “shifting the learning environment to a more social, flexible and personal space” and thus promoting a student centered, problem-solving and social constructivist approach to learning (Westermann, 2014; Saghafi, Franz and Crowther, 2014, Gonzàles-Gómez et al., 2016). The latter is, moreover, increasingly becoming a feature said to characterize contemporary learning settings in general.

According to Saghafi, Franz and Crowther (2014), the online learning setting will not, however, replace activities taking place in F2F environments in higher education. Rather, their research shows that both the F2F and web-based learning environments have their respective uses – but also their limitations. Therefore, they conclude that both settings work together in complementary ways for students if a holistic model for blended learning is adopted. Especially in professional education, opportunities for practice-related workshop activities are important for students' learning experience. Principally, it is the accessibility and flexibility of workshop spaces 24 hours – virtual or F2F – that is recognized as critical for students. According to Saghafi, Franz and Crowther's comparative study, the F2F synchronous workshop provides a learning space for students supporting hands-on skills training, peer learning and spontaneous feedback, while the virtual asynchronous workshop turns out to be better suited for constructive discussion, archival of design development and review of individual or peer progress.

Similar insights are generated from studies done by Westermann (2014) and Gonzàles-Gómez et al. (2016), who note that one of the advantages of the dual classroom setting involving online as well as F2F learning is that it supports the development of specific skills. In Westermann's study, students experienced that their critical thinking skills were stimulated because the online setting was used for preparing oral peer discussion in the F2F classroom environment through postings of written peer and teacher response in an online discussion forum (Westermann, 2014). In Gonzàles-Gómez et al.'s study, students found themselves better equipped for solving general science problems during F2F classroom and laboratory activities when online video lessons and instructions outlining the theoretical and practical aspects of laboratory work can be watched at any point in time prior to or after in-class sessions.

The visualizing potentials of the online element in blended learning are investigated in studies by Tambouris et al. (2014) and Olsson, Mozelius and Collin (2016). Both studies emphasize the extent to which online technologies can be used for creating a learning environment that through visual support represents an added value in students' learning experience. Graduate students' execution of the different steps in a problem-based learning project is, for instance, shown to be experienced as cognitively enriched through the latter's graphic representation via the use of Web 2.0 tools in an online learning platform (Tambouris et al., 2014).

As mentioned earlier, students' experience of the learning community and their own learner identity appears to be significantly affected by the online element of blended learning education. Several studies point to the paradoxes that inhere in “the incorporation of information and communication technologies into the learning and teaching experience” (Joksimovic et al., 2015, p. 638). On the one hand, it is pointed out that online LMSs – often used in online and blended education – create new opportunities for interactivity between student and

content, between student and teacher and among students themselves (Cheng and Chau, 2014). On the other hand, the digital learning environment offered by LMSs is also one in which students' geographical dispersal, asynchronous participation and limited visual contact are taken for granted (Joksimovic et al., 2015). Therefore, the sense of belonging to a meaningful learning community is stressed as an important factor in online/blended learning students' learning experience especially because it is difficult to make their social presence perceptible in the online environment (Joksimovic et al., 2015; Barber, King and Buchanan, 2015; Fletcher and Bullock, 2015). Moreover, studies have related students' sense of belonging to meaningful online learning communities to their engagement and learning achievement (Joksimovic et al., 2015; Tomas et al., 2015). Nevertheless, although seen as a crucial factor, student-student interactions and collaboration activities are not necessarily the sole prerequisite for online/blended learning students to feel part of a learning community. The presence of engaging academic content and a strong teaching presence are considered just as important for creating this feeling (Tomas et al., 2015; Joksimovic et al., 2015).

Since the establishing of meaningful learning communities is a distinct challenge in online/blended learning education because of the partial or complete lack of F2F interaction between student and teachers and among students, many studies have investigated how and the extent to which digital learning technologies can be used to support students' sense of partaking of a community of learners.

Closely related to the question of students' sense of belonging to a meaningful learning community in online and blended learning environments is the question of students' experience of their own learner identity (Baxter and Haycock, 2014). According to Baxter and Haycock building on Lave and Wenger (1991), the formation of learner identity is bound up with agency and feelings of being in control resulting from feelings of belonging to a learning community. They further claim that the development of "a strong and salient online identity" plays an important role for student retention and motivation in online learning programs. For the same reason, their study looks into how successful online learning forums contribute to social and academic integration as a means of consolidating students' learner identities. Their findings reveal that students' prior experience with social media sites such as Facebook tended to be transferred to the academic online learning forum and thus to impact both negatively and positively on their learner confidence and agency. For instance, the public nature of the online forum made some students feel their postings assume an air of authority and expertise, which, on the other hand, led other students to refrain from posting due to feelings of lacking knowledgeability. Finally, lack of peer response or teacher moderation seemed to be detrimental to students' learner identity because they felt isolated from and peripheral to the academic community of the forum.

In this part of the review, the aspects that have proved most prominent in terms of their importance for education in online and blended learning programs include the following:

- appropriate teaching and learning spaces online as well as off-line
- engaging and meaningful learning communities as a means of supporting students' social relations and their learning experience
- a strong and salient sense of learner identity

3. Course Design

In this part of the review, we look into the overall course design and the elements and activities that researchers find to be of relevance and importance when designing a successful blended/online course in higher education. As we have a special interest in the online part of blended learning course design in professional education, a specific focus is kept here.

Course design influences student satisfaction (Lee, 2014) and their perceived learning (Gray and Diloreto, 2016), and many elements can contribute to good results here. An overall contribution might be found in the suggestion that variation in (online) teaching and learning activities are necessary (Cheng and Chau, 2016; Fedynich, Bradley, and Bradley, 2015), but the activities and suggestions for specific course design can be numerous when research is to give an answer.

Blended learning design can successfully mix online activities with practice in the field and thus prepare pre-service teachers for their future work in the profession. Here, inclusion of digital collaborative tools and work with digital literacy of the pupils are - or should be - parts of everyday practice. Hunt (2015) focuses on

exploiting blended learning for introducing authentic learning in teacher education, and she concludes that through deliberate course design and the use of relevant digital tools, blended learning can offer pre-service teachers a digital platform for collaborative and inquiry-based learning related to practice in the field. Chat sessions supplement the group work and the teachers are present and active during the students' field work period.

In professional education, it is of high importance that the online as well as the on-campus activities relate to the professional life to come, and as profession programs have both content and skills as part of the curriculum, course design should consequently be developed to support knowledge transmission and skills acquisition (Heinerichs, Pazzaglia, and Gilboy, 2016). Heinerichs and colleagues find that this could be facilitated by the use of digital technology in a flipped classroom or in a blended format of online and offline activities. Also in a study (Sidebotham, Jomeen, and Gamble, 2013) among midwifery students, a blended learning design was created for F2F meetings, with focus on practice-related activities, roleplays, narratives and reflection, and online sessions with synchronous discussions, "home-grown" learning resources and active and present teachers. An innovative aspect was found in the double blends of both online-offline activities and of theory-practice activities.

Many agree that it is important to engage especially pre-service teachers in developing their capacity to use emerging technologies to develop teaching approaches that support interactive, engaging and collaborative learning (Chigeza and Halbert, 2014), and several researchers (Rivers, Richardson, and Price, 2014; Simpson, 2016) focus on the pedagogical value of dialogue to strengthen pre-service teachers' reflective practices and improve their knowledge of the value of talk for learning. Rivers et al. (2014) trace the use of various social networks in a blended learning setting as a means of incorporating more interactive discourse through web 2.0 tools. Their article concludes by stressing the positive impact that dialogue as a pedagogical tool had on the students' learning experiences (Rivers et al., 2014). Moreover, a study by Forbes and Khoo (2015) explores the potential of student-generated podcasts as a form of interactive formative assessment at a distance. The findings show that the experience empowered the teacher training students to develop the skills and confidence to initiate more independent inquiry into technologies to support their pedagogical purposes.

It can, however, be challenging to create sufficient learner support and link the online activities to campus resources (Fedynich et al., 2015) in order, for instance, to avoid students' evaluation of online activities as less valuable than on campus ones (Chigeza and Halbert, 2014). An answer to this challenge may be found in teachers' scaffolding of activities (Barber, King, and Buchanan, 2015) and the relation between them. Some suggest that an overarching pedagogical frame, explicit scaffolding of learning activities (through podcasts or online tutorials), appropriate use of media, hands-on assessment tasks and student-staff communication are vital for students' learning experience in a blended learning setting (Tomas, Lasen, Field, and Skamp, 2015). Moreover, it is found that teachers may need to scaffold online forum discussions in details in the beginning, set rules for them (e.g., when, how and how much to post to the forum) and contact the non-participating students (Beth, Jordan, Schallert, Reed, and Kim, 2015). As some students find that online meetings and teaching is less valuable because of less demand in the online participation, it is important to highlight interpersonal dialogues, interactions and scaffolding of the online activities. Thus, Chigeza and Halbert (2014) find that there is a need for several pathways of support to enable some of these pre-service teachers to be enabled online learners (Chigeza and Halbert, 2014), and a need for ways in which students can interact reflectively with content (Donnelly and Hume, 2014).

Likewise, some students find that peer-to-peer support is less valuable (Baxter and Haycock, 2014), and the impact of peer assessment seems to vary according to students' learning levels: low- and average-achieving students showed significantly improved performance but less impact on the performance of high-achieving students (Li and Gao, 2016). However, research often finds that peer-to-peer learning leads to satisfaction among students in online learning environments (c.f. Choi, 2016), and that social interaction and networked learning among peers should be included in effective online learning, for instance, in order to support self-reflection and not only to give access to information (Cheng and Chau, 2016).

Not only is social interaction found to create engaging learning in blended settings, so can online resources when used right. Several researchers (Martín-Rodríguez, Fernández-Molina, Montero-Alonso, and González-Gómez, 2015; Montrieux, Vangestel, Raes, Matthys, and Schellens, 2015) find that students consider web-based lectures to be an added value, especially when they function as course preparation (Montrieux et al.,

2015) and as a means of consolidating knowledge and improving learning across ethnic groups and gender (Lancellotti, Thomas, and Kohli, 2016).

Several studies also find that opportunities for interaction among students and among students and their educators is very important (Chiero, Beare, Marshall, and Torgerson, 2015; Fedynich et al., 2015) both to their satisfaction and learning outcome.

To sum up, the most important elements we find in this part of the review are related to interactions, links and scaffoldings

- between online and offline activities
- between campus-related and practice related activities and
- between students, teachers and content

4. Educator roles and relations

In the last part of the review, we look into educator roles and relations, with particular emphasis on the dimensions that are reported in the reviewed literature to have significant influence on student learning in professional programs offered through blended or online formats.

Several studies find that strong educator presence along with quality course content are essential elements in courses that successfully facilitate online student engagement and learning (Moore, 2014; Swan and Shih, 2014). Establishing educator presence in online courses can be achieved in a number of ways, such as through regular communication with students, consistent feedback and critical discourse modeled by the educator (Gray and DiLoreto, 2016). Online students need to feel connected to the educator, to other students in the course and to the course content (Southard, Meddaugh and France-Harris, 2015; Martín-Rodríguez, Fernández-Molina, Montero-Alonso and González-Gómez, 2015), which can be achieved in a supportive learning environment in which educators strategically combine audio, video, synchronous and asynchronous discussions, practical activities and other online tools to engage students (Gray and DiLoreto, 2016). Southard, Meddaugh and France-Harris (2015) found the use of high-impact videos featuring the educator and/or the course content particularly useful in promoting a strong educator presence and in cultivating students' interest in the topic under study, in particular in pure online courses where there is little or no synchronicity between the student and the educator. In the study carried out by Southard et al. (2015), introductions to undergraduate history lessons were filmed on the location of historical sites, and props as well as stop motion videos where static objects were brought to life and moved as the educator narrated were successfully used to strengthen students' feelings of connectedness to the educator and the content (Southard, Meddaugh and France-Harris, 2015).

Research indicates that online learning communities can help to create a feeling of connectedness to fellow learners and can help to establish trust in other students as a resource for knowledge construction and knowledge growth (Cho and Tobias, 2016). However, it is also clear that such engagement does not occur automatically; developing a learning community takes time and is only accomplished with conscientious effort (Beth, Jordan, Schallert, Reed and Kim, 2015). Moreover, participants need to feel that they are engaging in human-to-human interactions that will allow them to cultivate their professional as well as personal relations, and the presence of an educator can be a key factor in student engagement (Cho and Tobias 2016). A number of researchers find that the educator plays a crucial role in scaffolding students to successfully participate in asynchronous online discussions by providing clear guidelines for how to initiate and take part in online discussions that facilitate learning (Beth, Jordan, Schallert, Reed and Kim, 2015; Cho and Tobias, 2016). In a study on how responsibility and generativity were enacted in asynchronous online discussions in a hybrid course, Beth et al. (2015) conclude that educators can successfully scaffold students' online discussions in terms of both quantity (e.g., online discussion were scheduled at regular intervals and students were required to post a minimum number of posts) and quality (e.g., students were instructed to use a conversationally inviting tone, to provide contextual information and to address academic questions and comments to their peers). Others have found that in blended courses involving few F2F classes, synchronous online classroom sessions involving interaction and discussion can contribute positively to students' feelings of connectedness to their educator and fellow peers (Sidebotham, Jomeen and Gamble, 2014).

In blended courses, the educator must facilitate students' learning in the online environment as well as in the F2F classroom, which calls for a unique combination of roles and responsibilities. In a study investigating the perspectives of teacher training students about the instructional activities of blended courses, Hall and Villareal (2015) found that in F2F class sessions, educators should stress active participation and provide plenty of opportunities for students to interact and collaborate with their fellow peers and the educator, whereas specific and timely feedback as well as individualised responses to online assignments are of primary importance in the online environment. Research further shows that in F2F sessions of blended courses designed for professional bachelor programs, educators should create opportunities for students to apply the theory studied and to discuss and train the practical dimensions of the profession that may not translate well online (Sidebotham, Jomeen and Gamble, 2014; Hall and Villareal, 2015). Above all, educators must be easily available for students both online and, if possible, in person to avoid feelings of isolation (Hall and Villareal, 2015; Israel, 2015; Hunt, 2015).

Facilitating teaching and learning in an online environment poses a number of challenges to educators, who often struggle with adapting the practices they have found effective in F2F classes to an online environment (Mills, 2015). Fletcher and Bullock (2015) argue that in this respect, teacher educators are particularly challenged because asynchronous online environments may impede the fostering of positive relationships between the educator and her students, a relationship that is considered central to meaningful teaching and learning by most teacher educators. Their results indicate that, ideally, professional teaching programs should not be based on asynchronous teaching only, but should be blended with synchronous online class sessions and F2F interaction as well.

To sum up, the factors that have proved most salient in relation to the educator's role in e-learning, blended learning and online learning in the literature reviewed include:

- establishing strong educator presence in online settings and
- building online learning communities that foster positive relations

5. Conclusion and discussion

Many studies, and education institutions alike, are concerned with comparing different formats of e-learning, online learning, blended learning or F2F courses to find out which format is most effective in terms of, e.g., learning outcome and student satisfaction. However, research shows that teaching and learning are complex and are influenced by more than just the teaching format. For this reason, we should look into the many different factors that influence teaching and learning in different formats and in different contexts. This literature review has focused on the factors that affect students' learning experiences in e-learning, online learning and blended learning in higher education, with particular emphasis on professional education and teacher training. The findings from the research papers included in the review show that among the many factors, some seem more salient than others: educator presence in online settings, interactions between students, teachers and content, and deliberate connections between online and offline activities and between campus-related and practice-related activities.

More specifically, the reviewed literature offers numerous suggestions for specific course designs that are found to be effective in a particular context. Across studies, it is found that e-learning/blended courses should be designed to foster coherence between online and offline activities, between campus-related and practice-related activities and between students, teachers and content.

In relation to educator roles and relations, the dimensions that are reported in the literature reviewed to have significant influence on student learning in professional programs offered through blended or online formats include the educator's role in establishing strong educator presence in online settings and in building online learning communities that foster positive relations.

As for the students, research indicates that a number of factors influence their learning experience in e-learning/blended/online courses. The factors that are highlighted by the literature reviewed to be of specific importance for professional education students' learning experience and their learner identity include the presence of appropriate teaching and learning spaces online as well as off-line and the presence of engaging and meaningful learning communities that support the students' social relations.

In conclusion, the literature review confirms that there is an intense interest within the field of educational research to determine which factors affect learning outcome and student satisfaction in e-learning, online learning and blended learning in higher education, but further research is needed to better understand what influences students' learning experiences in the online formats of professional bachelor programs.

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