In this issue, we present eight papers that explore e-Learning from various positions and understandings of e-Learning as a phenomenon, within different fields and with a wide geographical distribution. Thus, the papers contribute to the understanding of e-Learning as a field in constant growth regarding directions and meanings.

In the first paper, Arshia Khan, Ona Egbue, Brooke Palkie and Janna Madden draw on the perspectives from their individual and diverse fields in their exploration of various pedagogical strategies for online learning courses. The aim is to identify strategies that can be incorporated into the design of online learning courses in order to foster a high level of student engagement, and based on multiple pedagogies. These strategies are explored in terms of collaborative student engagement tools for the design and delivery, and the role such tools play in creating an atmosphere for students to become active contributors to lively discussions. The paper emphasises the importance of deliberate course design in the pursuit of actively engaging students in online course settings.

In the second paper, Nurul Adila Hamdan, Maslawati Mohamad and Shahizan Shaharuddin present a case study involving eleven third-year undergraduate TESL (Teaching English as a Second Language) students in order to identify the undergraduate learners’ perceptions of hypermedia reading materials for teaching English as a second language, and the factors that may contribute to their reading comprehension. The findings of this study revealed various participants’ perceptions regarding hypermedia-based reading materials. The study found that the design of the hypermedia materials and content, in terms of the manner in which information was displayed, were among the factors which improved the learners’ reading comprehension.

In their contribution to the issue, Alberto Corbi and Daniel Burgos present a case study that demonstrates how virtual containers enhance the implementation of STEAM (science, technology, engineering, arts, and maths) subjects as Open Educational Resources (OER). The study shows how student engagement and satisfaction increase over time, partly because of the ease of use introduced by the container technology. The study proves that combining containerised educational resources and free and open distribution channels can be one of the cornerstones of a new OER approach in STEAM subjects.

Starting with the necessity for people in the present day to successfully orientate in a multilingual environment, Teodora Kiryakova-Dineva, Milena Levunlieva and Vyara Kyurova present the e-learning platform IPHRAS (Interphraseologie für Studien-und Berufsmobile). Their focus is on the methodology for foreign language learning in relation to IPHRAS as a multilingual electronic environment, where multilingual access is facilitated by thematically structured multiword units and with a priority on easy access to a variety of languages.

In the fifth paper, Manu Gupta, Sophie Marsden, Tony Oluka, Reetu Sharma and Henry Lucas explore some of the key issues involved in implementation of e-learning in higher educational institutions (HEIs) given the resource constraints within which many institutions have to function. The paper presents three case studies from such institutions involved in the education of health professionals. The institutions are of varying size, and each located in a different Lower- to Middle-Income Country (LMICs). The paper suggests that the use of appropriate ICT infrastructure, both in terms of hardware and software, and combined with effective access and bandwidth management policies, is crucial to the successful implementation of e-learning courses on health within HEIs based in LMICs.

The paper by Moses Basitere and Eunice Ndeto Ivala presents the results of a mixed quantitative and qualitative evaluation. The study explores the effectiveness of the combined use of Facebook social media as the communicative medium; Clicker technology as an interactive medium; and Wiley Plus web-based homework system as an adaptive medium for enhancing learning through interaction and dialogue activities, in and outside the first year Physics classroom. The study found that the use of Clicker and Facebook facilitated interactions between students and their teacher, in and outside the classroom as well as deep and meaningful collaborative learning of the subject content. Homework and assignments done on the Wiley Plus web-based homework system may have contributed to the good performance of the students in both mid-term Examination and Final Integrated Summative Assessment (FISA). Additionally, the study found that the
students agreed that if homework was not collected and graded, they would spend less time practicing course concepts.

Using survey analysis of students who participated in formal online learning in Korea, Jamie Costley and Christopher Lange in their study looked at relationships between the following variables: instructional design and future behavioural intentions, instructional design and germane load, germane load and future behavioural intentions, as well as the mediating effect of germane load on the relationship between instructional design and future behavioural intentions. The results show the importance of delivering instructional designs that communicate important information to students to promote understanding of course instruction to a point where students will continue using e-learning in the future.

In the last paper of this issue, Lily A. Arasaratnam-Smith and Maria Northcote present a study that explores the challenges and opportunities associated with the concepts of community and communication in online higher education. Rather than see face-to-face education as the prototype for quality, the authors understand online learning environments as unique and existing in their own right. In relation to online Communities of Practice (CoPs) the study identifies unique ways in which online communication (in the context of learning) is different from face-to-face communication, and consequently four ways in which this can be an advantage for students.

Journal Editors

Karin Levinsen and Rikke Ørngreen
Active Learning: Engaging Students To Maximize Learning In An Online Course

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Abstract: Student engagement is key to successful teaching and learning, irrespective of the content and format of the content delivery mechanism. However, engaging students presents a particular challenge in online learning environments. Unlike face-to-face courses, online courses present a unique challenge as the only social presence between the faculty and the student is via the Internet. In a recent poll conducted by the authors, 100% of the respondents considered student engagement a challenge regardless of the number of years they have been teaching online. This paper explores various strategies that can be incorporated into the design of online learning courses to foster a high level of student engagement based on multiple pedagogies. In addition, the role of collaborative student engagement tools for the design and delivery of online courses is discussed as well as the role these tools play in creating an atmosphere where students actively participate in learning activities and are contributors to lively discussions. Perspectives on various mechanisms of student engagement that are founded in classic active learning pedagogies and enhanced with new technologies are presented in this paper, including perspectives on the design of courses to facilitate student engagement as well as best practices of design and delivery of online courses. Finally, this paper emphasizes the importance of deliberate course design in the pursuit of actively engaging students in online course settings.

Keywords: active learning, higher education, student learning, student engagement, online course design and development, interdisciplinary collaboration, frustrations

1. Introduction

Student engagement is not only a challenge in traditional face-to-face classrooms but also, and debatably more so, in online courses. Online course delivery faces additional barriers to engaging students not typically present in face-to-face courses including the fact that course design and development must occur before the actual delivery of the material, effective time and resources management is necessary on the part of both the students as well as faculty when online, methods of encouraging student communication and interactions amongst themselves and faculty differ greatly from face-to-face delivery methods, and the efficient implementation of teaching tools used to deliver the online course is a challenge for many faculty. However, many of these concerns can be addressed through the implementation of active learning strategies that encourage students to actively participate in the online course content.

Typically, active learning is not associated with online or blended learning environment. However, there are several strategies for effectively incorporating and practicing active learning in non-face-to-face settings including the use of well-conceived discussions, group work and creating a collaborative environment that encourages and fosters a community of learning. It is critical to weave active learning through the major components of an online or blended course, including discussions, assignments and assessments to promote a high level of student engagement.

The quality of an online course in comparison to its traditional face-to-face counterpart is the most critical issue that impacts the design and development of an online course (Haugen, LaBarre, & Melrose, 2001). Some of the key components in online courses are the design of instructional material for the content delivery, student assessment of material, discussion management, time management and frustration handling. However, this paper adds an important item to this list: student engagement. In this paper faculty from three different fields, Computer Science, Industrial Engineering and Engineering Management and Health Informatics, discuss the multidisciplinary approaches of design and development of the key components identified above for online courses, best practices in online course design and delivery and various

mechanisms of student engagement they employed in online courses. These student engagement mechanisms are founded in classic pedagogies but adapted to suit the online course environment. This idea of applying traditional active learning methodologies to the online setting while retaining the function of actively engaging students in their learning will be central throughout this analysis.

2. Background on Active Learning

Just as in a face-to-face class, it is important to emphasize active learning in online courses. Allen and Tanner (2005) have described active learning as “seeking new information, organizing it in a way that is meaningful, and having the chance to explain to others” (p262). Studies have shown that employing such methods of active learning improves both students’ learning and their attitudes towards learning (Vygotsky, 1978; Chickering, Gamson, 1987; Armbruster et. al, 2009). However, many faculty still face challenges when integrating active learning into courses. Experimentation and exploration in teaching and learning methods is required to develop and adapt unique teaching methods to a course · including those being taught online (Rogers, 2010). While this may require additional effort, it is an effort that must be made if students are to be actively engaged in their learning; regardless of the medium in which the course is being taught. For example, when active learning was incorporated into a college level physics course, understanding of the topics increased 40% to 60% in comparison to traditional teaching methods (Laws et. al., 1999). Active learning strategies have been shown numerous times to promote student engagement and have a significant impact on student learning when implemented effectively throughout the course.

There are many mechanisms of active learning that can be utilized to enhance student learning. One learning model that has been core to the development of active learning strategies is Bloom’s Taxonomy. In fact, Bloom’s Taxonomy of educational objectives is one of the most widely used ways of organizing levels of expertise (Bloom et al., 1994; Gronlund, 1991). Bloom’s Taxonomy defines three domains of educational activities: Cognition, Affective, and Psychomotor. Each of these domains identifies levels of expertise, which can be measured through knowledge-based goals, emotional goals, and skills-based goals (Bloom, 1969). Currently this methodology is most commonly used in the higher education setting in the knowledge-based goals. However, Bloom’s higher order cognitive skills, such as application, analysis, synthesis and evaluation, demonstrate a deeper comprehension of material. These cognitive skills are strengthened through active learning strategies such as visual learning, cooperative learning, debates, drama, discussions, role-playing and peer learning/teaching (Bonwell & Eison, 1991). These activities allow students to direct their own learning, which is especially important in science disciplines because scientifically minded people are curious, constantly inquiring and are lifelong learners (Madhuri et al., 2012). According to Vonderwell and Turner (2005) “pedagogically effective convergence of active learning strategies and methods and technology tools can help faculty and students accomplish successful teaching and learning” (p66). This statement will guide our evaluation of online course delivery tools and methods that make material engaging and effective.

Integration of Active Learning into Online Courses

Integrating active learning into course material is crucial to engaging students, regardless of the environment. However, because of the unique nature and challenges of online courses, an understanding of the unique approaches to active learning is needed. In a recent survey conducted by the authors, 66% of the faculty and staff polled (n=29, and the number of responses for each question ranged from 23 to 29) have taught an online course. In the same poll 33% of respondents indicated that they had been teaching online courses between 3 to 5 years, while another 33% have been teaching between 6 to 10 years. Twenty-two percent and 4 % have been teaching for one to two years and ten years or more respectively. Of all respondents, 67% of the respondents have received some type of formal training for teaching online courses, including national level training, institute level training and education or a degree in online education while the rest of the respondents were self-taught. Of the surveyed faculty, 100% indicated that they were very concerned or somewhat concerned about student engagement in online learning. From this survey, it is evident that student engagement is a major concern for faculty and staff irrespective of the number of years they have been teaching.

Despite the apparent concern with student engagement demonstrated in this survey, a historic literature review shows a resistance to adoption of active learning methodologies (Vygotsky, 1978). Examination of the literature reveals that active learning has been promoted since the early 1980s. Seminal authors, Chickering and Gamson (1987) have stressed the need to engage students in activities beyond the traditional lecture
format. These activities should be based on higher level thinking, such as analysis, synthesis and evaluation of Bloom's taxonomy. However, the suggestion of doing activities beyond the traditional lecture to improve student engagement has met with resistance; instructors believed that students are actively engaged in the traditional lecture format. These varied viewpoints show a need for more understanding in this area. The recognition of the role student engagement plays in facilitating learning is a pivotal recognition and necessary starting point. However, this is not enough; this realization needs to drive improvement in course design to achieve active student engagement in all course deliveries. Various mechanisms for active engagement in learning and collaboration in online classes are explored below.

3. Strategies to Incorporate Active Learning in an Online Course Design, Development and Delivery

While the importance of active learning methodologies to improve student engagement has been thoroughly examined, the additional challenges faced by online course delivery changes how active learning practices are put into practice. A few aspects that should be considered with regard to online courses is the integration of design elements, accessibility of materials, value of interdisciplinary collaboration, development of community among students and faculty, encouraging valuable discussions and use of effective assessment methods.

The integrated course design models consist of the basic components of identification of situation factors, learning goals, teaching and learning activities and feedback and assessment (Fink, 2015). The proper design of these components is crucial to engaging students in an online environment. Poll and Weller (2014) outline six strategies to help develop best practice in the online environment (1) building a community, (2) clearly outlining course expectations, (3) utilizing online tools for interaction, (4) promoting the exchange of ideas, (5) providing timely and relevant feedback and (6) creating an environment that is student centred. According to the Pearson (2014) report “Implementing Comprehensive Online Learning Programs that Improve Student and Institutional Outcomes in Higher Education”, 74% of academic leaders rate online education learning outcomes the same or better compared to face-to-face courses. This data supports the integration of these strategies to encourage student engagement within a virtual community.

The authors have utilized several tools and teaching principles to incorporate active learning in online courses such as Piazza, Poll Everywhere, debates, interdisciplinary collaboration and industry collaboration. These tools were found to actively engage students in the courses and improve learning. Emphasis was given to increase accessibility of the course materials to the students. The ability of students to access course materials and engage in the course activities while they are on the go is critical for the success of an online course. Additionally, integration of learning with other disciplines, and choice of application and assessment type all play a critical role in actively engaging students (Khan, 2011, 2012, 2013, 2014, Khan & Erickson, 2014).

4. Significance of Interdisciplinary Collaboration

In this global age, collaboration across borders and disciplines is a norm (Khan, 2011). The concept of multidisciplinary teams spread across geographic boundaries working together using technology has been very slow to be adopted in higher education (O’Brien, Soibelman, & Elvin, 2003; Kaufman, & Brooks, 1996). Students in a class are coming from various parts of not only the country but also the world; online courses provide an opportunity to build a rich environment of collaboration. Doing so not only better prepares students for their future careers, but also serves to engage students in their learning. Collaboration also takes advantage of the fact that groupwork has been identified to be beneficial to student learning in an online environment (Koh, & Hill, 2009). For this reason, it is critical to foster a collaborative learning environment where students from varying disciplines with different cultures and ethnicities can work together (Erickson, & Khan, 2014). For example, in an interdisciplinary project, undergraduate students from one of the authors’ software engineering class collaborated with students studying Occupational Therapy to generate solutions for specific problems related to Occupational Therapy. This sequence of software engineering undergraduate courses (two consecutive semesters) utilized the concepts of interdisciplinary collaboration to engage students in real-world scenarios to engage and foster learning. The software engineering students were required to follow the principles of software engineering design and development to develop a software application. In this collaboration, the Computer Science students met with the Occupational Therapy students worked together in first identifying a problem in the Occupational Therapy field that could be solved using technology and came up with a design of an application to serve as a solution to the identified problem in the first semester. In the second semester, the students coded the application based on the principles of software
development. This provided a rich collaborative learning environment where students were discussing various real-life problems and their solutions. Students were asked to rate their proficiency in hard skills such as requirement elicitation or product design before and after the course. After completing the course, students ranked their proficiency in hard skills, such as requirement elicitation and product design, higher (Khan 2012). Soft skills such as communication, teamwork, rules of professional engagement, presentation and respect for diverse viewpoints were practiced in addition to the technical skills related to their professions (Khan, 2013, Khan & Erickson, 2014). Students self-reported a significant improvement in soft skills. In particular, students commented on increased ability to prioritize needs, think critically and interact professionally. After utilizing this interdisciplinary teaching methodology for three consecutive years, similar improvements have been reported in hard and soft skills each semester. In addition, the relevant real-world experience from this course sequence better prepared students for the transition to the workforce (Khan & Erickson, 2014). Because of these successes, we propose this as an example curriculum for engaging students in meaningful interdisciplinary activities.

Although higher education’s organizational structure creates boundaries between disciplines, interdisciplinary collaborations foster “innovative integration of multiple fields of study” with far reaching goals and outcomes (Newell, 2010). The key is to foster collaborative learning with contemporary issues. This allows for interaction with different groups including the community. This type of setting allows for experiential learning through a social and cognitive process. It enhances critical thinking skills, collaboration and self-reflection. Newell (2010) identified the importance for students of experiencing integrative learning to be prepared for a complex world. This type of curricular approach would ideally prepare students to understand complex situations through a comprehensive perspective. Successful academic & industry collaborations can enhance use of technology, cross-disciplinary work, and establish a community atmosphere within the course participants. For colleges and universities, it has an underlying potential to enhance recruitment, research or scholarship. Specifically, experiences can strengthen skills of faculty by keeping them current with industry expectations and informs curriculum development. For students, well thought out collaborations can provide real hands on experience, strengthen course engagement and even provide an opportunity for jobs.

Where do you start? Find a common ground. Identify an area that is mutually beneficial, or where training is needed. Search for grants that support the objective at hand. It is important to identify a champion from both the college and the industry. Most importantly, be creative!

5. **Accessibility of Course Materials**

Student engagement in online courses is very much dependent on students’ ability to access the material. Mobile eLearning applications increase accessibility to the course materials. Mobile learning is considered an extension of online technologies and is largely dependent on cloud-based services to eliminate the resource restriction of mobile devices (Bonwell, & Eison, 1991). Mobile learning provides students with access to course resources while on the go and is designed to allow real time access to the online course via mobile devices. While mobile learning has advantages, it also has its challenges (Khan, 2014). The advantages are that it provides access to learning anytime and anywhere adding accessibility to learning. Most learners have some sort of mobile device and having access to learning while on the go increases the chances of success. The challenges are that the mobile devices have limited resources such as viewable area, limited memory and processing power. Employing cloud based mobile learning eliminate the restrictions of memory and processing power (Alexandru, Niculae, & Loredana, 2013; Laouris, & Eteokleous, 2005). There are a variety of student centered mobile eLearning strategies such as the accessibility of course content that is faculty created as well as student created, in-class and out-of-class connection, assessment and self-assessment, tools that would facilitate student interaction, communication and collaborations (Martyn, 2007; Vygotsky, 1978). These tools provide increased access to course material as well as more ways to interact with classmates and faculty within the online environment.

6. **Creating a Community of Learning**

One of the most important components of online learning is to provide a forum for the development of a community. It is very important to have a statement of clear expectations of the students and the instructor at the beginning of the course. One way to provide expectations is through the use of a recorded welcome to the course. This allows students the opportunity to virtually meet you as you set the tone for the course. A welcome page describing where to find course materials and well-defined expectations for the overall course
as well as each assignment is key to setting the stage for student participation and engaging students in the course.

It is essential for the students to feel comfortable and valued in the course to be actively engaged in the activities of the course. Creating activities that engage students in critical thinking and thinking outside the box help create a community of learning (Hylton, 2007, Khan, 2014). Students can encourage each other by participating in the various activities. Discussions offer a great opportunity to design activities that increase student ownership and participation in the course. As was previously touched on, activities such as debates, role-playing, drama, and peer learning/teaching are valuable tools for increasing student engagement in the discussions. Students can create video clips of debates, drama, role-playing or peer teaching and post in the discussions to share with the class. Various modes of engagement such audio, visual and scripting can be used to facilitate discussions. Furthermore, the syllabus plays an important role in defining a relationship between faculty-students and the peers. Hence, the syllabus should identify overall course expectations, course schedule and when and how an instructor would provide feedback to the students. Another way of creating transparency in the faculty students-relationship is by the use of rubrics. Rubrics allow for clear articulation of the assignment expectations by guiding the students in overall performance and provide standardization.

Another significant piece in the development of a community of learning in an online course is communication. Communication in an online course is a critical component in the exchange of information in verbal and written forms. Most communication is in the written form and hence the writing skills and the ability to communicate thoughts through written messages are critical (Haugen, LaBarre, & Melrose, 2001). Interaction and communication between the students and between students and faculty is one of the most important elements of online learning (Kearsley, 1997). Kanuka et al compared various modes of communication and found the debate as one of the modes of learning where students had the most cognitive presence (Kanuka, Rourke, & Laflamme, 2007). The key is to not only require class participation within the course, but to promote styles of participation that engage and add value to the course.

7. Engaging the Classroom Through Discussion

A growing body of literature has shown that discussions are beneficial for promoting student engagement and developing critical thinking skills. Other benefits of discussion include improving communication skills (Dallimore, Hertenstein, and Platt, 2008), and enhancing students learning (Hamann et al. 2012; Huerta, 2007). Furthermore, active learning can be incorporated in discussions in online class settings. In an online course, discussion is an important component that can determine the success of the course. Simply put, the success of online discussion largely influences the effectiveness of online courses (Maddix, 2012).

It is critical to provide an environment in online classes that allows a high level of discussion, which at the very least is similar in quality to discussions that take place in a face-to-face classroom. However, discussions that take place in a face-to-face classroom do not always translate to an online course. Some benefits of online discussions over classroom discussions include convenience, additional time for students to reflect on discussion prompts and responses, increased participation and a greater sense of community (Dixon, 2014). Furthermore online discussion allows instructors more time to interact with students without the time restriction imposed by face-to-face-classes.

Dixon (2014) proposes three elements to be considered for online discussions to be successful including pre-assessment, relevance and assessment criteria. Pre-assessment involves finding out what students already know about the subject so that instructors have a better idea of an appropriate point from which to start the discussion. Relevance refers to how the material being covered pertains to the students. It is important for students to know how their learning applies to them or how it can be used in a real world setting. Finally, assessment criteria need to be clearly stated so that students know what is expected of them. Well-defined and clear assessment criteria help in preventing surprises.

To encourage participation and learning, students need to be comfortable with the new material, be actively involved and be able to analyze the material. There are several tools and strategies to promote active learning and student engagement including using small groups, debates and assigning different roles to students in discussions. For instance, in a study by Reese-Durham (2014) each student in an online course took on the role of facilitator or participant for a given topic. This resulted in an observed higher level of student engagement.
than witnessed in face-to-face-classes. Debates enforce content mastery, delivery, and communication of knowledge. One of the authors has used debate as a means to encourage students to not only learn their subject matter in-depth but also to communicate the knowledge they have gained to others. She identifies a variety of topics that lend to debatable concepts and asks the students to pick a topic they would like to debate on. After the students have picked their topics, she makes sure no more than two or three students choose a topic depending on how many facets of debate the topic lends. After the topics are selected and students know whom they are debating against, she assigns dates the debates will be conducted. The time allotted to each debate is between 15 and 25 minutes including the time for questions. If the class size is large, the students are asked to videotape the debate and then post the videos online for student viewing. Lastly, students have to complete short quizzes on each of the debate topics. The quizzes provide quiz provides a means of assessing the students who were not debating and the students debating are not required to take the assessment for their debate. This provides an avenue for increased learning by enforcing mastery of the subject the student is debating and knowledge of the topics of the debates they are observing. This has led to an observed increase in participation by students compared to watching a video or listening to a lecture.

Some tools for use in online discussions include learning management systems, video chat tools and discussion boards and forums. Learning management systems such as Moodle and Blackboard, host online classes and can provide a place for students to communicate with each other and with the instructor. In addition to learning management systems, some instructors choose to have an additional online discussion platform such as Piazza to manage discussions in the class. Lastly, video chat tools such as Google Hangout allow instructors and students to participate in discussions through video conferencing. Video chat solutions provide a variation to the more commonly used online discussion format that does not involve a video component.

8. Use of Effective Assessment Methods

The use of effective assessments methods is another important tool to support student learning and improve instructors’ understanding of student needs (Vonderwell & Boboc, 2013). The manner in which students are assessed conveys a strong message about what is important and how students should approach an educational experience (Garrison, 2011). In an online course, the use of appropriate assessment techniques is important because of its physically remote nature compared to a face-to-face learning environment. Assessments in online courses may pose greater challenges in cases where instructors attempt to adapt the assessment methods used in face-to-face classrooms. Therefore, it is important to use assessment techniques suitable for online learning. As in face-to-face classrooms, both formative and summative assessment can be useful in online classes. Summative assessments provide a measure of the level of proficiency achieved at the end of a class or class unit. Formative assessment provides feedback that can be used by both the instructor and students to make further improvements in the ongoing course. Instructors need to use a wide range of assessment techniques and should avoid using redundant methods (Vonderwell & Boboc, 2013; Bloom, 1994). Bloom’s Taxonomy provides a system to evaluate the curriculum, not only for assignments, as previously discussed, but also to evaluate assessments as well as to identify where content is introduced and how content grows in difficulty throughout the course. This is done by evaluating the outcome goals (whether it is knowledge, emotional or skill based) and comparing this against the goals of previous assignments to assure that goals are obtainable (not too challenging) and assessments are measuring concepts that have been expressed in previous coursework. In addition, this allowed for verification that content was introduced at a lower Bloom Taxonomy’s level and that higher levels of Bloom’s Taxonomy are introduced where appropriate over time. The most important question to ask when evaluating assessments is “does the content address the necessary level(s) where it was intended in the curriculum”. In one of the authors’ programs, a departmental group assessment process was created, where program-level outcomes were identified. The group then embedded these outcomes into relevant courses and individual assessments were designed to address the respective outcomes. This allowed the department to ensure content was weaved throughout the curriculum. Bloom’s Taxonomy, can be used to ensure that assessments meet the educational goals of the course.

The American Association for Higher Education (AAHE) (1987) provides a set of best practice principles for assessing student learning. According to the AAHE, assessment should be viewed as a vehicle for educational improvement and is effective when learning is reflected as multidimensional and longitudinal; meaning performance is revealed through increasing growth over time. One way to achieve these aims is to provide a clear process for goals and objectives. This task requires a multidisciplinary approach to institutional improvement. The 11 key findings for best practices in assessing learning outcomes (Benchmarking Study,
Best-in-Class Report, 1998) supports this finding by recommending assessment plans should be strategic in nature. Meaning an incorporation into the culture of the organization and other ongoing performance improvement efforts. Ultimately, good assessment takes a continuous, systematic, and multidimensional approach (Leskes, A., et al., 2004).

Designing effective rubrics is key to successfully assessing outcomes in any course. The Quality Matters Higher Education Rubric, fifth edition, 2014 provides a set of general standards including course overview and introduction, competencies, assessment, instructional materials, technology, support, and accessibility to ensure students achieve the desired learning outcome. The overall goal of rubrics is to teach students that learning is their responsibility, and to encourage students to become self-reflective. This will help student visualize identified strengths and weaknesses. One way to accomplish this is to have students use the rubric as a self-reflective exercise before submitting an assignment. This not only strengthens self-accountability but it also helps to guide students in expectations of the assignment. A final note on assessments, polls are a great tool for engaging students in an online course and to assess how well students are learning concept. They can be administered quickly to determine student progress as well as being useful as a basis for follow up discussions. By doing so, students’ engagement in course and progress towards course objectives can be quickly assessed and content can be adjusted as needed. By providing faculty a clear representation of student understanding, faculty are able to guide learning accordingly.

9. Challenges Facing Active Learning Integration in Online Courses

While many concerns in regard to student engagement in online courses have been discussed, one of the most prominent organizational challenges is the lack of recognition of the time that is needed to effectively design and administer online courses. Converting a face-to-face class into an online format can be a challenging process because online course development requires a lot of planning and specialized training (Cox and Egbue, 2014). Furthermore, a significant amount of time is required for developing an online course. The online learning environment creates many challenges that require patience, skills and experience in handling and overcoming. For instance, the bandwidth of the internet can cause the internet connection to slow down causing congestion and frustration for the faculty and students. Device incompatibility can cause problems with the access to the online instructional and assessment material.

In addition, frustrations can arise among faculty especially in cases where college administrators do not recognize the increased workload on the faculty. Furthermore, lack of resources including technology and personnel can cause dissatisfaction among faculty. The two most important factors that have significant impact on the delivery of online content are the technology used and the design of the course. (Kampov-Polevoi, 2010). Unavailability of resources adds to the time and effort required for both course development and management. Another frustration that can be experienced by both instructors and students is the resistance to interactive online instructional techniques. It is important to provide adequate resources and training, support from higher administration and outline clear goals and expectations in order to minimize agitation and resistance among faculty and students. If the students have not clearly understood their responsibilities and the expectations, this can cause resentment both on faculty as well as the students’ side. It is important that both faculty and students are aware of their responsibilities and expectations. Not knowing how many hours of the work the student is expected to perform, the student may overestimate the faculty time commitment, while the faculty may underestimate the time she/he may require to facilitate an active discussion during online office hours.

10. Conclusions

Despite the challenges faced in developing and delivering effective online courses, participation in online courses is becoming widespread. Various mechanisms can be used in the design of an online learning environment that potentially foster a high level of student engagement. It is hoped that the utilization of these methods will become more prominent in online course delivery. However, it is important to recognize that, regardless of the tools being utilized, designing an effective online course involves careful planning, considerable resources and dedicated time commitment as well as experience and expertise in teaching and learning. A recent poll by the authors, show that faculty and staff involved in both the design and teaching of online courses are very concerned about student engagement. The level of experience of these faculty and staff ranges from 1 year to over 10 years. This indicates that student engagement is a concern that exists.
regardless of level of teaching or experience and subject matter. Furthermore, student engagement is a process of continuous improvement and should be constantly revisited and evaluated.

From a faculty and student perspective, consistency in the design of courses is imperative for the success of a course. From a student perspective, when a student comes across courses with a similar design the navigation through the courses becomes easier. The student is aware of the delivery dates and the format of the course materials. From a faculty perspective of design and delivery of an online course, it is easier to have a consistent design to monitor quality of the courses. Inventing new ways to design courses requires research in the area of materials. From a faculty perspective of design and delivery of an online course, it is easier to have a consistent efficient course material delivery. Some best practices for online course development include using integrative course design with measurable learning outcomes, presenting information in a variety of ways, breaking information into appropriate segments, clarifying expectations, promoting active learning, and the effective use of discussions (Resources for Online and Hybrid Teaching - Center for Engaged Instruction, 2012). Although the fields of study of the three authors are different, they each bring their unique perspectives to the online environment. Sharing of teaching practices formally or informally can be helpful for all faculty in improving student learning. The online environment is different from the traditional face-to-face environment and hence the tools and teaching techniques used in the traditional face-to-face classroom cannot be directly applied to the online classes. These tools and techniques have to be modified to accommodate for the lack of physical proximity experienced in an online course.

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Hypermedia Reading Materials: Undergraduate Perceptions and Features Affecting their Reading Comprehension

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Abstract: Due to the potential of the Internet and blended learning environment, students, especially L2 learners, are often required to read references available online. A study was conducted to identify the perceptions of L2 learners comprising TESL undergraduates towards TESL-related hypermedia reading materials and the factors contributing to their reading comprehension. This case study involved eleven third-year undergraduate TESL students enrolled in a course called ‘Teaching of Reading Skills in an ESL Context’. Data was collected using Think Aloud Protocol, semi-structured interviews, and reflective notes. The findings of this study revealed various participants’ perceptions regarding hypermedia reading materials. Among the factors that improved their reading comprehension include the design of the hypermedia materials and content in terms of the manner in which information was displayed. The participants highlighted the difficulties associated with reading long hypertexts and expressed preference for texts which come in point-form format. Other features cited as being helpful in their reading were the inclusion of pictures, tables, diagrams, audio materials, and videos along with the text. Some other features included hyperlinks and glossaries provided by the websites that the students found beneficial in helping them understand the text. Other less favorable aspects of reading hypermedia materials included advertisements on the websites, easy access to social media websites, and poor Internet connection and bandwidth speed. These were reported to affect the reading process in such a way that they distracted the participants’ concentration, and this ultimately affected reading comprehension to a certain degree. It is hoped that these findings could provide insights for course developers in developing or selecting websites to suit their teaching and learning purposes.

Keywords: TESL students’ perceptions, hypermedia reading materials, reading comprehension.

1. Introduction

Day-to-day use of e-learning platforms in the field of education is becoming increasingly widespread. Students benefit in many ways through the use of technology in the teaching and learning process, in that there is access to learning materials on the Internet that assist them in the process of acquiring knowledge (Ally, 2004). Since students today are expected to become more active in searching for information and additional materials from a variety of sources, e-learning has become an almost indispensable part of the daily teaching and learning process (Sirkema, 2007). Living in the world of advanced technology has exposed students to Computer Assisted Language Learning (Beatty, 2003) as one of the sources for language learning and for obtaining additional materials, particularly reading materials. The abundance and variety of hypermedia reading materials have presented L2 students with easy access to information and knowledge for application not only for learning the English language but also for various other purposes. Comprehension of the materials thus is important to the learning process. However, reading strategies with hypermedia materials differ from reading the traditional printed texts. Additionally, according to Anstey and Bull (2006), reading hypermedia documents requires the students to be selective in choosing materials most suited to the learning requirement at hand, as hypermedia materials come in numerous forms ranging from basic electronic texts to audio and video forms. There is therefore a need to look further into e-learning as it relates to hypermedia reading materials and reading comprehension, in particular where academic needs are concerned. At the National University of Malaysia, a case in point involves the academic and university requirements of TESL students. In their third year of studies, these students are required to take a course called Teaching of Reading Skills in an ESL Context which aims to introduce, equip, and drill students with the main features and aspects of reading theories, research, and related instructional approaches as well as techniques associated with the ESL teaching and learning process. For this purpose, much of the main reading assignment includes the reading of hypermedia materials. For the students, seeking and understanding hypermedia materials is a significant aspect of the coursework. However, e-learning as it relates to hypermedia reading materials has not been extensively explored in terms of how much and in what way it helps students complete their coursework.
Thus, a study was carried out to gather the students’ perceptions towards hypermedia reading materials and identifying factors contributing to their reading comprehension.

The decision to choose TESL students as the participants in this study was seen as relevant because there was an important need for them to comprehend the hypermedia materials as a main point of reference to do the course. Two research questions were identified: First, what are the perceptions of third-year undergraduate TESL students toward the hypermedia reading materials, and second, what are the factors that contribute to their comprehension of the hypermedia reading materials? It is hoped that results of the study could provide insights into the efficacy of hypermedia materials and identify ways that could help both educators and students choose suitable reading materials appropriate for the course requirements. The results gained from this study would provide the information that is useful for teachers, particularly course designers, in their teaching career in terms of teaching their future students effective strategies for reading hypermedia materials.

2. Literature Review

This section will first review the literature on the important components related to online reading and the advantages and disadvantages of online reading. It will then examine the processes involved in online reading comprehension. A review of the related theory in online reading and past studies will also be discussed.

2.1 Electronic Literacies, Hypertext, and Hypermedia: Advantages and Disadvantages

Since the introduction of technology in the process of teaching and learning, the concept of ‘electronic literacies’ is no longer a new phenomenon to students. This concept includes “using computer[s], interaction through computer-mediated communication (CMC), understanding multimedia information as well as locating and evaluating online resources” (Park and Kim, 2011, p.2157). Based on the same concept, terms such as hypertext and hypermedia come into play. According to Farkas (2004), hypertext is defined as a text with links or hyperlinks. The links or hyperlinks provided may offer the users either another section or page of the website or maybe another new website (Warschauer, 1999). On the other hand, the term hypermedia is referred to the extended version of hypertext, whereby users will encounter other forms of materials such as pictures, audio, video, animation, or all of these in one combined material known as multimedia (Ketabi, Ghavamnia and Rezaadze, 2012). This implies that students can read, refer to, and learn not only from a simple electronic text but also from various kinds of materials. As mentioned earlier, reading any online references or learning material is unique and differs from the traditional printed text, as readers are able to choose any of the materials by ‘interacting with the machine’ (Barnes, 1994, p.27). As hypermedia reading comes in numerous nonlinear forms, students cannot treat it the same way as a printed text that they can review page by page. Barnes (1994) stated that students would have to learn navigational skills and become active learners in searching for information.

A number of studies have been conducted that explore the advantages and disadvantages of online reading. Since a large part of hypermedia reading involves hypertext, the advantages and disadvantages mentioned in these studies focused more on hypertext reading processes. According to Teeler and Gray (2000), hypertext is well formatted, easy to look at, and easily downloaded and saved to be read at any time and anywhere, even without an Internet connection. Furthermore, to help readers with better comprehension of the reading materials, hypertext is often equipped with pictures and graphics, including interactive hyperlinks, which enable readers to ‘go places’ and access other materials related to the same or similar topics of interest. In other words, reading takes place in a ‘non-linear path’ (Tseng, 2010, p.97). Readers can jump from one reading material to another and go back to the previous reading material. The hyperlinks provided also allow readers to have access to other support materials that are not available off the Internet. Despite these advantages, Nielsen (1995, p.154) pointed out that “reading from a computer screen is about 30% slower than reading from paper.” Troffer (2001) listed a few difficulties or challenges associated with reading from a computer screen: (a) the screen resolution is low as compared to printed text and (b) on-screen reading can lead to eyestrain. Britt and Gabrys (2001) also indicated that online reading could be more troublesome as a result of many factors. One factor is that, unlike reading a book, which a reader flips from one page to another in a linear manner, a reader needs to read hypertext in nonlinear manner. This refers to the practice of jumping from one website to another. Another factor is that a reader needs to use his cognitive abilities more in reading hypertext in comparison to reading a book, as he needs to select which block, website, or hyperlink that he prefers to read. Despite the benefits of non-linear reading for students, the reading process could be
affected, as online reading materials “remove text devices that typically build coherence in learner texts” (Tseng, 2010, p.97). Tseng (2010) added that students are also required to become ‘cognitively active’ and ‘perform double the task’ in order to comprehend the reading materials, as online texts are normally created from ‘building blocks of several shorter ones.’

2.2 The Process of Online Reading Comprehension

Readers are required to adopt new skills and strategies as they go through the process of online reading comprehension (Cairo and Dobler, 2007). There are at least five processing practices involved during online research and comprehension that can help readers increase their reading comprehension (Leu, Zawilinski, Forzani, Timbrell 2014). The first process of online reading comprehension is reading to construct useful questions. An individual reads on the Internet for many reasons, such as to look for information, expand knowledge, solve problems, or answer questions. Reading that is guided by questions often allows the readers to prompt and refine useful questions and finally meet their reading goals (Taboda and Guthrie, 2006).

Secondly, online reading involves reading to locate information. This requires readers to generate a few new reading strategies and skills which involve understanding every single bit of information, including the title, developing effective keyword strategies (Eagleton and Guinee, 2002), demonstrating skills in choosing useful websites (Henry, 2006), and scanning for information related to the topic (Route, 2006). Third, as suggested by Burbules and Callister (2000), online reading comprehension involves critically evaluating online information in which case there is a need for readers to evaluate the level of accuracy, reliability, and biasness of the information. Often with Internet materials, the information can be ideologically biased or inaccurate; thus, critical evaluation is crucial. Fourth, the reading process also involves reading to synthesize information from various sources. The Internet offers an abundance of reading materials, and due to this ‘gift’, readers are faced with the challenge of synthesizing all of the information gathered until the information most relevant to the reading objectives are found (Jenkins, 2006). Dole et al. (1991) added that, in order to do this successfully, ‘awareness of the reading process together with an understanding of the text’ is needed (as cited in Castek et al., 2011, p.95). Lastly, successful online reading comprehension involves the ability to communicate on the Internet (Britt and Gabrys, 2001). An interactive space is open to the readers in that there is made available a range of online tools through which to ask and answer questions on the Internet. Research suggests that this process of communication is linked to aspects of online reading comprehension (Boyd and Ellison, 2008).

2.3 Related Past Studies

To date, some studies in both local and international contexts have been conducted on the topic of reading hypermedia materials, but very few have examined the subject from the point of view of reading comprehension, particularly among TESL undergraduates. In the local context, Maslawati, Harieza, and Shahizan (2015) conducted a study involving first-year off-campus students registered in the Allied Sciences Faculty enrolled in an English course called English for Life Sciences. The objective of the study was to examine the students’ perceptions regarding the designed hypermedia and comprehension questions. Results showed that the participants of the study did not like any hypermedia reading materials which were considered ‘too lengthy,’ and thus tended to avoid such materials. In addition, reading hypermedia materials containing small-sized words with a narrow gap between the lines was also regarded as problematic. Another study done by Tseng (2010) looked at the effects of online reading on the students’ reading process among a group of 88 students enrolled in a first-year Freshman English course at a university situated in the northern region of Taiwan. The results revealed that the students disliked hypermedia reading materials that had a bright background, as it led to eyestrain. This was a similar issue raised by Leonard (1985), who found that a person could become uncomfortable while glaring at a bright screen too closely or over a period of time. Morris (2009) supported Tseng’s (2010) findings whereby an individual reading from the screen which featured a dark letter font against a light-colored background could experience eyestrain. Gilbert (2014) investigated learners’ interaction with printed and web-based text. His study, which focused on eight learners of English as a second language of a private language school in an urban area, utilized three types of research instruments, namely interviews, reading workshops, and participants’ diaries. His findings showed that, during the process of reading, searching, and collecting information from the Internet, the participants involved in the study found the design of the websites such as the use of bright text color and images attracted them to particular websites, thus motivating them to search for more hypermedia materials. However, they also mentioned the distraction and annoyance caused by pop-ups and flashing text appearing on screen. In brief, these studies suggest that the comments regarding hypermedia reading materials mostly related to the content and design of the materials. In addition, external factors such as advertisements and other distractions also played a part in the reading process. The question is this: how similar or different are the perceptions toward hypermedia...
2.4 Related Theory

According to Maslawati (2012), where hypermedia reading is concerned, teachers, facilitators, and experts are no longer the sole sources of knowledge for students. This means that, in the context of hypermedia reading, students need to become mentally active and initiate their own reading patterns (Yahya, 2008). Thus, through hypermedia reading, students will get the opportunity to explore, derive meaning, and extend their own comprehension of the reading materials resulting in active development of knowledge rather than passive. Tobias and Duffy (2009) and Beatty (2003) have both stated that the use of technology in education, especially as a source of knowledge, has become part of the learning process since the creation of CALL, further demonstrating the need for students to adapt to this new learning environment. It can be seen therefore that the most relevant learning theory related to this study is the cognitive constructivist theory. The construction of new knowledge occurs when students go through an adaptation process whereby they need to accommodate the newly acquired knowledge with their previous or existing knowledge (Maslawati, 2012). Indirectly, they develop more in-depth knowledge, which in turn leads to better hypermedia reading comprehension. Furthermore, online or hypermedia reading requires students to become active readers during the reading process in which they are encouraged to seek answers to questions online without being restricted to the classroom or the need to get assistance from the teacher. With the variety of sources available, students have the opportunity to control and choose their reading materials as long as they are related to the course requirements (Herman and Gomez, 2009).

3. Methodology

This study employed a qualitative research adopting the case study method. This is considered appropriate as the researchers were interested in obtaining a better and more in-depth understanding of the participants’ hypermedia reading process and their perceptions rather than just the outcome of hypermedia reading (Yin, 2009; Creswell, 2009). In this study, the researchers’ aim was to describe TESL students’ reading process and their perceptions toward the hypermedia reading materials. In order to create a more natural setting for the online reading process, data collection was conducted in the lecturer’s room at a time convenient to the participants. This was mostly conducted in the evening. The main data collection tool was the Think Aloud Protocol (TAP). Semi-structured interviews were carried out, and participants’ reflective notes were taken for triangulation purposes.

3.1 Participants and Settings

The participants for this study consisted of TESL students, selected on the basis that they fulfilled the criteria of the study. There were 28 third-year undergraduate TESL students at the National University of Malaysia enrolled in the Teaching of Reading Skills in an ESL Context, a required course for their degree. For this study, twelve students volunteered to participate, but only eleven of them, all female students aged between 22-24 years old, remained committed until the end of the study. These students obtained either Band 3 or 4 in the Malaysian University English Test (MUET), and thus can be considered modest and competent users of English, respectively. To conform to the research ethics, only volunteers were included as research participants (Merriam, 2009). Even though there were only eleven participants, the data collected from them was considered sufficient, as the purpose of a qualitative study is to obtain in-depth information so that a deeper understanding of the phenomenon at hand can be obtained. The participants were also given pseudonyms to maintain anonymity and confidentiality in regard to the ethics of a qualitative study (Given, 2008).

3.2 Data Collection Tools

Think Aloud Protocols (TAP)

Think Aloud Protocol (TAP) was the main data collection technique in view of a few benefits it offers. Ketabi, Ghavamnia, and Rezazadeh (2012) states that, by using TAP, researchers can access more in-depth information as participants are verbalizing their reading and expressing their views aloud during the course of the actual activity. In the case of this study, the online reading was an ongoing task revolving around the topic Reading Models, which was one of the topics discussed in the course. As the reading assigned came from any TESL-related hypermedia texts, which the participants could access at any given time, there was a need to capture the reading process as the participants were engaging with the materials. TAP was considered an appropriate way to accomplish this. The participants were allowed to express their thoughts orally either in English, Malay,
The participants in this study were also requested to write reflective notes after the TAP/interview session. The students were told that they could write about their perceptions, thoughts, and feelings regarding the hypermedia reading materials, problems encountered, and how they solved them. The function of reflective notes is to capture in writing information concerning the participants’ thoughts, perceptions, feelings, needs, or fears that could not be captured during the TAP/interview session. In addition, Ortlipp (2008) states that participants become consciously aware of their actions when they write reflective notes apart from the freedom of writing down everything that they felt during the TAP/interview session.

The process of data analysis in this study involved three main phases, which were data transcribing, data coding (encoding scheme), and data analysis. Dornyei (2007) describes the process of transferring the data from audio into textual form as transcribing. For this purpose, the researchers transcribed all of the TAP/interview data of all eleven participants and afterwards coded and categorized the data into themes and subthemes. This whole process of encoding the data into different categories or themes involved rearranging, recoding, restructuring, and interpreting the data using Nvivo 10. The next step was to compare the categories/themes across data for triangulation purposes. Further details on the themes and subthemes will be given below in the findings section.

4. Findings and Discussion

In general, the participants’ perceptions toward the hypermedia reading materials were varied. The researchers have categorized the data into two main themes, each with its own subthemes.

4.1 Content and Design of the Hypermedia Reading Materials

Length of the hypermedia reading materials

With reference to the content, four participants stated that they did not like lengthy hypermedia reading materials. This is illustrated in the following comments from two of the participants, obtained from their reflective notes and interviews:

“I don’t like something in a long text” (Participant H).

“...if the text is longer, I don’t like it,” and “If the text happen to be a long passage that needs me to scroll up and down to move to another page, I became confused easily and might end up missing some important points while reading it” (Participant I).

The comments above showed that, for the participants, lengthy hypermedia reading materials could affect their concentration, which resulted in some loss of comprehension. In this case, Participant I further mentioned in the interview that long passages contained some words that she could not understand, and when enquired, she further stated that, “Short sentences just stated the main points or main idea.” This is a statement which is supported by other participants. For example, Participant E in her reflective notes said that “simple point (form) is easier for me to understand rather than reading long sentences.”
A few other participants also mentioned a similar problem, such as Participant G, who pointed out that she preferred the text to be “in a point” form. It appears thus far that understanding of the hypermedia reading materials among the participants was facilitated by the arrangement of the content consisting of point form of only main ideas. To the participants, it would be easier to understand these kinds of hypermedia texts compared to lengthy ones that comprised the main idea, explanation, and examples in continuous prose, which they found rather confusing. The physical need to constantly scroll up and down added to this difficulty. The findings of this study were similar to those of the study conducted by Maslawati, Harieza and Shahizan (2015). When choosing hypermedia reading materials, students were likely to avoid any lengthy materials and opted to choose those that are presented in point forms. It is not clear from the responses whether the difficulties above were language related. However, it can be implied from comments such as ‘long words’ and “words that I do not understand” that some language problem was involved to a slight degree.

Additional Materials: Picture/Table/Diagram/Audio/Video

From the participants’ TAP/interview session and reflective notes, it was found that additional materials provided on the Internet such as pictures, tables, diagrams, and audio and video features contributed to the participants’ comprehension of the hypermedia reading texts. As stated by participant J in her reflective notes:

“So when I do not understand the passage, I will watch the video provided. It improves my comprehension.”

Participant C agreed saying that:

“I think when I look at the diagram first, I might have better understanding when I read the text.”

Both responses indicated the usefulness of additional materials to the text such as diagram, audio or video in helping the participants obtain a better understanding of the hypermedia reading materials. In line with the cognitive constructivist theory, by referring to these additional materials made available on the websites, students were able to construct new knowledge by relating it (picture/table/diagram/video/audio) with previous knowledge, either from the existing texts or other previous ones. This process in turn helps students to build more in depth knowledge of the subject (Maslawati, 2012). It is believed that the participants in the present study went through a similar process, as reflected in the following comments:

“Basically images are like extension of the paragraph. Instead of having a paragraph like hundred words, I rather have mind maps with main ideas and sometimes I can relate it with my previous lesson so that I can understand the reading materials better” (Participant G).

Despite these advantages, a few participants found certain tables or diagrams accompanying the reading materials to be confusing and troubling. For example, Participant F found that a few images were “not really helpful” because of their small size and non-editable format (“...when I click it doesn’t get any bigger”). Where tables were provided, it was found that they could not be understood. As stated by Participant F, “...there is no words. I cannot understand the table.”

What these findings suggest is that participants had the opportunity to be more selective in choosing suitable materials as for their reading preferences. The choice to access additional materials such as videos to supplement the hypermedia texts is an instance of this freedom. The participants, however, were also required to be smart in choosing the materials that would help them comprehend the topic related to their course requirements (Herman and Gomez, 2009).

Hyperlink and Gloss

The findings of the study also show that the hyperlinks or glosses provided on the websites helped facilitate better understanding of the reading materials. As noted by Nation (2001), learners might interpret certain difficult words incorrectly, thus leading to a misinterpretation of the content. Clicking on the textual glossaries
normally would provide learners with an accurate meaning of the relevant word. This was also pointed out by Participant J in her reflective notes:

“I also click the hyperlink provided in the website because it contains more information about what I want to know and also certain words that have underline (gloss) because actually it has additional information about that word. The hyperlinks and that underline words are helpful as I often click it, it gives more specific information about some key words.”

As TESL students were required to read numerous L2 reading materials, they were likely to encounter some difficult words. For learners with limited vocabulary, the hyperlink and glossaries can help them understand the topic being discussed as comprehensible information of the words is available to the learners (Garrett-Rucks, Howles and Lake, 2015). Basically, the strategy of using hyperlinks and glosses helped the participants with the comprehension of the hypermedia reading materials.

Color and Size of the Fonts

When the participants were asked about the design of the hypermedia reading materials, the majority highlighted some issues regarding the color and size of the font. There were mixed reactions to color. For example, the interview responses of Participants D and E indicated the following:

“It’s a little bit childish; with pink and flowers but I think it’s okay. It attracts me” (Participant D).

“... the font is colorful and bright, which have attracted my attention to read” (Participant E).

These findings were similar to Gilbert’s (2014), in which the research participants were attracted to reading hypermedia reading materials with bright text colors. On the other hand, other participants were less enthusiastic. As noted by Participants I and F in their reflective notes:

“...but the use of so many colors can be distracting too because I might get confused in distinguishing the main ideas of the text from its supporting details and examples.”

“...the font is too small, I think. I think if it’s bigger, it will help me more.”

In the case of Participant I, the different colors affected her concentration while reading. Further probing showed that the font size added to the difficulties of reading experienced with color. The combined effect resulted in eyestrain and eye fatigue, as participants reported having to really squint their eyes to read. It was also reported that they had to stop reading momentarily to “rub their eyes” before continuing. The loss of concentration experienced by the participants could affect the comprehension of the hypermedia reading materials. This can clearly be seen in the case of Participant I. Such a problem is further heightened given the fact that reading a hypermedia material is different from reading a printed text. According to Nelson (1992), with hypermedia texts, the eyes move in circular motion because readers read the information in scattered bits and pieces and not in a straight line from left to right as they do when reading the printed texts (Maslawati, Harieza and Shahizan, 2015).

4.2 Other Challenges

In comprehending the hypermedia reading materials, the design and its content were not the only challenges. There were also the advertisements to contend with, easy access to social media websites, problems with Internet connection, and physical issues such as sore eyes. It is believed that these matters could also affect the participants’ hypermedia reading comprehension. In the case of advertisements and other pop-ups, most of the participants reported becoming distracted and losing focus and understanding. Gilbert (2014) also noted similar findings. Some of the comments obtained from the reflective notes of participants B and E included:

“There are some advertisement shows beside the text that make me distracted” (Participant B).

“I am easily distracted by the ads at that particular time of reading” (Participant E).
With the participants the strategies to reduce these distractions included choosing websites which had minimal or zero amount of advertisement, or installing Adblock extension into their computer. Another way was by simply closing the website and choosing another related hypermedia reading materials.

Easy access to social media websites could also be another cause of disruption. Three participants revealed that they tend to go to social media websites such as Facebook and Twitter, resulting in a loss in concentration and eventually affecting reading comprehension. As noted by Participant J:

“…usually I will open one or two tabs for social media site like Twitter and Facebook. If I get bored of reading the articles or journals, I will switch to my social media tab.”

The issue with social websites is that the majority of the participants used them solely for fun, to communicate with friends for other reasons than to discuss the reading materials. As stated by Lenhart et al. (2007), teenagers use and treat online social media websites as a venue for social interaction – a place where they can share their thoughts, tell stories, and interact with others. In this study, only Participant B made use of online social media websites to share her reading materials with her classmates.

Another challenge confronting the participants was bandwidth speed or Internet connection. As hypermedia reading required a good Internet connection, any problem with connection and speed could disrupt their reading sessions. Four participants stated that slow bandwidth speed was de-motivating and caused them to lose interest while reading. Participant F had the following to say in the interview:

“…when there is some problem with the internet, I became lazy to do anything related to researching.”

Participant D also agreed, saying that, “It (slow internet connection) will de-motivate my interest to read.” The findings corroborated Park and Bonk’s (2007) findings, whereby it was found that one of the challenges of reading in an online environment was the problem with the Internet connection or bandwidth speed.

5. Conclusion

The researchers were able to shed light on two research questions of this study: (1) What were TESL students’ perceptions towards hypermedia reading materials and (2) what were the factors contributing to their reading comprehension?

There are a few major features of hypermedia materials that affect students’ level of reading comprehension as well as their reading interest, namely the presence of audiovisual materials, glossaries and annotations, and the design of the websites. Among the main results drawn from this case study is the preference among the students for hypermedia materials which consisted of diagrams and videos, as they helped them to enhance their understanding of the reading materials. These features also enhanced the students’ understanding on the topic they were required to learn, in particular among visual and auditory learners. The second important feature is the availability of glossaries and annotations. Glossaries and annotations provide more detailed information, definitions, or explanations of unfamiliar words in the text. These features seemed to be essential for students because vocabulary is the most comprehensive and most difficult aspect of English for second language users. They also help readers understand the sentences better. Thus, they are more motivated to continue reading if their comprehension is high. They would skip the website if the jargon was too difficult for their proficiency level.

The layout of the website, specifically its design, color, font size, table, and diagrams, also affect the students’ reading. A website, which is too crowded with information and advertisements, resulted in readers losing concentration. Pop-up advertisements are always known to annoy readers and distract them from their reading. The small-sized fonts, especially those below 11 point, and glaring background colors would impede students’ reading interest, because after some time they would experience eye fatigue. Furthermore, websites which consist of a text or texts which are too long require the students to scroll up and down the pages. The display of tables and diagrams with little or no accompanying description like keys and labels would also adversely affect reading comprehension.
Other challenges are unstable Internet connection and low bandwidth. Low bandwidth often results in poor video quality, and thus students are not able to watch videos on YouTube or other websites easily. The slow loading and choppy video quality results in students’ loss of interest. These findings could be reported to the relevant authority in order to resolve the Internet problems. Better Internet connection and bandwidth are important to accommodate students’ needs to obtain instructional information online.

These findings could provide some guidelines for course designers when selecting hypermedia materials for their students to read or watch. The course designers may need to further add some features into the hypermedia materials like glossaries, annotations, tables, and diagrams to enable students to read more efficiently. The findings could also provide some insights to the course designers regarding the selection of materials with simpler and shorter sentences, appropriate font size (specifically font size 12 to 14), appropriate colors for the background, and proper use and labeling of diagrams.

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Open Distribution of Virtual Containers as a Key Framework for Open Educational Resources and STEAM Subjects

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Abstract: This paper presents how virtual containers enhance the implementation of STEAM (science, technology, engineering, arts, and math) subjects as Open Educational Resources (OER). The publication initially summarizes the limitations of delivering open rich learning contents and corresponding assignments to students in college level STEAM areas. The role that virtual containers can play in current distant education is then discussed, starting by reviewing related teaching efforts around the use of legacy virtual machines. We then focus on the superseding container technology and how it can bridge the gap between online students, humble computing resources, teachers and IT specificities. As a practical example, we present an experience carried out at the online School of Engineering & Technology at Universidad Internacional de La Rioja (UNIR). Within the context of a subject about Physics for Computing Engineers, we describe the satisfactory evolution from using conventional software distribution methods towards the transition to virtual containers. Thanks to this virtualization approach, the necessary student activities can be implemented, the required software tools can be easily distributed, and the accompanying documentation can be seamlessly presented. The results show how student engagement and satisfaction increased over time, partly because of the easiness introduced by the container technology. Our experience proves that combining containerized educational resources and free and open distribution channels can be one of the cornerstones of a new OER approach in STEAM subjects.

Keywords: virtual containers, STEAM, Open Educational Resources, content distribution platforms

1. Limitations of open educational resources in STEAM

Open Educational Resources (OER) are reaching a relevant level of acceptance in the college-level academic sphere, as the authors in (Zancanaro et al., 2015), (Hatzipanagos and Gregson, 2015) and (Allen and Seaman, 2016) have summarized. Many reputed academic institutions are already distributing free digital content: California State University (http://als.csuprojects.org), MIT OpenCourseWare (http://ocw.mit.edu), Washington State University (https://teach.wsu.edu/oer) and the Tufts Open Courseware (http://ocw.tufts.edu), among others. In addition, non-profit institutions are offering free OER materials like OpenStax (http://cnx.org) and the Open University (http://www.open.ac.uk). Furthermore, there are associations whose goal is to bring together open educational resources and OER creators, contributors, students, and consumers, such as the Open Education Consortium (https://oerconsortium.org), EDUCASE (https://library.educause.edu), OERu (https://oeru.org), OER Foundation (http://wikieducator.org/WikiEducator:OER_Foundation), and OERCommons (https://www.oercommons.org).

As pointed out by (Albright, 2005; Pearce et al., 2012), open educational resources have contributed to the democratization of education by allowing students and teachers to live together in a framework of mutual benefit. Also, as (Burgos, 2006) highlights, the non-hierarchical relationships that emerge between OER learners, OER creators, and teachers contribute very positively to the improvement of formal and informal learning settings, inter-personal interaction, and the overall educational process. Finally, (Downes, 2007) has written a very thorough review regarding sustainable paradigms for open educational resources and discusses several distribution, technical, staffing and funding models.

An OER typically consists of an electronic/multimedia teaching, learning, or even research resource. These resources are mainly available at no cost and under license types that have very few restrictions. Within the contents of an OER, the student can find any material envisioned for educational purposes (i.e., textbooks, related readings, interactive simulations, games, quizzes, assessment software, etc.).

In computing and engineering education, there already exist plenty of open source software initiatives. However, they cannot strictly be considered as OER since usually no companion instructions or teaching guides (i.e., proposed activities, starting tutorials, auto-correction tools, etc.) can be found. For instance, even though they are de facto open resources, all open software repositories like Github or Sourceforge and the code hosted inside them, cannot be considered as OER given that they do not necessarily aspire to play an educational role.

Reference this paper as: Corbi A and Burgos D, “Open Distribution of Virtual Containers as a Key Framework for Open Educational Resources and STEAM Subjects” The Electronic Journal of e-Learning Volume 15 Issue 2 2017, (pp126-136) available online at www.ejel.org
Besides, traditional educational software deployment in institutions can become a tedious task, which is usually delegated to teachers, students, and other non-technical staff. This difficulty arises from the huge variety of computer systems and architectures. In the case of cross-institutional collaboration, the situation worsens, as the authors in (Nerantzì, 2012) examine in detail. The lack of documentation when manipulating these contents also adds extra complexity. OER (and any kind of software-based learning material) not only require access to these digital resources by the student, but they also require knowledge for their installation, configuration and proper use, as summarized in Fig. 1.

![Figure 1: Usual phases in the implementation and use of a software tool.](image)

In face-to-face teaching, the process just described can take place with the means and resources of the educational institution, and the student can ask for help when needed. Nevertheless, in distant learning, the student finds him/herself alone facing all types of technical and learning difficulties. This loneliness can be felt even more intensely in the specific case of OER, where students do not have any institutional or official tutoring contact with the creator of the learning resource and therefore cannot ask for any sort of support.

Some of the required tools entail a huge level of complexity to achieve their proper deployment. In addition, other learning contents require very subtle computing environments such as:

- Specific operating systems and versions.
- Pre-installed libraries, frameworks, and runtimes like Java, Python, dotNet, etc.
- Specific user permissions or admin rights for installing and running software.
- Specific hardware: processor, memory amount, GPU capabilities, etc.

Faced with these situations, the only alternatives are the following:

- Require the student to acquire or replicate the architecture and software conditions necessary for the activities and contents taught.
- Allow the students remote access to a controlled working environment, which is deployed and managed by the institution or by third parties (i.e., cloud-based hostings such as Microsoft Azure, Salesforce Heroku or Redhat Openshift),
- Limit the underlying technologies needed by the learning resource to those that enjoy a broad consensus and level of adoption, i.e., international standards such as W3C and HTML5, ECMA and C#, or ISO and C++.
- Virtualize each working environment through the so-called virtualization technologies, which are tackled in this article.

From our point of view, the only option from the listed above that can be successful for a vast majority of scenarios is, undoubtedly, virtualization, which will be justified below. There is a current tendency to think that cloud-based solutions are the best answer to the above-mentioned problems. Nevertheless, some applications require significant computational resources to be executed in a time-sharing/remote environment and performance may decline significantly in these cloud scenarios. In this paper, we propose virtual containers (discussed in detail in Section 3) as a vehicle for delivering complex educational resources. We study a specific implementation of these containers named Docker.

Docker concentrates a large portion of its appeal in the management of an openly accessible repository of virtualized environments or images. This repository behaves like an OER management tool and can be considered to be an OERaaS platform (OER as a Service) that is ready for use in distant learning scenarios. This attractive characteristic will be discussed in Section 4, but before addressing this possibility further, we will first discuss the contributions of legacy/classic virtualization technologies in e-learning.
2. **State-of-the-art in virtualization of e-learning tools and OERs**

In its traditional or classic conception, virtualization (also referred to as legacy virtualization in this paper), is the implementation of a partial or complete hardware component or system by means of software exclusively. These emulated components can include disks, processors, network infrastructures, peripherals, or full desktop computers (including graphics, media playback, and sound). Virtualized resources are managed by a so-called hypervisor, which adds an abstraction layer between the real hardware (host) and the virtual scenario (guest). The main companies related to classic virtualization are Oracle, Parallels, Citrix, and VMWare. On the other hand, the main open source projects are the well-known VirtualBox and QEMU.

Even when dealing with virtualized environments, the efficiency and versatility achieved by modern commercial and open/non-commercial solutions almost match those achieved by host systems (Soares Boaventura et al., 2014; Seo et al., 2014). Fig. 2 shows an example of the speed that is attainable in database access (VMware, 2008).

![Figure 2: Native vs. virtual performance in SQL access to a database.](image)

This type of virtualization has a huge disadvantage: each time a new activity or (educational) content is created, it has to be wrapped by a new complete virtual machine. This usually entails greater upload and download bandwidth requirements for both the student and the institution. It may also involve a reduction in performance when several exercises, and thus several machines, are executed concurrently. This disadvantage can be overcome thanks to virtual containers, which are discussed in Section 3.

Each new virtual machine is, in turn, distributed following specific conventions and formats (OVF, VDI, VDMK, etc.) agreed upon reputed companies and projects that are affiliated with the Open Grid Forum (OCCI-WG, 2010).

There is an interesting study carried out by (Bruce, 2010) about the application of virtual machines in education that analyzes the barriers that are preventing the entry of virtualization in schools. The main barriers are the following:

- Lack of skills and knowledge by teachers and students.
- Lack of resources by educational centers and institutions.
- Disagreements between the stakeholders in the educational system.

However, IBM (IBM, 2007) predicts an unstoppable rise of virtualization technology in all areas and recommends IT services in schools to join this trend. Other research groups in educational technologies such as (Nauzycielski, 2011) have performed a comprehensive analysis of existing virtualization technology and its application to the teaching of subjects related to networking.

Traditional virtualization and virtual machines have been used as educational tools in STEAM since their technological birth. Typically, these educational resources emulate full desktop environments with everything...
necessary for the student to begin solving the required tasks with the greatest ease of use possible. Usually, the choice of virtual machines has mainly been influenced by the degree of complexity of the resource to be used by the student. If a resource required an arduous configuration for its use, then, a properly configured virtual machine seemed to be the best choice. For example, that is the case for GATE (Geant4 Application for Tomographic Emission). GATE offers the download of a traditional virtual machine based on the popular Ubuntu Linux desktop distribution with all the software necessary to directly operate with this framework related to particle and medical physics.

![GATE](image)

Figure 3: Some educational resources that are distributed as classic virtual machines (WWT, CloVR, vGATE, and a VirtualBox image for chemistry teaching).

Similarly, the authors in (Goodman et al., 2012) have developed a virtual machine-based learning environment for astronomy (WWT). The CloVR project (Angiuoli et al., 2011) shares the same goals, but it is focused on teaching genetics. The authors in (Kind et al., 2009) have implemented a VirtualBox virtual machine for teaching chemistry, and researchers in (Hamada, 2009) have done something similar in math-related subjects. The BioImg project (Dahlö et al., 2015) is aimed at centralizing a complete repository of legacy virtual machines with learning resources for the teaching of biology. The web pages of these projects are shown in Table 1. Fig. 3 shows some screenshots of these learning environments.

<table>
<thead>
<tr>
<th>Project</th>
<th>URL</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>GATE</td>
<td>opengatecollaboration.org</td>
<td>Simulations in medical physics and radiotherapy</td>
</tr>
<tr>
<td>WWT</td>
<td>worldwidetelescope.org</td>
<td>Framework for working with a virtual telescope</td>
</tr>
<tr>
<td>CloVR</td>
<td>clovr.org</td>
<td>Genetic analysis</td>
</tr>
<tr>
<td>BioImg</td>
<td>bioimg.org</td>
<td>Exercises in bioinformatics</td>
</tr>
</tbody>
</table>

3. Virtual containers

Virtual containers (Rosen, 2014) can be considered light virtual machines that are typically based on a shared GNU/Linux system. They are designed to run an instance of a specific application (and not a canonical full-screen desktop environment with a complete set of applications). A container’s mission is usually to implement a web service: a Ruby on Rails, NodeJS, or PHP application that owns an interactive TCP/IP port. The way
to do this is by running a virtual machine that implements just the components that are strictly necessary for such a service to run.

Containers have become the great allies of programmers, system administrators, and DevOps (development and operations) because they can be easily deployed on any computer infrastructure that has the minimum support pre-installed. The main advantage is its lightness and the ability to work in both development and production environments. The difference from traditional virtual machines is that all contained (or containerized) applications share the same underlying software layer, as shown in Fig. 4.

Figure 4: Classic virtualization (left) vs. container virtualization (right).

The main projects that use virtual containers are Xen (Barham et al., 2003), LXC (Rosen, 2014), Docker (Liu and Zhao, 2014), KVM (Kivity et al., 2007), OpenVZ (Kolyshkin, 2006), VMware ESX (Muller and Wilson, 2005), and libvirt (Bolte et al., 2010). There are also interesting comparisons between these technologies such as those carried out by (Deshane et al., 2008; Che et al., 2010, and Fragni et al., 2010).

In recent years, virtual containers have occupied an important niche in systems administration (Rosen, 2014). Container technology is currently considered to be the best answer to the problem of how to get software to run reliably when shifted from one computing environment to another. A container consists of a complete and packaged runtime bundle, which includes the target application and all its dependencies (i.e., linked or static libraries, helper programs, state or configuration files, etc.). By containerizing an application and its dependencies, differences in the underlying infrastructure are abstracted away. In contrast with conventional virtualization technology such as VMware Fusion, Parallels Desktop, Oracle VirtualBox, etc., several containerized applications share a single operating system (OS) kernel. This makes them lighter and less resource-hungry than conventional virtual machines (less than 100 megabytes or even less) and enables the distribution of large scale educational environments. As an immediate consequence, a container can easily be run either on humble local user/student hardware or on less expensive commercial cloud infrastructures (Joy, 2015).

Many projects related to the core technologies in containerization have emerged recently and many computer engineering companies, communities, and associations (both large and small) are involved. KVM from Open Virtualization Alliance, ESX from VMWare, or Docker from dotCloud are just a few examples (Che et al., 2010). As with other alternatives, Docker implements a simple, high-level interface to provide lightweight virtual environments that run isolated processes. However, Docker has a key advantage over other choices, the so-called Hub. The Docker Hub is a free online registry service for distributing containers (Fig. 5). It also provides search utilities for container discovery, management, and team collaboration (Hagstrom and Essary, 2009). As we suggest in Section 4, the Docker Hub can implicitly behave as a service for OER distribution and may be regarded as an OERs as a service (OERaaS) environment.
Undoubtedly, the main application of virtual containers is the distribution of services and applications. However, containers are also catching the attention of science research groups as a means of assuring the reproducibility of experimental results. For example, the authors of (Boettiger, 2015) examined this possibility in the case of Docker and (Clark et al., 2004) for Xen. However, its application has hardly been explored in the academic realm, or mode specifically, as a core teaching resource in distant education. Therefore, we propose the suitability of Docker containers to ensure a correct, simple, uniform and open distribution of educational content. More specifically, we suggest the use of Docker and its Hub for the distribution of open learning resources. Another important reason for selecting Docker is its strong open source foundation and its healthy developer community only comparable to other worldwide relevant projects such as the Linux kernel.

4. The Docker HUB as an OER distribution platform

One of the most successful implementations in the ecosystem of virtual containers is Docker (Tuomas, 2015). This virtual container alternative works with the concept of inter-connectable and inter-dependent images, which gives it great flexibility and explains the commercial success that it is already having in its thus far short life. These images are container snapshots that fit together like puzzle pieces and form a virtual operating environment. Each container incorporates just the frameworks (libraries, binaries, configuration files, support scripts, etc.), specific configuration files, and the software necessary to perform one task.

Docker has a public, open, and free container repository that handles thousands of these snapshots that are already ready to be downloaded and deployed. This repository is called the Docker Hub (Fig. 5) or simply Hub. Because registration is free and does not involve any royalty, a registered user can upload images to the Hub and share them with a vast and growing community of users. Some of these images have markedly academic objectives because they are eminently designed to recreate specific educational environments for many of the knowledge areas of STEAM subjects. Therefore, the Hub behaves as a de facto OERaaS platform from which hundreds of educational resources are distributed and served daily.

Table 2 shows some Docker images that are related to science and education and in which repository (within the Hub) they can be found. A repository name usually has two parts: author/image. The first one refers to the author of the image and the second one to the image itself.

Table 2: Some repositories of container images related to education in the Docker Hub.
The images belonging to the official repository are considered to be of great relevance in specific environments and are usually developed, maintained, and uploaded by institutions with a long tradition. This is the case of the famous Scratch software (Resnick et al., 2009) from the MIT, in the field of education.

5. Research

As a practical example, we discuss the experiences carried out at the online School of Engineering & Technology at Universidad Internacional de La Rioja (UNIR). In the context of a Physics for Computing Engineers subject, we describe the satisfactory evolution from using conventional software distribution methods towards the transition to Docker containers for broadcasting each assignment’s underlying software. Each homework set was given to the student as a virtual container. Our working hypothesis is that virtual containers can significantly improve the student experience when having to solve complex mathematics, physics and other STEAM-related college level exercises.

These assignments ranged from simple physics problems to be solved with a set of Python scripts to more complex simulation scenarios that required intricate software outlines. This is the case of an exercise related to the study of sub-atomic particle and photon tracks/collisions calculated with the legendary Geant4 package from the CERN. All of the containers deployed the necessary software tools for each physics task, examples, and companion resolution guides, thus freeing the learner from these duties and allowing him/her to concentrate on the problem itself and how to solve it. All of the containers (and all of the proposed activities) shared common resources such as the Kernel, basic libraries, or a Python environment.

The above-mentioned taught physics subject (our evaluation scenario) has an eminently applied focus. The methodology followed is the study of the main computing tools for projects that are currently part of modern physics experiments. The commitment to the implementation of these activities is voluntary since they usually involve more time and dedication by the student. That is why this block of exercises (Table 3) is called alternative activities. Although they are given some weight in the course grade, their execution and resolution is not mandatory. In early editions of this physics course, each of these tools was distributed in a more traditional way, i.e., through discrete software packages for each operative system that each student had to install on his/her own computer. Despite the careful preparation of each tool, compatibility problems and configuration issues arose in a fairly high number of cases. For this reason, in subsequent academic years, the use of classic virtual machines (complete desktop environments) was favored for certain activities. One of these activities was the particle physics lab. To minimize the complexity related to the deployment and execution of this exercise, a headless virtual machine (not desktop-based and without graphical interface) was created. This machine was downloaded by students, who could access it through a SSH session. This session enabled the execution of the necessary calculations. The only drawback related to this way of distributing a learning content of this type is that if this particle physics assignment ever requires (even minor) modifications, a new and complete virtual image has to be rebuilt from scratch.

As with the simulation of fundamental particle interactions, the vast majority of these cutting-edge scientific projects (particle physics, accelerator physics, nuclear medicine, electromagnetism, optics, circuit analysis, etc.) require very specific computing environments that are very difficult to reproduce outside of the research/academic field in which they were conceived. This means that when these tools have to be deployed in a foreign educational environment, technical difficulties may normally arise.

For the 2015-2016 academic year, the School of Engineering decided to move the implementation of some of these activities to Docker-based virtual containers. This has led to huge workflow and methodological simplification for all students since they were only required to install the basic Docker toolchain. Once installed, the students were able to download these resources from the Hub website or through the more modern tool called Kitematic (Fig. 6), which was developed by the Docker team to handle virtual containers in a more convenient way.

Our evaluation process consisted on measuring the rate of satisfaction of students relative to the use of virtual containers and the number of successfully completed tasks with and without virtual container-based technology. These assignments were submitted through the assignments tool in a Sakai-based online campus. Students also filled a simple satisfaction questionnaire at the end of the semester, rating their satisfaction...
regarding the use of Docker and virtual containers as an appropriate method for designing and delivering remote STEAM labs.

**Table 3: Proposed activities executed with virtual containers**

<table>
<thead>
<tr>
<th>Activity</th>
<th>Software</th>
<th>URL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Circuit analysis</td>
<td>NGSpice</td>
<td><a href="http://ngspice.sf.net">http://ngspice.sf.net</a></td>
</tr>
<tr>
<td>Symbolic maths</td>
<td>Maxima</td>
<td><a href="http://maxima.sf.net">http://maxima.sf.net</a></td>
</tr>
<tr>
<td>Function plotting and charting</td>
<td>GNUPlot</td>
<td><a href="http://gnuplot.info">http://gnuplot.info</a></td>
</tr>
<tr>
<td>Optics</td>
<td>GNU Octave</td>
<td><a href="http://octave.sf.net">http://octave.sf.net</a></td>
</tr>
<tr>
<td></td>
<td>OpenCV</td>
<td><a href="http://opencv.org">http://opencv.org</a></td>
</tr>
<tr>
<td></td>
<td>Python</td>
<td><a href="http://python.org">http://python.org</a></td>
</tr>
<tr>
<td>Particle physics</td>
<td>Geant4</td>
<td><a href="http://geant4.web.cern.ch">http://geant4.web.cern.ch</a></td>
</tr>
<tr>
<td></td>
<td>Root</td>
<td><a href="http://root.cern.ch">http://root.cern.ch</a></td>
</tr>
<tr>
<td>Quantum physics</td>
<td>Ruby</td>
<td><a href="https://www.ruby-lang.org">https://www.ruby-lang.org</a></td>
</tr>
<tr>
<td></td>
<td>Java</td>
<td><a href="http://java.com">http://java.com</a></td>
</tr>
<tr>
<td>Word processing of scientific documents</td>
<td>LATE\textsuperscript{X}</td>
<td><a href="https://www.latex-project.org">https://www.latex-project.org</a></td>
</tr>
<tr>
<td></td>
<td>HTML5</td>
<td><a href="https://www.w3.org">https://www.w3.org</a></td>
</tr>
<tr>
<td>Medical physics</td>
<td>DCMTK</td>
<td><a href="http://dicom.offis.de">http://dicom.offis.de</a></td>
</tr>
<tr>
<td></td>
<td>ITK</td>
<td><a href="http://www.itk.org">http://www.itk.org</a></td>
</tr>
<tr>
<td></td>
<td>VTK</td>
<td><a href="http://www.vtk.org">http://www.vtk.org</a></td>
</tr>
<tr>
<td></td>
<td>C++</td>
<td><a href="https://isocpp.org">https://isocpp.org</a></td>
</tr>
</tbody>
</table>

These images were publicly available on the Docker Hub and they could be downloaded and used by any student, regardless of their institution. For this reason, these images can be considered as OER, and the Docker Hub has played the role of an OERaaS.

![Image of Docker Hub container images](image)

**Figure 6:** Kitematic allows the free download of container images created for the physics subject presented in this research

6. **Results and discussion**

Our results show how student engagement and satisfaction increased over time, partly because of the ease and swiftness introduced by the container technology in the distribution of each of the physics lessons mentioned above (Fig. 7).
Figure 7: Evolution in the percentage of students (superimposed black line) committed to execution of alternative activities based on virtual containers. In each week, a complete new technology and science problem (entailing a radically different computing scenario) was introduced. Some of these technologies and frameworks are summarized in Table 3.

These resources were openly available in the Docker Hub for one semester. Enrolled students accessed, downloaded, and run them as plain OER in their own personal host systems. Our experience proves that combining containerized educational resources and free and open distribution channels can be one of the cornerstones of the OER approach in STEAM subjects. Fig. 8 shows the evolution in the commitment of students to the elaboration and submission of alternative activities involving richer computing scenarios. Clearly, the 2015-2016 semester represents a huge difference (in student commitment) when compared against the previous academic years.

Figure 8: Evolution in the commitment and dedication to alternative activities based on the use of scientific software tools. Only in the 2015-2016 semester, virtual containers were used as part of the teaching methodology. The vertical axis entails the percentage of submitted alternative activities (discussed in Section 5). The pie graph shows the degree of student satisfaction with the technology of virtual containers (applicable only in the 2015-2016 academic year, when the satisfaction questionnaire was handed in to the students).

Similarly, during the 2015-2016 academic year, interest has been increasing with a significant rise in week 6 (Fig. 7). During that week, the students carried out the same exercise related to particle physics (described above). In this activity, the students simulated a beam of particles and their possible interactions with matter and detectors. The ease of implementation of this task by means of a virtual container attracted a large
number of students to continue solving the rest of the proposed activities, which were also distributed as lightweight interdependent containers.

Also, our results correlate with the increasing number of Docker images available in the Docker Hub and that are related to education in STEAM subjects (Fig. 9).

![Figure 9: Evolution in time on the number of Docker images dedicated to STEAM education.](image)

7. Conclusions

The simplification of the distribution of computing environments in education is a key element in attracting students to the use of modern and highly complex STEAM learning tools. The virtual containers represent a powerful tool for distribution of OERs. In this article, we have focused on the Docker project and its Hub platform, which are aimed at the easy and open delivery of virtual containers. We have demonstrated through an actual case study how this tool can operate as an OERaaS platform. Throughout the duration of this case study, we perceived and measured a progressive increase in the interest and commitment of students towards the use of the proposed educational tools. As a future line of work, our research group is considering the use of unikernels as a method for delivering rich technological and scientific content (including related assignments). Unikernels represent and deeper simplification of the virtual container approach, given that all necessary computing elements (operative system kernel, basic libraries, frameworks, drivers, scientific application, etc.) reside in just one minimal, binary, executable file. The main advantages of unikernels over containers are the improved security, the small footprint and the increase in speed.

Acknowledgements

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References


Iphras as an E-Learning Platform for Idiomatic Competence

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Abstract: The integration of E-learning has expanded in a variety of directions to a degree that its successful application is of great importance to all sectors of education and training. E-learning can offer unquestionable advantages to everyone involved in both the assessment and the knowledge transfer process (Owens and Floyd 2007; Luchoomun, McLuckie and van Wesel 2010; Damyanov and Tsankov 2016). Some of the challenges of e-learning methods rest in choosing the right platform, and in determining the scope of the selected material as well as the adequacy of its user friendly methodology. Among the features of e-learning platforms that are applicable to a wider audience is the criterion of multi-language application.

As regards E-learning in foreign language education, there are three pragmatic and cultural aspects which are often omitted from the e-learning system: 1) the transfer of idiomatic competence; 2) the acquisition of cultural concepts; and 3) the inclusion of small and endangered languages. This is not the case with the elaboration of the e-learning platform IPHRAS - Interphraseologie für Studien-und Berufsmobile. The proposed paper presents its main achievements and focuses on the methodology for foreign language learning in a multilingual electronic environment. The process is facilitated by the incorporation of thematically structured multiword units (idioms and collocations). Its priority is easy access to a variety of languages, including Greek, Turkish, Romanian, Bulgarian, through more popular languages such as English and German. The degree of translation equivalence of its elements facilitates not only multilingualism, but also the initial phase of mastering the vocabulary of additional languages. The IPHRAS platform was elaborated by an international team of Balkan researchers and language instructors and funded by the European Commission within the Lifelong learning program.

Keywords: e-learning platform, foreign languages, multilingualism, idiomatic competence

1. Introduction

Despite the fact that phraseology as a separate linguistic branch is widely popular as a research field, there is still serious scarcity of studies of phraseology in e-learning. The present paper contributes to the overcoming of this scarcity by discussing the data collection and data design techniques for the development of idiomatic competence in the context of the multilingual language platform IPHRAS developed under the project of the same name. The project started in 2013 with a duration of two years. It was conducted under Nr. 530962-LLP-2012-DE-KA2-KAMP in the Long Life Learning Program. Partners were the Thüringer Hochschulverband Jena, the Institute of Slavic languages and Institute for Indo-European languages at Friedrich Schiller University of Jena (Germany), the Lucian Blaga University in Sibiu (Romania), the South-West University “Neofit Rilski” in Blagoevgrad (Bulgaria), the Yildiz University, Istanbul (Turkey) and the Green Institute in Athens (Greece). The Project was funded by the European Commission. The first year was spent building up the design, the methodology and the corpus criteria. The second year was dedicated to the linguistic processing of the multilingual data. For the purposes of this research the analysis has been limited to the design and methodology stages, leaving aside the implementation phase as an opportunity for future discussion.

The development of idiomatic competence, a component of linguistic and communicative competence, in foreign language learning and second language learning (hereafter FLL and SLL) is difficult for the following reasons: 1) idiomatic expressions come from various walks of life, social practices, and culture-specific phenomena, which makes them hard to learn; 2) during teaching, they should be put together in coherent groups facilitating their memorization; 3) learning to use them correctly requires systematic language knowledge and differs from the acquisition of word meaning; 3) they are complex linguistic units which first need to be identified as such, then their meaning can be decoded, and finally their usage context needs to be established; 4) idiomatic or phraseological meaning is often generated not only from the pragmatic context but also from the cultural code; 5) idiom identification is different from the identification of words and their free combinations, which is why learners often fail to comprehend them as semantic wholes. All these difficulties can be illustrated from a comparative perspective by the following example. In Bulgarian the phrase
‘Zhelaya ti kasmet’ (Good luck) is expressed in German through the formula *Hals- und Beinbruch* ‘break a leg’, which sounds more like a curse that like a good wish, as can be seen in Figure 1:

Figure 1: Study card of the phrase Hals- und Beinbruch in the IPHRAS e-learning platform

Additionally, this phrase belongs to the informal register and should not be used in formal situations. This example demonstrates the relevance of the communicative situation to the understanding and restricted use of such idiomatic expressions.

The abovementioned difficulties in learning, using, memorizing, and comprehending phraseological language pose special requirements to the design of e-learning platforms for figurative language and set phrases.

A pragmatic approach to idiomatic comprehension in e-learning overcomes the abovementioned difficulties using the illustration techniques wherein a picture presents the literal meaning of the phraseological unit in its foreground and uses this to symbolically transfer the figurative meaning through an atypical property of the object in the picture. Such image metaphors are also used in picture dictionaries and traditional learning methods to visualize both the literal and the metaphorical meaning. This, according to Marešová (2009), supports the learning in the multi-user virtual environment. Another possibility for achieving idiomatic comprehension, however, is to convey the literal meaning through music. Such effect is further discussed by adopting a musical intelligence in E-learning and occurs especially with e-learning music applications for children (Wu & McMahon 2014).

Another technique used for electronic idiomatic comprehension is based on mobile services and on the fact that learners nowadays prefer using their smart phones to acquire all types of information. The application Short Message Service uses text messages to automatically send three idioms a day (Hayati, Jalilifar & Mashhadi 2013). What makes these difficult to learn is the lack of semantic proximity and the fact that they are not united by any criteria other than their belonging to the phraseological level of language.

An issue that comes up when constructing e-learning platforms for idiom comprehension is the structure and organization of the phraseological unit card. It is very similar to the processing of idiomatic expressions for the purposes of data collecting for dictionaries (common unilingual, bilingual or even multilingual phraseological dictionaries). It is not only an encyclopaedic endeavor, but its success depends to a great extent on the methodological approach to the construction of the dictionary or the platform, respectively. And if Williams (2012:217) notes that bringing data and dictionary together is like “real science in real dictionaries”, then the way of how to present the phraseological expression in a data base collection or another type of data processing requires more than the ability to find the most adequate ways of translating the units. The problems of compilation and presentation of idiomatic expressions in a data base for an E-learning platform are similar to the problems of phraseological compilation. The main issues, according to the Russian linguist and phraseologist Arsenteva (2014: 11) occur in designing the phraseological entry, the presentation of the connotation and its potential, the types of definitions, the phraseological counterparts and the translation of idioms having no such counterparts. In addition to these problems, there is a prevalence in research papers of contrastive bilingual analyses of set phrases but studies of multilingual databases are still rare (Kühn 2007:630).
This paper tries to contribute to the solution of these issues through an exploration of a multilingual electronic environment for the enhancement of idiomatic competence.

2. IPHRAS as an E-learning platform for idiom comprehension

As an e-learning platform for idiom comprehension IPHRAS is yet another attempt to deal with the problems these linguistic units entail in learning and teaching. It sets certain goals which are to be achieved through its content, design and structure.

To start with, the platform needs to be suited to both persons without foreign or second language background and to people with knowledge of a foreign language, as well as to language instructors and experts in the field. Secondly, idiomatic expressions included have to be applicable to specific communicative situations reflecting student and worker mobility in new linguistic environments. In response to these two tasks, IPHRAS has two different thematic spheres: routine formulas with everyday use and set phrases employed in job interviews and job application. The units in both fields have extremely high frequency of use and meet the requirement of practical applicability posed by the situation of living, working, or studying abroad, which entails intercultural dialogue in institutions and in informal context. In addition to this, IPHRAS also offers teaching materials for language instructors. They are presented in an order of increasing difficulty and are aimed at practicing the selected language units in suitable communicative situations. The division between everyday use and formal use still persists, but the more advanced learners can benefit from the beginner exercises as these are more pragmatically oriented and also offer a large variety of synonyms of the units in the main list.

Thirdly, IPHRAS gives equal status to seven languages which belong to different language families and use different types of graphic encoding (Latin, Cyrillic and Greek scripts). Each language can be chosen both as a source and as a target language. This makes it possible for a learner to use the routine formulas and become initially familiar with a language that is completely new to him/her, especially in cases of language contact where more languages are used simultaneously like those from the Balkan Language Union (Greek, Bulgarian, Turkish, Romanian). This property of IPHRAS is of special importance because in a multilingual environment the factor language popularity may not be relevant at all. The equal status of IPHRAS languages is important for yet another reason. It corresponds to the five basic aspects of multilingualism: psychological, social, cognitive, pragmatic, cultural (Riehl, 2006: 6).

Another way to achieve this quality is to base the choice of the presented units on the similarity of their content in all the seven languages, on the correspondence of their components, and on their shared cultural background. Each language, for instance, has set phrases for meeting, greeting, or congratulating people on different occasions. The semantic and syntactic connections between these phrases render their memorization easier. Thus the phrase Cheers in English corresponds to the German Prost with variants Zum Wohl or Prosit. They are all used when drinking on a certain occasion. The Bulgarian language uses the formula ʻ̬̖̌̔̌̏̚ Nazdrave ʻ̬̖̌̔̌̏̚ Nazdrave both for drinking and for wishing someone health when they sneeze.

Finally, IPHRAS meets the requirement of being user-friendly and effort-saving. Since the acquisition of idiomatic as well as multilingual competence takes hard work and a lot of time, the platform has a simple and clear design. The first step is the choice of one of the seven languages as a source language. On the screen appear four working areas: Learning mode; Practice mode; Teacher materials, Glossary & Help. The content of each area is accessed through a dialogue box. The Learning area contains the thematic groups of idioms comprising the routine formulas and the more extensive field job application. The specifically grammatical information is separated in a different rubric. Still, it is one click away in case it is interesting or necessary to the user. This separation of the information for users and for experts saves time and efforts. Another manifestation of the platform’s user-orientation is the audio option application. It makes it possible for them to hear the phrase articulated by a native speaker. Additionally, each type of information is designated by a separate symbol, which additionally facilitates working with the platform.

3. The methodology behind IPHRAS

While idiomatic competence in the first language occurs directly during language acquisition as a result of intuitive use, in FLL and SLL this is a mediated process and requires a minimum of language knowledge and specific instruments. IPHRAS applies such an instrument realized in two phases by transforming FL and SL data...
into language input through its data collection (negotiation) and date design (presentation) techniques as shown in Figure 2:

**Figure 2:** Methodological model for learning idioms in an electronic environment

The model presented above consists of four basic and two ancillary components. The component *language data* is independent as a reflection of the existence of natural languages.

The ancillary components are operational and mediate the transformation of language data into language input. The component *e-learning platform* reflects the electronic environment and is the material manifestation of the *input* component. In learning phraseological units in the first language speakers directly transform language input into language output. In learning a second or foreign language this process is indirect and requires additional information such that may take the form of e-learning platforms, mobile services, illustrated materials, the foreign language classroom or any other educational means. The *input* component is a ‘container’ of accessible knowledge activated through the e-learning platform. The *output* component is a result of the combined activity of the learner as a user of *input* information and the e-learning platform as a provider of such information. This activity leads to the development of (multilingual) idiomatic competence and has different value for each user with regards his/her goals in learning a foreign language therefore the output, unlike the platform, is a dependent variable. Thus the methodological model contains two procedural components (collection and design techniques) and three resultative ones (input, output, platform), superimposed by the independent component *language data.*

### 3.1 Data Collection (Negotiation) Techniques

The first negotiation technique requires that an agreement on the type of phraseological units be achieved. There are two different conceptions of the nature of idiomatic expressions in language: the narrow view and the wide view. According to the narrow view phraseological units are poly-lexemic expressions whose meaning is not deducible from its components (Burger, Buhofe, Sialm and Eriksson 1982). According to the wide conception of their meaning and form, idioms also include set phrases – units of language whose syntactic form is fixed and they are similar to mono-lexemic forms in this respect. Their meaning, however, is deducible from their form and what is special is only their context of use (Palm 1997). This technique is important because the adoption of only one of the conceptions will be detrimental to the data collection process and will deprive the platform of its integrity and unity. Also, this is a way of choosing the sources for the excerption of the language units, as some of them are not to be found in phraseological dictionaries. Besides, many monolingual explanatory dictionaries lack a good phraseological component.
Since the users of the platform include mobile people and temporary visitors for study or work purposes, the aim of the corpus is to enable orientation and competence in two main domains: everyday communication and communication for administrative purposes. As the field of administrative communication is rather broad, the designers concentrated on the phrase connected with job search and job application in order to avoid indiscriminate inclusion of expressions in the database. Other thematic fields can be added in case of a future extension of the platform.

The next negotiation technique is the agreement on the applicability level of the units in the platform. It should take into account the work/study mobility of the users and the multilingual nature of their target environment. Most importantly, however, it makes allowances for the foreign language level (if any) of the users. This makes it suitable both for beginners and for people who have some familiarity with the target language or languages. What makes the platform unique in this respect is that all languages can serve as both source and target languages in the search process but the collection of the corpus data was first conducted in German, which was used to design a list of the expressions to be included in the database. In connection to this, the retrieval of each phrase can occur from each (source) language into each (target) language.

As to the comparison and status of languages, it should be taken into account that the Romani language has restricted vocabulary. Therefore, in agreeing on the possibility for all languages to serve as both source and target in the platform, it had to be excluded from the option of being a source language because of its limited capacity.

The technique of agreeing on the scope and content of the platform includes the adoption of a variety of criteria as to their arrangement. It often occurs not in alphabetical order but in terms of their semantic proximity. Random choice of units cannot lead to well-structured and resultative entries which can be used for the purposes of education. Complying with the applicability of the platform to people with basic language and/or multilingual competence the authors have chosen to start with routine formulas for greeting, saying goodbye, wishing, gratitude, etc. These are widely used in everyday situations and largely equivalent in the languages of the platform. They are a good way to start developing sensitivity to the difference between the structural and the semantic component of each idiom.

Importantly, it can so happen that in one language the phrases expressing thankfulness are much more than the respective phrases in the other languages. Sometimes, the use of a certain expression can be specifically related to a situational context and render additional meaning as a result. For example, the concluding phrase in formal correspondence in Bulgarian is always Суваждение `uvazhenie`. In English there is a choice of two basic phrases with regards to whether the author knows the recipient or not: Sincerely (recipient familiar), Faithfully (recipient unfamiliar). Most often, however, especially in e-mails the phrase is Best regards, Kind regards or simply Best. Such a differentiation cannot be achieved in Bulgarian, but it does occur in German.

In view of the usefulness of the platform, the scope and content technique described above also needs to follow the phraseological diversity of the input content in the formal use of language in job applications. In other words, the sphere of looking for, finding, and getting a job is reflected in language with a variety of phraseological units and thematic groups of idioms: key job application phrases, letter of application, experience and qualification and CV. Sometimes, as a result of the specific sphere of use, the input includes not only set phrases but also mono-lexemic word forms, such as reference, interview, trainee, training, but also work permit, final certificates, further education, vacant position, working hours.

All the negotiation techniques mentioned above are prerequisites and a necessary condition for the correct execution of the next group of techniques in the methodological model of the e-learning platform IPHRAS which make the data design an efficient tool for educating learners.

### 3.2 Data Design (Presentation) Techniques

The first data design technique is connected with the establishment of a backup support site which serves only for building up lists of words in two axes. The vertical axis gives the phrases and the horizontal axis – their syntactic and semantic description and their usage. It does not allow for any phrase to be included in the target language until it has been completely processed in the source language, i.e. until its semantic and grammatical information has been presented in the form of special fields retrievable in the actual platform as
study cards. The ultimate goal of these study cards is to facilitate the learning of set phrases especially in the cases when their components in Language 1 and Language 2 differ.

Another problem challenging the conceptual frame of the design of IPHRAS is the differentiation between literal and figurative meaning. In working with traditional dictionaries, the users directly confront the set phrases and their equivalents. The meaning of the components remains unknown and is not directly explicited. Learning phraseological expressions for multilingual purposes, however, cannot neglect this issue. This is especially true if we assume that the platform needs to be comprehensible for people with basic or no foreign language competence. For this reason the question whether a certain set phrase should be presented only with its translation equivalent in the target language is of great importance. Such a presentation does not take into account the juxtaposition between the word for word translation of the components and the meaning of the expression. In accordance with the scope and content negotiation practice of the platform, the differentiation between literal and figurative meaning can be resolved only by means of the platform design. Thus the presentation of the phrase job advertisement adopts the following shape: source language phrase – translation equivalent – word by word translation, as can be seen in Figure 3:

Figure 3: The opposition translation equivalent vs word by word translation in the IPHRAS platform

<table>
<thead>
<tr>
<th>Phrase</th>
<th>Application</th>
<th>Inflection</th>
<th>Grammar</th>
<th>For experts</th>
</tr>
</thead>
<tbody>
<tr>
<td>zur Weiterbildung bereit sein</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Translation</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>to be willing to undertake further education</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Word by word translation</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>zur Weiterbildung</td>
<td>bereit</td>
<td>sein</td>
<td></td>
<td></td>
</tr>
<tr>
<td>for further+education</td>
<td>for further+education</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Meaning</td>
<td>Target language</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>to be willing to undertake further education- to be prepared to do further studies</td>
<td>zur Weiterbildung bereit sein</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Additionally, the literal translation is visualized with arrows connecting each component of the set phrase with its translation. In addition to these three elements, a fourth element of equal importance is added – the meaning in its context of use. Importantly, in view of the language level of the learner, the phrase and its translation equivalent have an audio option.

The next data design technique optimizes the working screen by making effective use of its two spatial axes – the horizontal and the vertical one. The phrases in each language are arranged vertically and the explanations occupy the horizontal axis. The working screen space has a horizontal control menu which, in addition to the information on the meaning and context of the phrase, presents its application (in sentences), its inflections (the grammatical information necessary for correct sentence use), and the expert data on the concrete item. Another technique that makes the design of the data learner-oriented and efficient is the division between the learning mode of the platform and its practice mode. In the practice mode the users are offered lists of exercise types which they can use in choosing the form of their practice. For example, this mode gives the learners an opportunity to translate an expression from one language to another. The answer can be electronically checked by the system and the platform calculates the user’s progress in terms of the number of correct components of the expression and gives the correct answer.
Next, the practice mode also gives them access to study cards of the type ‘IPHRAS to go’, as Gieseke-Golembowski (2015) calls them. These study cards can be printed with a large variety of content options which can be customized. The learner may tick on any of the following: *phrase, examples, inflection, for experts*. Because the platform is multilingual and since it contains two different thematic fields of phrases, the learner mode also offers 84 lists which reflect all the possible combinations of source and target languages. This makes it possible for learners of languages which are not popular or are endangered, such as Romani, to double-check meanings of idioms easily and without the use of a mediating lingua franca.

4. Conclusion

One of the requirements to the modern person in the global world is the successful orientation in multilingual environment. Through its seven-language system complying with the general methodology of electronic language learning, IPHRAS contributes not only to the development of multilingual competence, but also to the mastering of specific idiomatic competence (Bock and Gieseke-Golembovski 2014, Sava 2014, Güneş 2016). The usefulness of the platform for its multilingual purposes is facilitated by the systemic use of the techniques of negotiation in the process of data collection and presentation in the data design phase. This makes it possible for the comprehension, learning, and use of the linguistic units to occur as output to the opportunities offered by web-supported education. Thus the methodology of IPHRAS plays a crucial role in overcoming the difficulties learners confront both in traditional and in electronic educational environment.

References


Lessons Learned From Implementing E-Learning for the Education of Health Professionals in Resource-Constrained Countries

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Abstract: The growing global demand for tertiary education has led to the increased use of e-learning approaches around the world. Demand has increased most rapidly in low and middle income countries (LMICs), which account for half of the students currently enrolled in higher educational institutions (HEIs). But the implementation of e-learning programmes in resource-constrained settings faces many obstacles. This paper explores some of the key issues involved in implementation of e-learning in HEIs involved in the education of health professionals, given the resource constraints within which many institutions have to function. We present case studies of three such LMIC institutions of varying size and primary purpose. The paper suggests use of appropriate ICT infrastructure, both in terms of hardware and software, combined with effective access and bandwidth management policies is crucial to the successful implementation of e-learning courses on health within HEIs based in LMICs.

Keywords: e-learning; global health education; connectivity; bandwidth management; capacity building; educational technologies

1. Introduction

The development of innovative ICTs, increased accessibility of the internet, and a growing global demand for tertiary education (Wende, 2003) has stimulated interest in e-learning – “the use of digital or electronic technologies and materials to support teaching and learning” (Power, 2014) – in many countries (Tinio, 2002). Investment in e-learning has the potential to provide high quality teaching at a lower long-term cost per student (Bates, 1995; Olsen, 2015), though initial costs may be higher (Kumpu, et al., 2016). It has been argued that the internet provides opportunities for the development of a ‘global classroom’ where individuals can learn in distant locations, at different times, and at their own pace, leading to a “borderless education … that crosses the boundaries of both time and space” (Middlehurst, 2006). By extending access to health professionals who are highly motivated but struggle to overcome the financial and social costs associated with full time attendance at a tertiary education institution, e-learning could contribute to capacity building in resource poor regions where they are most needed (Marrinan, et al., 2015; Hvorecký, et al., 2005).

The global demand for higher education is rising rapidly, with over 150 million people estimated to be seeking tertiary education by the year 2025 (Suhail, Lubega and Maiga, 2014). This demand is particularly prevalent in those ‘low and middle-income countries’ (LMICs), as defined by the World Bank, which account for half of the students currently enrolled in higher education institutions (World Bank, 2000). In particular, there is a rapidly increasing demand for global health related courses (Kerry, et al., 2011), which is reflected in the 34% growth in the number of recognised medical schools over the five years from 2007, many in LMICs (Duvivier, et al., 2014). In resource-poor environments, the advantages of e-learning may offer a way to satisfy this demand. There has been strong support in many LMICs for the integration of e-learning into existing healthcare teaching programmes, given a recognition of the need to substantially increase the number of qualified providers and ensure their more equitable distribution within a context of limited financial resources and academic staff (Frehywot, et al., 2013; Bollinger, McKenzie-White and Gupta, 2011). However, implementers...
of e-learning programmes in these settings face many obstacles. Experience has taught that the integration of ICTs into the activities of any organization is a complex process that needs careful conceptualization and detailed planning (Greenhalgh and Stones, 2010). There are also obvious cost implications associated with both the initial acquisition of required hardware and software and, often not sufficiently considered, its long term maintenance and eventual replacement (Kumpu, 2016; Khan, Hasan and Clement, 2012). Even where financial constraints can be overcome, a lack of suitably qualified and experienced personnel may be a serious limitation, given that the success of e-learning projects is “often dependent on the skills and quality of technical support provided to end-users” (Gray, Ryan and Coulon, 2003). Without such support, the ability of even the most enthusiastic teachers and students to access and use the technology effectively may be severely hindered (Prostiv and Atkins, 2016; Valdez, et al., 2004). Users need continuous and timely help from technical departments, which may prove very difficult to provide when resources are severely limited (Moolman and Blignaut, 2008). Here we address some of the technical and logistical constraints to be negotiated by those attempting to develop new e-learning initiatives.

2. Methods

The aim of the paper is to inform those wishing to explore the potential for e-learning in courses targeting the health professions in HEIs using case studies from three institutions that deliver such courses. The case study approach seemed most appropriate, given that there has been limited previous research in this area. It seemed reasonable to assume that multiple interacting factors, concerning which we have at best anecdotal knowledge, would play a role in determining the relative success or failure of e-learning initiatives, and that those factors might vary considerably between institutions. The possibility that a case study could “examine a particular instance but illuminate a general problem” (Merriam, pp. 30) seemed most appropriate to the present task.

We selected the case studies from the twelve academic institutions in LMICs that collaborated on a recent e-learning project (Lucas and Kinsman, 2016). Selection was based on the diversity of the cases, in terms of both size and purpose. On this basis we selected: a major university with a prestigious College of Health Sciences; a medium size health research institute; and a relatively small academic institute primarily concerned with the education of health professionals. The case studies were conducted by three of the authors in their own institutions. They were conducted using a combination of their existing knowledge, a review of the variety of internal documents detailing the evolution of e-learning activities, and a series of semi-structured interview with key informants, both those involved in the development of courses and those supporting the use of ICTs in their implementation. The interviews focused on the resource and technical issues that arose during the design and implementation of relevant courses. In particular, they addressed: current, planned and potential e-learning activities; the main challenges encountered in course implementation; and strategies adopted or suggested to overcome those challenges.

Whilst we recognise that there is great variation between resource constrained countries and between individual institutions in those countries, we aim to identify some key issues raised in one or more of the studies and consider the approaches used to address them, in the hope that this may assist other health sector organisations who wish to incorporate e-learning into their training programmes.

3. Findings

3.1 Case Study One: Indian Institute for Health Management and Research (IIHMR), India

The IIHMR (Jaipur) is a university in Rajasthan, northwest India. It focuses on management, research, education and training in the health sector, with 300 students per year accepted onto its MBA courses, and with 46 faculty members covering a wide range of disciplines. It also collaborates with Johns Hopkins University (JHU) in offering their MPH programme as a blended learning course. This is designed to provide high quality public health capacity building at a relatively low cost, targeting students from LMICs.

Alongside traditional modes of instruction, IIHMR uses a wide range of educational technologies, with teaching content delivered via the internet, the Institute intranet and DVDs/CDs. Internet-based courses use an interactive learning management system (LMS) and incorporate a range of multimedia components including live streaming and recorded videos. The MPH course uses a LMS developed and maintained by Johns Hopkins University, with onsite technical support provided by IIHMR. This degree of outsourcing was seen as the best
option, given the significant financial investment, resources and expertise that an on-site server room demands.

There is a single ICT department (12 employees) providing technical support to the Institute, including network administration, software installation, network maintenance, resolving hardware and software problems, and security. The Institute runs a basic digital literacy course for students, removing the need for the ICT department to deliver such training. The internet connection is provided through both a local area network (LAN) and a wireless network. Staff and students access the internet using 200 computers maintained by the ICT department and connected to the LAN, or laptops and mobiles linked to the Wi-Fi network. The university relies on leased lines from two commercial Indian ISP providers, at speeds of 20 Mbps for regular operations and 5Mbps as a standby option.

3.1.1 Challenges

Increased use of ICTs for educational purposes has provided many opportunities for IIHMR students but has raised a number of managerial, financial and technical challenges. These include: providing the required Institute-wide infrastructure (in terms of both hardware and software); designing and implementing an e-learning platform, which involved substantial initial expenditure and a dedicated team to maintain and upgrade it; providing support to both faculty and students; and managing bandwidth to avoid network congestion and allocate resources in line with Institute priorities. The ICT department has identified three main risks related to the network: excessive consumption of bandwidth; lack of compliance with Government regulations (for example, visits to websites banned by the Indian Panel Court); wilful misuse of the system, for example cyber bullying, computer hacking; and use of unauthorised software.

Growing use of multiple devices (mobiles, laptops, tablets) by students has led to increased consumption of bandwidth, placing a considerable additional burden on the network. The university environment is very challenging to monitor and manage, given the diverse range of demands on the system and potential for rapid and sometimes unexpected fluctuations in demand over time. Many students use the internet not only for educational purposes but to access social media sites or download music and videos. Such activities may consume much of the bandwidth and substantially downgrade access for other users. However, they are very difficult to prevent without imposing constraints on those who wish, for example, to access educational videos, download academic articles or attend relevant webinars.

3.1.2 Management strategy

In order to improve the performance of the network within existing resources, the department has adopted a multifaceted approach to reducing congestion. This focuses on: a fair usage policy agreed with users; network monitoring; and effective enforcement of access regulations. Network administrators monitor traffic flows, detect and eliminate viruses and provide real-time performance indicators. The freely available monitoring tools Wireless Network Watcher and Find Mac Address have proven very useful in identifying computers and devices connected to the network, including laptops, tablets and mobiles, allowing resolution of IP conflicts and restricting access where necessary.

In order to reduce overload, the ICT department uses a number of network optimization techniques:

1. A user authentication system, restricting access to the network.
2. Local caching for frequently used materials including e-textbooks and video clips.
3. Implementing a unified threat management approach (Christopoulos, 2011) using an all-in-one security application. This also allows users to check their internet usage and generate reports (figure 1), making users aware of the demands they are making on the system.
4. Blocking peer-to-peer torrent sites used to (sometimes illegally) download video and music files, except in exceptional circumstances and under the supervision of a member of the IT department.
5. The formation of user groups for prioritizing of network traffic.
6. Offline access to electronic mail services.
3.2 Case Study two: Indian Institute of Public Health Gandhinagar (IIPHG)

The Public Health Foundation of India (PHFI) is a public-private initiative with headquarters in Haryana. It oversees four academic institutions, the Indian Institutes of Public Health (IIPH), engaged in public health education, training, research, and policy advocacy. IIPHG has 12 faculty and runs two full time on-campus courses, Public Health Management and Industrial Health, and four online courses: Research Methodology; Managerial Effectiveness for Healthcare; Health, Safety and Environment Management; and Public Health and Hospital Management for Nursing and Allied Health Professionals. To date, 277 students have enrolled in the online courses. A variety of technologies are used for course delivery including stand-alone computers, the internet and DVDs. Teaching activities include webinars, video conferences, and the use of videos made by students to facilitate classroom discussions.

Resources include around 35 desktop computers, 50 laptops, printers, still and video cameras, voice-recorders, microphones, a LAN and Wi-Fi enabled internet facility, a computer laboratory, video conferencing facilities and a library of educational CD/DVDs. The online courses are hosted via a Moodle based platform run on a local server. Apart from basic course content, reference materials and assignments, each course has provision for periodic online interactive sessions between students and faculty, a discussion board and online quizzes. Adobe Presenter and Camtasia are used to record lectures and WiziQ for interactive sessions. The learning platform also allows online registration, fee payment, application tracking, automatic email reminders, certification, and student feedback. It can be accessed by enrolled students over any available internet connection. Almost all online courses are in blended format, allowing both faculty-enabled and self-learning modes. Each includes a series of voice-over-power-point (VOPP) lectures by faculty members.

IIPHG leases a 2 Mbs internet line for around $US3,200 per year. As indicated above, the internet is available through LAN and Wi-Fi connections within the institute. Additionally, portable internet data cards are provided to all faculty and research staff to facilitate internet access elsewhere. When IIPHG moves to a new campus with upgraded ICT infrastructure, access will also be provided via mobile phones.

While PHFI has a dedicated ICT department to support the IIPHs, IIPHG has a single officer who manages all ICT related needs. This officer has a diploma in Computer Applications, 20 years of experience and is trained in networking and visual learning, internet security processes, network storage and digital documentation management.

3.2.1 Challenges

Alongside increasing demand, the IIPHG distance learning platform is also evolving to meet rising student expectations. It is planned to phase out VOPP as the primary mode of delivery in favour of approaches which
make full use of multimedia content. Compatibility with other online applications that can add to the learning experience such as Skype, Google Hangout and WhatsApp are also being pursued. A related challenge will be the recruitment and retention of individuals with the qualifications and expertise in both software and multimedia required to translate materials provided by IIPHG staff into exciting and attractive formats for online courses.

One specific problem in the preparation of VOPP lectures is the difficulty in ensuring high quality sound. At present recordings have to be done outside of normal working hours and noise reduction software used to improve audio quality. As the number of distance learning courses increases, there are plans to create a recording studio to enable higher quality audio and video materials. Plagiarism in submitted assignments by students is another concern of faculty responsible for online courses. Manual recognition is the only safeguard at present but with increasing student numbers there is a felt need to install and use plagiarism software.

3.2.2 Management strategy

A number of factors have led to increased demands for bandwidth, including use of multiple devices – laptops, mobiles and tablets – by students, interactive methods of teaching online courses and live demonstrations by faculty. Various strategies are used to address bandwidth limitations. It has been necessary to place strict limitations on internet access by visitors and outsiders. As indicated above, the majority of lectures in online courses are VOPP presentations. These are pre-recorded and uploaded, usually on a weekend, holiday or evening as maximum bandwidth demand occurs during normal office hours (Fig.2 and 3). Similarly, interactive sessions and those using live telecasts are timetabled on weekends and it has become standard practice to record all live discussion and chat sessions held between faculty and students. Such recordings are used to prepare question and answer banks to help students who could not attend live sessions.

Options for purchasing a higher bandwidth connection are currently being considered. A range of other ways to improve bandwidth management are also under discussion including a dedicated firewall, single sign-on per user option and a revised allocation policy governing bandwidth distribution to different user groups. In the meantime, for online courses that have high student uptake and need improved bandwidth support, it may be necessary to run parallel course units with limits on the number of students in each unit.

PHFI has a defined Internet Usage Policy and a firewall that can be used to manage and monitor network usage. There is an automated system that monitors how many times the distance learning portal has been accessed. This data can be analysed by course, student, location of access, etc. Within IIPHG, while a dedicated firewall has been established for one project, none is yet operational across the institution. Currently there is no restriction on bandwidth usage by type of user groups and no automated system to block unauthorised websites. Additional features of some purchased software, for example the Quick Heal anti-virus package, are installed and used in all institutional computers to block certain sites, manage cookies, intercept spam messages, etc. Additionally, a manual bandwidth tracking system helps the IT department understand usage patterns and restrict questionable activity, for example downloading very large files. If the latter is regarded as necessary, specific requests must be made to the IT department to facilitate its acquisition without disruption to other users. For example, material can be downloaded during periods of low bandwidth demand and circulated using the local server or pen drives.

**Figure 2:** Broadband usage tracking system: Usage on 3rd December 2014 (Wednesday)
3.3 Case study three: Makerere University College of Health Sciences, Uganda

Makerere is one of the oldest and most prestigious Universities in Africa. The College of Health Sciences is one of nine constituent colleges that offer day, evening and external courses to some 42,000 undergraduates and 3,000 postgraduates. There are some 4,000 academic and administrative staff. While the College has a considerable degree of autonomy, many ICT services are centralised and overall policy and resource allocation decisions have to involve multiple stakeholders. The University e-learning policy aims are:

1. To improve the quality of graduates, utilizing modern instructional materials and methods, including increased use of ICT.
2. To provide greater access to university education through non-conventional approaches in teaching and learning i.e. distance education and a ‘virtual university’.

These goals are to be achieved by: creating an organizational and technical environment that promotes long-term in-house e-learning training capabilities; ensuring that all students and academic staff are trained on a continuous basis; developing university wide and global e-learning networks based on academic interest groups and research collaborations; and establishing a common Distance Learning Environment.

The Directorate for ICT Support (DICTS) is a central service unit that provides expert services and guidance to all academic and administrative units. It is composed of around 30 personnel with expertise including Database Management, Systems Management, Planning and Maintenance, Networks Management and End User Support. The e-learning function was moved to the College of Education and External Studies and currently comprises two staff concerned with pedagogy and one with providing technical support. The Makerere University e-learning Environment (MUELE) uses the Moodle LMS and has over 60,000 users and 1,500 courses. However, there is a tendency to use the platform as a passive repository for course materials and not take advantage of the capacity for course management, quizzes, setting and marking assignments, student forums, blogs, etc. Use of such facilities can be hampered by University polices which promote a tradition model of education. There are other projects/development partners within the university that run online courses, including the ARCADE-HSSR Project, building capacity in health systems and services research (Guwatudde, et al., 2013), the Regional Universities Forum for Capacity Building in Agriculture, MESAU a partnership of five academic institutions in Uganda targeting the medical education sector and VUCCnet, focused on human resources in cancer control in Africa.

The university leases a 170Mbs connection at a cost of around US$40,000 per month from the Research and Educational Network for Uganda, a consortium of research organizations and institutions. Optical fibre cables were laid underground from the provider source to the university data centre to improve the quality of the link to the NOC. Students and staff can access Internet and Intranet services using cables or via wireless routers. All university ICT services are hosted in the DICTS Network Operating Centre (NOC) with a backup centre approximately 2km away. Since 2005 the University has used various LMSs including Blackboard, Kewl.NextGen and TUSK. In 2008 a decision was made to migrate all courses to Moodle. MUELE is installed on a Power Edge 720 with 8GB RAM and 5TB of hard disk storage with backup on a Power Edge T610 with 4GB RAM and 2.5TB of storage. It uses the Slackware Operating System and MySQL for database management.
A number of blended courses have been run using MUEL E, using both asynchronous and synchronous access modes. The technologies used have included Adobe Connect, GoTo Meeting, Skype, SCOPIA and a dedicated Video Conferencing facility. The university also provides OpenCourseWare, developed by the Massachusetts Institute of Technology, and related library services including Dspace, an institutional repository application, and Virtua, a cataloguing system.

3.3.1 Challenges

The university has experienced many challenges in implementing e-learning facilities:

1. The growth of the university and associated demand for internet access by an increasing number of staff and students has posed serious problems in terms of available bandwidth. In addition, because priority is given to those working on the campus, access from outside can be severely limited, especially in terms of video and synchronous communications.
2. University policies do not encourage the use of the e-learning platform to support traditional teaching methods – one requires students to attend all lectures face-to-face.
3. A relatively small proportion of students can easily access computers to use the internet when off campus.
4. The local network which links the University to the internet has been developed in an ad hoc manner and services are often disrupted by the need to repair cables.
5. Blended courses using video streaming have struggled to overcome incompatibilities between different learning hubs, which often purchase hardware and software without considering the potential limitations in terms of ease of communication with other users if they do not adhere to the guidelines developed by DICTS.
6. Maintaining the technical and user documentation required for the effective use of the e-learning platform has typically proved much more time consuming than expected, resulting in those responsible often delaying making necessary updates.

3.3.2 Management Strategy

Various actions have been taken to limit demand. Individual downloads are limited to a maximum of 100Mb per connection during peak hours and access to YouTube, a major contributor to bandwidth consumption, is not allowed during normal office hours. Frequently accessed web-based material is copied and stored on the local server and all university websites and mail services are hosted within the NOC. Such actions have substantially improved the internet experience, reducing access and download times. The University recently procured bandwidth management software which should allow DICTS personnel to efficiently allocate additional bandwidth to individuals or research groups with specific needs, for example to run blended learning sessions or video conferencing.

The real time consumption of bandwidth by each college, and designated groups within each college, is automatically monitored using freely available open source software (PFSense Firewall and CACTI), allowing major users to be identified (Figure 4). Again using open source software (ntop and NAGIOS), any unplanned excessive demands on the network can be rapidly recognised, and decisions are taken as to how respond (Figure 5).
4. Discussion

The three very different health research and teaching organisations described in the above case studies share a common ambition to take advantage of the opportunities provided by advances in the use of new technology in education. Not only do they aim to use the technology to complement traditional teaching methods in the delivery of courses to their own students, but to make such courses available to a much larger audience via distance learning. Taken together they provide an interesting illustration of the trade-off between availability of resources and freedom of action when attempting to establish e-learning courses on public health and health research. Thus IIPHG has limited IT and human resources but, with just 12 faculty members, considerable flexibility in the use of those resources and the potential for rapid innovation. The College of Health Sciences has the equipment, staff and, very importantly, large volume of tried and tested course materials to address much larger challenges but can only do so by navigating existing University protocols and negotiating access to resources with colleagues who may have quite different priorities.

In large organisations there clearly has to be an established resource allocation policy, with clearly defined limits on flexibility, if staff are to have confidence that their access will not be regularly disrupted to meet the ‘special needs’ of others. Allocation of resources is of course a very familiar problem to those working in the health sector, and the problems of network allocation share some of the same characteristics. While a simple ‘equity of access for all’ principle may seem to be the obvious basis for policy, this could impose severe...
constraints on innovation and experimentation, which often tend to give rise to unpredictable demands for additional resources at short notice.

The case studies reinforce the argument that a lack of suitably qualified, motivated and experienced personnel is a common major barrier to the development of e-learning generally (Khan, et al., 2012), and in global health education. This relates both to the systems professionals required to implement and maintain the necessary hardware and software, and to the need for a teaching staff with the interest and aptitude required to design e-learning materials and collaborate with technical staff in developing systems that are not only attractive and easy to use but consistent with the highest educational standards. Again, close collaboration between teaching and technical staff may be easier in smaller institutions if both sides are encouraged to see themselves as part of a single team. In larger organisations there may be a very important role for intermediaries, either teachers who have acquired technical expertise or IT staff with a willingness to explain technical issues in ways that can be easily understood by teachers (Afshari, et al., 2009; Nawaz, et al., 2010).

Another common concern across the case studies is limited IT infrastructure and particularly bandwidth availability (Hvorecký, et al., 2005; Okine, 2006). This has always been problematic but is becoming increasingly so as expectations rise more rapidly than system improvements. Students now expect easy access to everything the internet has to offer not only using the many desk-top computers made available in each organisation but using laptops, mobile phones and tablet computers. Such technical challenges are important considerations for organisations embarking on e-learning, as they may well impact on student overall experience of public health courses (Atkins, et al., 2016), which can in turn impact on educational attainment (Owston, Lupshenyuk and Wideman, 2011; Sowan and Jenkins, 2013).

Based on evidence from the case studies, online teaching is perfectly feasible where participants have access to a local intranet based on a server that stores the required teaching materials and on which the LMS is run. All three case studies mention downloading material from remote sites during periods when demands on the internet are at a minimum, for example at night or during holiday periods, and storing it on a local server. This apparently rational solution does have the problem that there is a risk of contravening copyright law, given that many sights make material freely available for individual downloads but explicitly forbid their uploading onto another site. Access to external sites can cause substantially greater problems, but it is the provision of distance learning services to users outside of the network, either in formal learning hubs or accessing learning materials using external wireless links that give rise to major difficulties. Since there are now a multitude of valuable teaching resources on global health and research methods that are hosted on external sites, arranging reasonably high quality access to such sites is also very important. Though direct comparisons of network resources are notoriously difficult due to the multitude of factors affecting quality and speed, table 1 sets out some of the basic indicators, together with those for the UK research organisation of one of the authors for comparison. This may suggest that smaller organisations can be at an advantage, with even a basic communications package allowing a reasonable bandwidth allocation across multiple demands.

Table 1: Staff numbers and bandwidth

<table>
<thead>
<tr>
<th>Organisation</th>
<th>Academic Staff (A)</th>
<th>Bandwidth (B)</th>
<th>B/A</th>
</tr>
</thead>
<tbody>
<tr>
<td>IIHMR</td>
<td>46</td>
<td>20Mbs</td>
<td>0.43</td>
</tr>
<tr>
<td>IIPHG</td>
<td>15</td>
<td>2Mbs</td>
<td>0.13</td>
</tr>
<tr>
<td>Makerere</td>
<td>1,477*</td>
<td>170Mbs</td>
<td>0.12</td>
</tr>
<tr>
<td>IDS UK</td>
<td>170</td>
<td>96Mbs</td>
<td>0.58</td>
</tr>
</tbody>
</table>

* Makerere Human Resource Directorate as at January 2014

Measures adopted to address the above issues include limiting access to a single device for a given user, using dedicated firewalls, limiting the maximum size of any download at peak times, and blocking access to sites such as YouTube during working hours. One issue raised by IIHMR, but with universal application, is the difficulty of distinguishing ‘reasonable’ from ‘unreasonable’ internet access. Downloading of photographs, PowerPoint presentations or videos, which may involve very large downloads, may be a perfectly reasonable action if they enhance the teaching experience. There is no simple way, for example to distinguish between a
YouTube video that is clearly for entertainment purposes, and one that is directly relevant to a given course, without viewing the download.

5. Conclusions

As indicated by the above case studies, there is considerable enthusiasm for the idea of using new technology both to enhance the experience of their own students and to make their courses available to a much wider audience. To achieve their objectives they typically have to overcome major constraints in terms of hardware, software and human resources and they face a continuing battle to meet the challenges of a rapidly evolving technological environment which makes little allowance for those struggling to keep up with the latest developments. Some issues can be addressed by the institutions themselves. Others, such as limited national or regional infrastructure for broadband internet access need to be brought to the attention of policymakers and thought leaders, making clear that this can pose serious barriers to the expansion of access to potentially very valuable e-learning facilities for expanding global health research education. We recognise that the findings from three purposively selected case studies should not be seen as representative of the diverse range of academic and research bodies in resource-constrained environments. Our suggestion is that this research can provide a starting point for further work to investigate other institutions and examine if they have similar challenges and barriers to implementation.

Finally, it is particularly important that academic institutions in high income countries recognise the needs of those in LMICs and support and encourage their counterparts in developing systems that are well adapted to their specific needs and circumstances. Recent developments, for example the growth of ‘cloud computing’ (Armbrust et al., 2009) and the promise of greater opportunities for sharing hardware and software resources, could have important implications in terms of allowing easier entry to advanced e-learning engagement by less privileged education institutions in LMICs, and thus contribute to global health capacity.

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References


An Evaluation of the Effectiveness of the use of Multimedia and Wiley Plus Web-Based Homework System in Enhancing Learning in The Chemical Engineering Extended Curriculum Program Physics Course

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Abstract: Today’s 21st century students are regarded as ‘digital natives’, who are influenced by digital environments for acquisition of information, communication and interaction. With the emergence of new technologies, educators are encouraged to find meaningful ways of incorporating these technologies into their classrooms. The practice currently in South African classrooms is still the traditional lecture method, which poses limitations on students’ learning due to its frequent lack of interaction and communication between students and educators. As a result, there is a need for educators to adjust their teaching methods and create learning environments that stimulate dialogue and engagement in and outside the classroom. This paper presents results of an evaluation of the effectiveness of the use of Facebook social media as communicative media, Clicker technology as an interactive medium, and Wiley Plus web-based homework system as an adaptive medium for enhancing learning through interaction and dialogue activities in and outside the first year Physics classroom as described in Laurillard’s framework. Both quantitative and qualitative methods of collecting data were used in this study. A student feedback questionnaire and focus group interviews were carried out to elicit students’ opinions on the effectiveness of the use of these technologies in the first year introductory Engineering Physics course. Quantitative data on student performance was analysed using descriptive and inferential statistics, while qualitative data was analysed using inductive strategy. Results showed that the use of Clickers and Facebook facilitated interactions between students and their teacher, in and outside the classroom, which resulted in deep and meaningful collaborative learning of the subject content. This resulted in better student performance in the homework and assignments done on the Wiley Plus web-based homework system, which may have contributed to the good performance of the students in both mid-term Examination and Final integrated Summative Assessment (FISA).

Keywords: Clicker technology, Facebook, and Wiley Plus, Web-based homework

1. Introduction

The inclusion of technology in the classroom has revolutionized the education environment and impacted on the way students learn and access educational materials (Cobcroft et al., 2006). Most of the learners populating today’s classroom in South African universities and colleges use different digital technologies to support their learning (Jaffer, 2007). In the classroom, technology encourages inquiry, enhances communication, production of learning materials, and helps students express themselves better (Baek et al., 2008). In Engineering and Sciences classrooms, the use of technology helps students to participate in classroom activities and understand content faster (Ivala & Gachago, 2012). Furthermore, technology also helps educators to provide timeous feedback to the learners (Laurillard, 1997, 2013).

The social network site (SNS) Facebook enjoys high popularity among university students, who use the technology to create a platform for community of practice outside the classroom as described by Bosch (2009). Facebook as an SNS promotes active participation, connectivity, collaboration, community and sharing of knowledge and ideas amongst its users (Ivala & Gachago, 2012).

The inclusion of Clicker technology in classroom instruction has been reported by many researchers to improve educator-learner interaction and provide a space for active participation by all students. In South Africa, the use of technology such as Clicker combined with interactive media to enhance learner active participation, collaboration and engagement is still in its infancy, with little research published in the field (Gachago et al., 2011).
The use of web-based homework (WBH) online systems has rapidly been growing in the education sector, especially in the developed countries (Bonham et al. 2003). College researchers in the area of mathematics, physics and science related courses recognize the importance of homework assessment, provision of instant individual feedback to students and its impact on students' academic performance (Bonham et al., 2003). However, providing individualized instant feedback to students is nearly impossible and time consuming. Hence, there is a need for designing ways of providing instant feedback to students. As a result, this has led to the development of Adaptive software packages such as Wiley Plus online media, which allow students to complete homework assignments online.

This study used Laurillard’s conversational framework to evaluate the effectiveness of Clicker technology as an interactive medium, Facebook SNS media as communicative medium supporting the “discursive activities” and Wiley Plus web-based homework system as an adaptive medium to enhance learner dialogue, learner and educator interactions, active participation and collaborative learning in and outside the classroom.

The main aim of the study was to evaluate the effectiveness of the use of a combination of multimedia such as Facebook, Clickers and Web-based homework system Wiley Plus, in supporting different learning outcome using Laurillard’s conversation teaching and learning framework. This study was guided by three main objectives:

1. To evaluate the impact of Facebook SNS as a communicative medium on students’ performance in a first year ECP Physics course. Analysis of students’ academic learning activities on Facebook outside the classroom were conducted.

2. To evaluate students’ experiences on the implementation (piloting) of the Clicker technology as an interactive medium in an ECP first year Physics course.

3. To evaluate the impact of Wiley Plus web-based online system as an adaptive medium for promoting learning through experiential tasks such as Web-based Homework (WBH) and assignments.

In line with the above objectives, this paper will present findings based on research questions adapted from a similar study done by Jones et al. (2008) at the California State University, who used the Wiley Plus web-based system in an introductory first year accounting course. See Appendix A for research questions.

The following sections were used to organize the paper: (a) The context of the study, brief information about the participants of the study and where the study was conducted; (b) The theoretical framework that underpins the study; (c) Literature review on the three technologies used in the study; (d) Methodology used to collect data for the study; (e) The findings and discussion of the study; (f) Conclusion and recommendation; (g) References and (h) Appendix A, on research questions used on web based homework section of the study.

2. Context of the study

The study was carried out at the Faculty of Engineering, Department of Chemical Engineering at a University of Technology in South Africa. The participants of the study were 34 out of 47 students who were enrolled for the ECP Chemical Engineering program in 2014 and working towards a national diploma.

3. Theoretical framework

This study was informed by Laurillard’s conversational framework for teaching and learning (Laurillard, 1997). The theory advocates that teaching and learning is a dialogic activity in which learners attempt to reconstruct the mental model of the course content (Laurillard, 2013) as shown in Figure 1 below. This framework is composed of five media forms, which are (a) narrative, (b) interactive, (c) communicative, (d) adaptive, and (e) productive. Each media form supports different types of learning experiences. Narrative media tell or show the learner something (e.g. text, image). Interactive media respond in a limited way to what the learner does (e.g. search engines, multiple choice tests, simple models, and in the case of this study the Clicker technology). Communicative media facilitate exchanges between people (e.g. email, discussion forums, and in the case of
this study a Facebook closed group). Adaptive media are changed by what the user does (e.g. some simulations, virtual worlds) and supports: (a) experimenting, (b) practising, and (c) clarifying internal relations. Automated grading of homework assignments such as WBH is a form of adaptive media which facilitates interaction by helping students move from initial conceptual understanding to experiential knowledge that closely approximates the teacher’s mental model of the course material (Jones, 2008).

![Figure 1: Laurillard educational media framework (Laurillard, 2013)](image)

The learning process in this framework is supposed to support an iterative exchange between teacher and students, which occurs at two distinct levels. The first level is referred to as “discursive activities”, whereby the teacher presents the conceptual knowledge, idea, principle, and theory to be learned. Then learners are supposed to engage with the course content through dialogue, asking questions and receiving responses from the teacher. Through this dialogue between the teacher and the learners, the teacher clarifies or elaborates on the course material. The second level is the “interactive or experiential activities”, whereby the learner puts the theory into practice, application and action through experiential tasks such as homework exercises, laboratory experiments, or even field trips. The teacher continually monitors the learners’ experiential progression and provides feedback, which enables learners to improve their understanding of the course material (Laurillard, 1997, 2013). Learners at the same time are expected to reflect on their experiential learning and “adapt” their actions, as a way of blending the theory and practice. The model argues that interaction is central to “deep” learning (Laurillard, 2013).

4. Literature Review

4.1 Communicative media, Facebook a Social Network Site (SNS)

Literature on the value of using Facebook for teaching and learning is quite convincing and on the rise in universities and colleges (Basitere & Ivala, 2014; Ivala & Gachago, 2012). Basitere and Ivala et al. (2014) reported the effectiveness of the use of Facebook outside the classroom to bridge first year students’ Mathematical knowledge gap between high school and university. Additionally, Badge et al. (2012) reported that encouraging engagement with social media, students develop connections with their peers, establish a virtual community of learners and ultimately increase their overall learning. Furthermore, social network sites provide an opportunity to enrich student-teacher relationships, which results in positive learning experiences for both parties (Mazur et al., 2010). Hence, social networking services such as Facebook, Twitter and Myspace have gained huge popularity among university and college students globally over the past few years. This study will evaluate the effectiveness of Facebook SNS as a communicative medium outside the physics classroom.

4.2 Interactive medium, Clicker software Technology

Clickers are interactive technology that enables instructors to pose questions to students and immediately collect and view the response of the entire class. Research has shown that Clicker technology increases active participation and students’ engagement level in the classroom (Gachago et al., 2011). Kay and Lesage (2009) reported the benefits of using Clicker technology for:
(a) Overall improved students’ attitudes towards the course,
(b) Learning benefits such as improved student interaction, discussion, and peer learning,
(c) Improved students’ class attendance, students’ active participation and engagement, and
(d) Improved on the provision of instant feedback on formative assessment and also teacher reflection on the students’ understanding of the course material, which helps the teacher to modify the teaching, based on students’ feedback.

Additionally, most of the researchers have reported Clickers’ benefit in large classrooms and little research has been reported on the use of Clicker technology in small classes (fewer than 60 students) (Kay and Lesage, 2009).

4.3 Adaptive medium, web-based homework system

In the literature, web-based homework has been used for formative assessment 1) to provide feedback for the teacher to modify learning activities and experience, 2) to identify and remediate individual student deficiency; 3) to improve student learning and build student confidence, and 4) to improve students’ metacognitive awareness of how they learn (Bonham et al., 2001; Bonham et al., 2003; Jang, 2009). However, the main goal for which many universities use web-based homework is to provide instant individualised feedback to students, which is often time consuming in paper-based homework and beyond the resources available in the universities (Tang et al., 2002; Bonham et al., 2003; Demirci, 2007; Jones, 2008). With the lack of experienced tutors and teaching assistants, many universities around the world are abandoning time intensive approaches of collecting and grading paper-based homework (Mestre et al., 2002).

There are several studies comparing the impact of WBH on paper-based homework (PBH) reported in the literature. For instance, Bonham et al. (2003) reported on a college physics study that there was no statistical difference in exam score between students who used Web Assign WBH and those using PBH system. These results were also in agreement with results obtained in a study conducted in 19 college-algebra classes (Mestre et al., 2002; Hauk et al., 2005) using the Web Work online system. However, results from studies by Mestre et al. (2002), Hauk et al. (2005) and Bonham et al. (2003) were in agreement that WBH was as effective as PBH. A study conducted by Jones (2008) using commercial web application Wiley Plus to automate grading of multi-part accounting exercises on a first year introductory accounting course for students majoring in business, showed that the web-based homework system enhanced learning but did not increase student interaction. Furthermore, the study found that immediate feedback and allowing for multiple attempts encourage students to practice with the course material.

Additionally, a study conducted by Mestre et al. (2002) using Online Web-based learning (OWL) at a large U.S. public university found that offering WBH led to an improved overall exam performance in a physics course. Findings indicated that students who used OWL to submit assignments for grading scored significantly higher in examinations compared to those who submitted PBH. The mean difference between WBH and PBH was found to be about one-third typical exam standard deviation. These results were in agreement with results from a study by Tang et al. (2002) using Web Assign on college physics and calculus courses. The study findings showed that using Web Assign to deliver and grade WBH increased the level of interaction with faculty peers, increased time spent on course work and students’ collaboration outside the classroom, and enabled faculty to provide instant individualised student feedback on homework assignments.

For the findings reported in this paper, Wiley Plus WBH was used to provide, submit, and grade exercises and to monitor at-risk students on weekly homework assignments. Students were given 96 hours to submit the web-based homework assignment, which was based on the sections of the chapter being taught in the classroom. Students’ performance marks on the WBH were compared to students’ marks on the paper-based tutorial mock test, mid-term test and FISA. When working on Wiley Plus, students received individual feedback on the completed portions of the physics exercise each time they clicked the <Submit Answer> button. After one attempt of the homework assignments, students received a publisher-provided hint in questions to which they had given a wrong answer. On the second attempt, all parts of the exercise were graded and the scores were recorded on the grade book. Students were given the option to view the solutions. Students could also view the online grade book in Wiley Plus to see the total score for the web-portion of the assignment along with class averages.
5. Methodology

Both quantitative and qualitative methods of collecting data were used in this study in order to ensure triangulation of data and to enhance the significance of the findings by integrating different ways of knowing (Caracelli et al., 1997).

5.1 Context and participants

The study was conducted in the 2014 academic year at the Department of Chemical Engineering at a University of Technology in South Africa. The participants of the study were first year National Diploma Extended Curriculum Program (ECP) students. The ECP program has been designed to support students who are enrolled in a Chemical Engineering program with ≤50 percent pass rate in high school (matric) Mathematics and Physical Sciences. To ensure that the ECP students succeed in their studies, the students take half a workload compared to mainstream students (mainstream students are those who enter the Chemical Engineering National Diploma program with matric marks above 50 percent and who take six subjects per semester). As part of providing learning support to these students, the lecturer responsible for teaching Physics with support from the department piloted Clicker technology to enhance discussion and engagement in the classroom, a Facebook closed group as a communicative medium platform outside the classroom and Wiley Plus online system to provide online homework assignments with an aim of ensuring that students receive immediate rich feedback. The online system not only provided online assignments but also video, animation, PowerPoint presentations and a prescribed e-book, which were supposed to be beneficial to both the teacher and the students.

5.2 Data collection methods

Facebook data on students’ participation was extracted using a PHP script, which makes use of the Facebook application interface (API) written and self-hosted by Mr Dzumbuluwani Mmbara (IT specialist) of Musuku Africa Pty (Ltd), South Africa. The data extracted showed how the ECP Chemical Engineering students participated on the Facebook close group to support learning activities. Student participation on Facebook in this study was defined by 1) the number of academic posts posted by individual students, 2) students’ post comments on the academic posts posted by other students, and 3) the number of students who liked the posts. Students’ posts in this study were in terms of asking questions on the course content, which encouraged informal academic interaction and indicated to other students that their opinion on the subject of the post is required or it mattered. A survey was administered at the end of the term, followed by focus group interviews with students, to solicit student comments in order to obtain deeper feedback on their perception, opinions and attitude towards the use of Clicker, Facebook and web-based homework. Students’ scores on the WBH were extracted for comparison to students’ scores on the paper-based tutorial mock test, mid-term test and FISA, which were gathered and recorded by the lecturer and saved on his computer at work.

5.3 Data Analysis

Quantitative data was analysed using descriptive and inferential statistics, while qualitative data was analysed using an inductive strategy. Focus group interview data was recorded on tape and transcribed verbatim. The interviews were analysed focusing on the identification of conceptual themes and issues emerging from the data, using techniques such as clustering, and making contrasts and comparisons (Miles & Huberman, 1994). The researchers were especially interested in moments in the study that could be construed as the focal points for the benefits of the use of Facebook, Clicker technology and the Wiley Plus web-based system for enhancing student learning. The inferential statistics were calculated using the Pearson product moment correlation coefficient (PPMC) to evaluate the strength of the correlation between WBH and tutorial mock test, mid-test and FISA. A t-test was used to determine the significance of the correlation coefficients of the WBH compared to tutorial mock test, mid-test and FISA. Descriptive statistics such as frequencies were used to understand students’ participation in the Facebook closed group.

5.4 Ethics Approval

The participants’ consent to participate in the study was sought and the purpose of the study was explained to the students. Interview transcripts and student scripts were available for the students to scrutinize. Anonymity and confidentiality were adhered to as promised to the students. The Fundani Centre for Higher Education and Development ethics committee gave ethical clearance for the study.
Findings and discussion are presented in the subsequent section using themes, which emerged from the data analysis.

6. Findings and Discussion

This paper reports on an evaluation of the effectiveness of Clicker technology as an interactive medium, Facebook SNS media as communicative medium supporting the “discursive activities” and Wiley Plus web-based homework system as an adaptive medium to enhance learner dialogue, learner and lecturer interactions, active participation and collaborative learning in and outside the classroom. Findings and discussion are presented under the following categories derived from themes emerging from data analysis:

- The use of Clicker software technology to improve students’ participation and interaction with the course content and lecturers’ reflection on their teaching practice;
- The use of a Facebook closed group for students’ interaction with the course content and peers;
- The use of Wiley Plus Web-based homework for enhancing student learning beyond the classroom.

6.1 The use of Clicker software technology to improve students’ participation and interaction with the course content, peers and lecturer, and lecturers’ reflections on their teaching practice

Students were provided with a Clicker technology remote to choose a correct answer on given conceptual questions. Students were given 120 seconds (2 minutes) to make their vote/choice. After polling was closed, the Clicker technology gave the polling results on how students voted in percentages (see Figure 2) on what students thought was the right answer to the question asked:

![Clicker technology results](image1)

**Figure 2:** How Clicker technology was used by students to respond to conceptual questions

After the polling, a case of two strong opposing views on the correct answer arose as reflected in the polling results in Figure 3. This was followed by students’ discussion of why their choice of answer was correct. After the discussion, the lecturer opened the polling again to see if students had changed their choice based on peer discussion. The lecturer facilitated engagement between the students and only got involved when the second polling still indicated two strong opposing views, showing some students had misconceptions of the content and compelled the lecturer to reflect on his teaching and come up with a way of teaching the particular content in ways that enhanced student understanding as advocated by Laurillard’s conversational teaching and learning framework.
Students indicated that Clickers encouraged passive students to participate in class discussions as all students responded to the Clicker questions, as evidenced in the following quote from one of the students:

**Student A:**... for me it’s good that in class we actually get a tough question then everyone has got a chance to engage. So some of the students like me, I’m shy of raising up my hand and actually asking what’s happening there but if you use Clickers, everyone will just click, click what you think. Then the next thing the percentage is shown on the board. Obviously, then if we’ve got more or less 50% on the answers then we’re all going to engage. Why do you say this, why do you say this then afterwards the lecturer then clarifies everything. So even the person at the back who’s shy, wasn’t able to ask the question then gets the clarity of which the question is going to come in the exams maybe, or the skill is going to help you to tackle another question in the exam. So it’s easy for everyone to learn in that way. So, I really enjoyed and liked the Clickers. [sic].

Students who are shy in class felt that Clickers encouraged them to participate in class discussions as the Clicker technology displayed students’ responses anonymously. Furthermore, the above results show that the use of Clickers enabled students to engage more deeply with the course material, peer interactions and student-lecture interactions during their discussions on their choice of answers, which enhanced their understanding. Students also reported that the use of the Clicker technology enabled the lecturer to pick out whether students understood the course content/concepts:

**Student C:**... I think that it was an advantage to the lecturer and also to the students because he used it as a recap of the lecture because he, like when he’s done teaching, lecturing he can actually see like how many students do understand the concept that he taught. [sic].

Hence the use of the Clicker technology helped the lecturer in reflecting on the students’ actions or understanding of the content and used this knowledge to modify the way he taught the content in order to improve students’ understanding.
6.2 The use of a Facebook closed group for students’ interaction with the course content and peers

Findings from analysis of students’ Facebook activity showed that students posted a total of 107 academic posts (see Table 1) during the second semester (July to December 2014). The academic post generated 267 comments and some students responded to the posts by liking the academic posts or comments and discussions (168 likes).

Table 1: Students’ Facebook activity in a closed group for Physics

<table>
<thead>
<tr>
<th>Facebook activities</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Academic posts</td>
<td>107</td>
</tr>
<tr>
<td>Comment discussions on academic posts</td>
<td>267</td>
</tr>
<tr>
<td>Like on academic post or comments</td>
<td>168</td>
</tr>
</tbody>
</table>

Students’ posts were in terms of asking questions, which encouraged informal academic interaction and indicated to other students that their opinion on the subject of the post was required or it matters. Some students responded to the academic posts by use of post comments, which are comments generated in response to the academic post. Other students liked the post, which is a way of letting the students who posted the post know that they engaged with the content and enjoyed the comment or post.

Figure 4 (a) and (b) showed a screenshot example of how students participated in a closed Facebook group by posting academic posts, which generate discussions and comments, or students respond by liking the academic post or the comments. The use of smart phone cameras to upload questions or responding to an academic post was one of the most commonly used methods by students in sharing information with each other. The lecturer’s presence on the closed Facebook was also appreciated by the students in giving clarity and guidance on questions that students are battling with. This also gave a chance for the lecturer to reflect on the learner actions based on the academic post or comments and discussions to modify the description of the missing knowledge concepts on the section currently being taught in the classroom as supported by Laurillard’s conversational framework for teaching and learning (Laurillard’s, 2007). Student mentorship through Facebook was also visible in this study in Figure (4b) by a second year ECP student responding to a question posed by the first year student (response “Mandilakhe Facebhuk”, a second year ECP student). This was also supported by the quote as exemplified below;

**Male Student A:** “I just interact with people and I also have like mentors there. So when I have a problem I just chat with them and they help me sometimes”. [sic].

This also supported the study by Badge et al. (2012), who reported that encouraging students’ engagement with social media helps students to develop connections with their peers, hence establishing a virtual community of learners, which ultimately increases their overall learning of the course material.
Time series closed group Facebook Data

There was a steady rise in academic posts (35), academic comments (86) and likes on comment or post (53) in the months of July and August 2014 (see Figure 5). Furthermore, the number of posts dropped from August to October to below ten resulting in a drop of academic comments, as comments and discussions are based on academic posts posted by the students. This might have been partly due to the introduction of the Wiley Plus adaptive media online platform for supporting the web-based homework assignment in August 2014, as students spent most of their time and mostly support on the online platform, which guides students on how to respond to questions through video and hints. This was confirmed during the focus group interview:

**Student E:** …“Like first semester when we were doing Mathematics Facebook was amazing because questions were popping up now and then in second semester we were focusing more in Wiley Plus adaptive media and then Facebook was kind of left aside, so ja”. [sic].

A semester break during the month of September could also have contributed to the low participation. However, results show that there was increased student activity between the months of October and November, which are the examination period (see Figure 5). The same trend was observed in a study conducted by Vivian et al. (2014).
Web-based homework as an adaptive medium

The survey results showed that 73% (34 out of 46) of ECP students responded to the survey and participated in the focus group interviews. Fifty-six (56%) percent (N=19) of the students were female. Eighteen percent (18%) of the respondents were between the age of 17 and 18 years, 59% between 19 and 20 years and 24% between ages 20 and 25 years. Twenty-four (24%) percent of the respondents achieved high school Physical Science marks at level 3 (40-49%), 65% achieved at level 4 (50-59%) and 12% achieved at level 5 (60-69%). The rest of the findings are presented by using questions, which guided this study.

Research Question 1: If homework is not collected and graded, would students spend less time practising course concepts?

Over eighty (80%) percent of learners (53%-strongly agreed; 35% agreed) indicated that they spent less time practising course concepts when homework was not collected and graded. This was confirmed during student focus group interviews:

STUDENT B: …I actually think that some of the questions on Wiley should be for marks because what we’re actually seen like when we first used Wiley Plus, Mr Moses said that the first two tests are not for marks. And if you actually check on that, not a lot of people attempted it. But when he started saying okay, guys, these are for marks, that’s when you could see that people are on the IT centre. They are doing the questions and all that. So I think in a way it should also be for marks, ja. [sic].

The above findings support the findings of Jones (2008) and Tang et al. (2002) in which 71% of accounting students and 58% of physics and calculus students respectively claimed they would study less if homework was not collected and graded. Additionally, the results can be interpreted as students’ endorsement of the web-based homework assignment (Tang et al., 2002) as it motivated students to study and practise course concepts.

Research Question 2: Do students prefer paper-based homework with no individual feedback to web-based homework with individual feedback?

More than 60% (50% disagreed; 15% strongly disagreed) of learners indicated that they preferred web-based homework with individual feedback, 15% percent pointed out that they preferred paper-based homework with no individual feedback compared to web-based homework with feedback and 21% neither agreed nor disagreed. These results confirm Jones’s (2008) findings, which showed that over 70% of accounting students overwhelmingly preferred W BH with individual feedback compared to paper-based homework with no feedback. Wiley Plus web based online system allowed students more than one attempt for each online

Figure 5: Facebook time series in Physics class first semester Correlation
homework assignment submission, which students saw as an advantage over the paper-based homework. Also the instant feedback provided after each attempt was said to be an advantage for the WBH compared to PBH.

Research Question 3: Where do students access the web to complete online assignments?

Fifty-nine percent (59%) of the students reported that they completed their homework assignment at home, 16% accessed the assignment using a cellphone, while 41% accessed using their laptops and 41% using the university Information Technology (IT) centre computers. These results are in contrast with Jones’s (2008) findings in which 84.1% of the accounting students completed their homework at home and 12.2% completed their assignments at university. Although students receive free Internet data to use at this university where the current study took place, university Internet is slow at times, which makes it difficult for students to access online assessments. Hence, students who use their cellphones and laptops at home have to pay for their own data to access the web outside the university.

Some of the students indicated that they could not afford Internet data to access Wiley Plus at home as indicated in the quote below and as a result they used the printed version of the Wiley Plus text book from the library to read and prepare for the assignment at home and complete the online assignment at the university as free data was provided for each student to use on campus.

STUDENT E: …The disadvantage of this is that at home, I don’t have Internet at home and therefore the Wiley Plus was a problem for me and that’s why I took the book out and the book was also wow. So I prefer if you can give the Wiley book to some of the students who don’t have Internet at home.

Research Question 4: Do students believe technical issues with computers, the web, or the WBH systems affect their course performance?

Fifty-five percent (55%) of the students (26%-strongly agreed; 29%-agreed) reported that technical difficulties with computers, the web or web-based homework affected their course performance, with 26% neither agreeing nor disagreeing. A little less than 20% (18%) disagreed that web-based and technical difficulties were a concern. Students also elaborated on this during the focus group interviews by indicating that the Internet was slow at the university. However, this only happen for a short period of time when students were still getting used to the introduction of the web-based homework system as indicated by the student below:

STUDENT C: …What I didn’t like about Wiley at first it was a bit problematic. I don’t know if you guys all remember the Internet problems and stuff. But then as time goes by it was just easy and nice.[sic]

This finding is in contrast with findings from Jones’s (2008) study, whereby most of the students (67.5%) reported that technical difficulties did not affect their course performance; with 19.3% neither agreeing nor disagreeing, and 13% indicating that technical difficulties with web-based homework were a concern.

Research Question 5: Do students perceive automated homework grading as a form of course interactivity?

Over sixty percent (60%) of the students (24%-strongly agreed and 41%-agreed) were of the opinion that WBH promoted course interaction and peer learning (student collaboration), and 35% of the students neither agreed nor disagreed. The promotion of peer learning was also reported during the focus group interviews:

STUDENT D: …If you still don’t understand we could discuss amongst ourselves. It actually promoted a lot of group work because we would go to IT centre and then try to get these things done, get your answers and ask other people.

As the Wiley Plus web-based online platform is an adaptive medium, which has the capability to change its state due to user response as defined in Laurillard’s conversational framework, there was no student-teacher interaction but student collaboration and computer-student interaction did occur. Computer-student interaction by nature is interactive but does not promote teacher-student interaction (Jones 2008). Computer-student interaction was beneficial as it promoted student-content interactions as students received more
exercises with instant individual feedback, multiple attempts, access to video and animation from the web-based online system as indicated in the following quote:

**STUDENT E:** ...it helped with video thing, everything. I think we got more work in Wiley, than we could in class because we would get feedback right there and there and then you know that I'm wrong here. [sic]

Research Question 6: How many hours per week do students spend on web-based exercises?

Most students (56%) spend 2-4 hours per week completing web-based homework and other Wiley Plus activities such as reading the e-book, watching videos and animations, while 29% of students spend 0-2 hours and 9% spend between 4-6 hours.

**STUDENT F:**... Okay, ja it helped me with my marks because sometimes I would spend like four hours in Wiley sometimes like – let me say most of the time when I’m at IT Centre then I’d be like, let me just open Wiley and do some questions or read. Wiley, I have the book as well. So sometimes I do not need to go to the IT Centre, I would just stay in my room and then do some questions and then read. [sic].

The above results confirm Jones’s (2008) findings in which students in an accounting course indicated that 49.4% of them spent between 2-4 hours per week completing web-based homework, which was over and above time spent on any paper-based homework required for the class.

Students also indicated that they used Wiley Plus online system to catch up with the work if they missed a class:

**STUDENT G:**... Like some of the topics that we did example, like I think it was Heat Transfer, I was not in class that time and then I sat down with my Wiley Plus e-book in my room and then I studied. And then I found it easy...[sic]

Research Question 7: Do students believe web-based homework enhances learning?

Over 75% (32% strongly agreed; 44%-agreed) of the students reported that Wiley Plus web-based homework enhanced their learning of the physics course content. Only 9% of students disagreed, while 15% neither agreed nor disagreed. These results corroborated Jones’s (2008) findings, which showed that 71.1% of the accounting students reported that using Wiley Plus enhanced their learning of the course content. Additionally, Tang et al. (2002) reported similar findings (over 64% agreed) in a calculus and a physics course using Web Assign online system. The researchers in the current study are in agreement with Jones (2008) in suggesting that irrespective of which online system used, online homework based systems seem to be perceived by most students to enhance learning of the course material.

Research Question 8: What is the ideal number of attempts students should be allowed before assignment submission?

On this question, students were asked to indicate the number of attempts at exercises they preferred before submitting web-based homework for final grading. Results showed two opposing views among students, with 53% of the students preferring 1-2 attempts and 47% preferring 2-3 attempts. The students who preferred 1-2 attempts felt that too many attempts encouraged a trial and error approach to the homework completion, while those who advocated more than two attempts indicated that it helped them in learning and trying different ways of solving problems:

**STUDENT I:** ......The reason why we have more than one attempt is because we need to learn, you can’t just do it once and get the answer. You have to try different ways of getting that answer. So I don’t think that they have to reduce the number of attempts.
However, the idea of multiple attempts was said by some of the students to have also promoted cheating collaboration among students on completion of assignments especially in the multiple choice type questions. In this regard, students sat in groups of three and each made a choice until one got the correct answer on the first attempt. Those students who got the wrong answer on their first attempt could use their second chance to answer the question based on their peers’ correct answer:

**STUDENT J**: … Because if you sit as she said, three, then if I click A, and she clicks B, she clicks C then the second time we’re going to click D, then obviously D’s the right answer.

The above results may explain why some of the students performed lower than 50% in the paper-based tutorial mock and mid-test, while in the Wiley Plus web-based homework assignment system they scored higher marks (see Figures 6 and 7).

The survey results showed that 73% (34 out of 46) of the ECP students responded to the survey questions and participated in the focus group interviews. These results also indicate that some of the students did not understand the purpose of web-based homework as a formative assessment.

**Research Question 9: Are exercise hints and links to electronic and online animation helpful in clarifying what is required?**

Over 90% (50% strongly agreed; 47% agreed of the students indicated that Wiley Plus online exercise hints were helpful in giving them clues on how to solve a problem and hence enabled their understanding of concepts. The usefulness of hints was also confirmed during students’ focus group interview:

**STUDENT H**: … Like for me, ma’am, I liked it very much in the sense that it provided more time to actually do the questions and then if you went wrong it gives you a hint on how to tackle it. Then if you went wrong the second time then, maybe it pops the answer so that you can read how the answer should be done.

The above results are contrary to what Jones (2008) found in a study using Wiley Plus WBH in an accounting course, whereby only 43.3% of the students found hints provided by the Wiley Plus system to be helpful, with 25.3% of the students neither agreeing nor disagreeing and 31.4% of the students indicating that the hints were not useful. Students also appreciated the availability of hyperlinks to other media texts such as video, animations and an electronic e-book version of the Wiley Plus WBH.
STUDENT I:... *What I liked about the Wiley Plus* it’s the thing, the videos and the hints like after reading you study, you do some questions and then if the questions, they are not clear, like sometimes you do not understand the questions clearly. So we view the thing – the clips, we watch the videos and then they explain how it’s done and stuff like that and then after that if still you don’t understand still, they give you a hint and then you do it and then you get it correct.

The provision of hyperlinks to other texts also resulted in students taking full control of their learning, independent learning, and promoted a learner-centred approach to learning.

**Research Question 10: Is there a correlation in student performance on WBH compared to the paper based tutorial mock test, mid-term averaged test and FISA?**

A series of paired sample t-tests was done to compare the average marks students scored on the Wiley Plus WBH with the marks obtained in the tutorial mock test, mid-test and FISA. The first paired sample analysis was run to determine if there was a correlation between the WBH and paper-based tutorial mock test. Findings indicated a significant strong positive correlation between the WBH and paper-based Tutorial test with a correlation coefficient (r=0.5068) and t-test value of 3.9436 at a critical value of 2.014 (α=0.05), suggesting that students who scored high on the WBH tended to score high on the paper-based tutorial test. Likewise students who performed low on WBH also tended to perform low on the paper-based tutorial mock test (see Figure 6). Figure 6 below clearly shows that 52% of the students with high scores of (≥50%) in WBH scored high (≥ 50%) on paper-based tutorial mock test. Likewise, 11% of the students who scored low score on WBH (≤ 50%) scored low on paper-based tutorial mock test.

![Figure 6: Correlation between Wiley Plus marks compared with paper-based tutorial mock test](chart)

However, 37% of the students who scored high on Wiley Plus scored low on the tutorial mock test. This may be due to students’ cheating collaboration as indicated in Research Question 6. Additionally, the mean score on WBH was also high at 70% compared to 49% on the tutorial mock test.

The second paired-sample analysis was run to determine if a correlation existed between WBH and the mid-term test. Results showed that a positive correlation existed between the WBH and mid-test marks, with a correlation coefficient of r=0.4805 and t-test value of 3.6753, with a critical value 2.014 (α= 0.05). These results showed that students who scored high on WBH also score high on mid-test, while students who scored low on
the WBH also scored low on the mid-term test (see Figure 7). Figure 7 illustrates that 52% of the students with high scores on WBH performed well on the mid-term test, while 37% of the students who scored high on Wiley Plus WBH did not score high in the mid-term test. Although the results showed a coincidence of the same percentage (52% and 37%) score as in the first paired sample analysis, the percentages do not represent the same group of students as in the first paired analysis but a mix, as some of the students who scored 50% and above on the paper-based mock test scored lower than 50% on the mid-test. The mean score of 70% for WBH was still high compared to that of the mid-term test, which was 48%.

![Figure 7: Correlation between Wiley Plus marks compared with averaged mid-term tests](image)

A third paired-sample analysis was run to determine if a correlation existed between WBH and FISA marks (FISA covers all sections in Physics 1 and it is done at the end of the semester). Results showed a significant positive correlation between WBH and FISA marks, with a correlation coefficient $r=0.6532$ (see figure 8) and t-test value of 4.9948 at a critical value of 2.014 ($\alpha=0.05$). These results suggest that students who scored 50% and above on WBH had a higher chance of scoring 50% and above on the FISA. The FISA mean score was 52%, which was slightly higher, compared to the one on the paper-based tutorial mock test and mid-term test.
Furthermore, results shown in Figure 8 indicate that 65% of the students who scored 50% and above on WBH also scored 50% and above on the FISA. The same 11% of the students who had low scores on the paper-based mock test and the mid-term test also obtained low scores on the FISA and the 20% of students who scored high scores on WBH consistently obtained higher scores in the paper-based tutorial mock test, mid-term test and the FISA.

Overall findings in this study clearly reveal that a combination of the use of the Wiley Plus WBH, a Facebook closed group and the Clicker technology created a learning environment, which was conducive for students’ deep and meaningful learning (Anderson 2003). The Clicker technology increased students’ participation in class, student-student interactions, student-content interactions and student-lecturer interactions during the lecture time, while the Facebook closed group facilitated student-content interactions, student-student interactions and student-lecturer interactions beyond the classroom. Wiley Plus WBH facilitated aspects promoted by the Facebook group with the exception of student-lecturer interactions.

7. Conclusion and recommendation

Findings show that multimedia in the form of Clicker technology, a Facebook closed group and Wiley Plus WBH were used in this study. The Clicker technology was used to increase student participation and interaction with the course content during the lecture time. Facebook and Wiley Plus WBH were used to extend learning outside the classroom and improving collaborative learning and engagement with their peers.

Results indicated that the Clicker technology increased students’ participation in class, student-student interactions, student-content interactions and student-lecturer interactions during the lecture time, while the Facebook closed group facilitated student-content interactions, student-student interactions and student-lecturer interactions beyond the classroom. Wiley Plus WBH facilitated aspects promoted by the Facebook group with the exception of student-lecturer interactions. These are all characteristics which, according to Anderson (2003) promote meaningful and deep student learning.

Furthermore, students indicated that they preferred web-based homework with individualised feedback compared to ungraded paper-based homework as it enhanced their learning. There was overwhelming agreement amongst the students that if homework was not collected and graded, they would spend less time practising course concepts. Thus, they emphasised the fact that graded assignments encourage students to engage more with the course content. Additionally, results showed that some students cheated in their engagement with the online homework by practising what the researchers in this study call and define as cheating collaboratively, which perhaps hindered their understanding of the course contents. To solve this
problem, the researchers are of the opinion that randomised questions and also reduced mark allocation if students get the answer on their second attempt may be a solution. Also, the researchers suggest that the instructor should explain clearly to the students the purpose of the online-based homework (which is for formative assessment) so as to ensure that students use the resource to enhance their understanding of the course contents instead of just doing it for marks, which promoted collaborative cheating and students' lack of deep understanding of the course contents as evidenced in some of the students' scores on the WBH, Mid-test and FISA.

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References


APPENDIX A: Research questions for Wiley Plus web-based homework.

(a) If homework is not collected and graded, would students spend less time practising course concepts?
(b) Do students prefer paper-based homework with no individual feedback to web-based homework with individual feedback?
(c) Where do students access the web to complete online assignments?
(d) Do students believe technical issues with computers, the web, or the WBH systems affect their course performance?
(e) Do students perceive automated homework grading as a form of course interactivity?
(f) How many hours per week do students spend on web-based exercises?
(g) Do students believe web-based homework enhances learning?
(h) What is the ideal number of attempts students should be allowed before assignment submission?
(i) Are exercise hints and links to electronic and online animation helpful in clarifying what is required?
(j) Is there a correlation in student performance on WBH compared to the paper based tutorial mock test, mid-term averaged test and FISA?

In addition to the above questions borrowed from Jones et al. (2008), the researchers added the following additional question;
(k) Does the use of Facebook and Clicker technology in combination with the Wiley Plus web-based homework online system enhance students’ interaction with the course content, students and their lecturers?
The Mediating Effects of Germane Cognitive Load on the Relationship Between Instructional Design and Students’ Future Behavioral Intention

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Abstract: Instructional design is an important aspect of the learning experience within formal online courses. One way in which online instructional design may benefit students is by increasing their future behavioral intention to use educational materials. This is important because research has revealed that students’ use of educational resources is strongly connected with academic success. Additionally, higher quality instructional design will increase students’ levels of germane cognitive load, which is a powerful indicator of learning. This study surveyed a group of students (n = 1314) who participated in formal online classes in South Korea to investigate the relationships between instructional design and germane load, germane load and future behavioral intention, as well as instructional design and future behavioral intention. Results showed positive correlation among each of these relationships. Furthermore, a mediation model was used, and results showed that germane load completely mediates the relationship between instructional design and future behavioral intention. These relationships are examined to better understand learning and future behavioral intention in relation to instructional design within online learning environments.

Keywords: behavioral intention, cognitive load, germane load, e-learning, instructional design, MOOC

1. Introduction

Massive Open Online Courses (MOOCs) often serve as a replacement for traditional face-to-face university courses through the use of e-learning environments that substitute for offline university classrooms (Lee & Lee 2015; Yuan & Powell 2013). MOOC-like courses have gained recent popularity around the world, as university students are seeking alternative means of learning in higher education (Yuan & Powell 2013). South Korea in particular has experienced an increase in such online learning enrollment due to advancements in technology and more government funding, which has led to more high-quality online offerings (Kim & Santiago 2005; Korea Internet & Security Agency 2015; Korean Ministry of Education, Science & Technology 2010; Lim 2014). MOOCs have been found to be diverse in regards to user location around the world, professional background, age, and gender (De Waard, Abajian, Gallagher, Hogue, Keskin, Koutropoulos & Rodriguez 2011). Reasons for participation in MOOCs include schedule flexibility, the convenience of studying anytime and anywhere, the desire to access courses that may not otherwise be available, the possibility of professional advancement and future economic benefits, topic curiosity, as well as simple enjoyment (NCES 2008; Traphagan, Kucsera & Kishi 2010; Yuan & Powell 2013).

In addition to examining reasons why students participate in MOOCs, it is useful to understand the reasons why students decide to continue using MOOCs in the future. This is particularly important, as participation issues are apparent in MOOCs, as students who use them are not always successful in staying motivated and often fail to effectively engage in the content (Yuan & Powell 2013). Potential influences of students’ intentions to continue using MOOCs include the reputation of the MOOC, perceived openness, perceived usefulness, and student satisfaction (Alraimi, Zo & Ciganek 2015). It is also important, however, to look at instructional design decisions that may influence MOOC users’ decisions to continue. Effective instructional design is important in online learning situations because of the need to compensate for the physical absence of an instructor. This is so that students are able to maintain focus and process information in ways that support high levels of understanding that may be lacking in online situations (Al-Qahtani & Higgins 2013; Cole, Shelley & Swartz 2014; Jung 2000; Lee & Rha 2009). Investigating aspects of instructional design along with germane cognitive load is useful in this area, as germane load is reflective of how well students understand content delivered through instructional design (De Jong 2010). Furthermore, increasing germane load through effective instructional design may help to discover ways of promoting further usage of e-learning in the future (Liu, Chen, Sun, Wible & Kuo 2010).

Past research has looked into ways in which specific types of instructional design are beneficial to both germane load as well as students’ intention to continue using e-learning. It is generally accepted among researchers that effective use of instructional design should result in higher levels of germane load (Cierniak, Scheiter & Gerjets 2009; Sweller, Van Merrienboer & Paas 1998). Learning, which has been seen as a direct result of higher levels of germane load, has been positively linked to instructional design that focuses on instructor control of the learning environment (Costley & Lange 2016). Additionally, instruction focusing on design and organization used for setting the overall plan of the course has been found to promote perceived learning among online students (Shea, Fredericksen, Pickett & Pelz 2003). Positive relationships between instructional design and intention to use e-learning have also been found. Such research has conceptualized instructional design as a way of providing individual learning support (Liu, Liao & Pratt 2009), as well as promoting interaction between students (Cheng, Wang, Yang & Peng 2011). Acknowledging that effective use of instructional design is beneficial to both germane load and intention to use, it would be useful to examine the relationship between germane load and intention to use to see if students who have a good understanding of the content also plan on continuing with e-learning in the future.

Although research has looked at instructional design that leads to higher levels of learning and continued usage, some aspects of instructional design focusing on the overall planning of the course have yet to be examined as a way to promote future behavioral intention based on a better learning experience. Such instructional design factors are promoted by Anderson, Rourke, Garrison & Archer (2001), which include setting the curriculum, designing methods, establishing time parameters, establishing group norms (netiquette), and utilizing the medium effectively. The current study surveyed a group of students in South Korea (n = 1314) participating in the Open Cyber University to see if students who received instruction reflective of Anderson et al.’s (2001) instructional design model, also showed higher levels of germane load and intention to use. It may be the case that Anderson et al.’s (2001) instructional design model contributes to the student learning experience and also students’ decisions to continue with e-learning in the future based on that experience. With that being said, the current study looks at relationships between the following: instructional design and germane load, germane load and future behavioral intention, instructional design and future behavioral intention. Furthermore, because it is thought that the actual reason why students plan on continuing with the e-learning process is due to high levels of understanding gained from the instructional design, it is hypothesized that there will be a mediating effect of germane load on the relationship between instructional design and future behavioral intentions. It is worth investigating whether instructional design that focuses on setting the plan for the course leads to an increase in germane load, further enhancing the learning process and possibly contributing to students’ future behavioral intentions. Based on these ideas, the following hypotheses are proposed:

**H1.** Levels of instructional design are positively correlated with future behavioral intentions.

**H2.** Levels of instructional design are positively correlated with germane load.

**H3.** Levels of germane load are positively correlated with levels of future behavioral intentions.

**H4.** The effect of instructional design on future behavioral intentions is mediated by germane load.

### 2. Theoretical Background

#### 2.1 Instructional Design

Within the Community of Inquiry’s conceptualization of teaching presence, instructional design and organization is made up of five parts: setting the curriculum, designing methods, establishing time parameters, establishing group norms (netiquette), and utilizing the medium effectively (Anderson et al. 2001). Because online classes may lack some of the norms established in face-to-face classrooms, instructors need to be more explicit and transparent in their planning process (Anderson et al. 2001). Anderson et al. (2001) emphasize the importance of this design process, stating that the five aspects of design should all be applied to give students a clear idea of the overall plan of the course in order to maintain focus and direction. Shea et al. (2003) provide a descriptive account of what instructors specifically need to address within each of Anderson et al.’s (2001) categories so that students can fully comprehend the design of the course and take advantage of the design in order to succeed. Setting the curriculum should include the distribution of documents specifically indicating important course goals and outcomes. Learning activities and assignments are important in online learning, but explanations of how to participate in and complete them is needed through instructor explanation of how to participate in the learning activities. Clear instructions of how to complete certain tasks can give students a better idea of how to succeed in the course. Furthermore, students need to be aware of specific dates that
assignments and activities should be completed by. This is done by establishing time parameters to help students keep pace with the course. Utilizing the medium effectively focuses on helping students to make sure they have no problems using the technology required for completion of the course. Shea et al. (2003) describe this as helping the students take advantage of the online environment. Finally, establishing group norms refers to an adherence to what Anderson et al. (2001) call “netiquette”. Instructors need to help students in this area to ensure that they are adhering to acceptable behavioral norms within the online environment, including communicating in a respectful way online.

2.2  Germane Load

Instructional design is often linked to aspects of cognitive load theory, which explains the existence of three elements related to the learning process: intrinsic load, extraneous load, and germane load (Sweller et al., 1998). Intrinsic load represents the complexity of the learning content in addition to the prior knowledge of the content that the individual processing the content has (Sweller & Chandler 1994). Extraneous cognitive load occurs through poor instructional design that causes unnecessary processing within the working memory, leading to a negative effect on germane load, and ultimately the learning experience (Cierniak et al., 2009; Leppink, Paas, Van der Vleuten, Van Gog & Van Merriënboer 2013; Schmeck, Opfermann, van Gog, Paas & Leutner 2015). Unlike intrinsic load and extraneous load, higher levels of germane load are viewed as more useful to the learning process (Cierniak et al. 2009). Specifically, germane load represents how well students understand the contents, which directly contributes to learning. Furthermore, some research claims that germane load reflects the effort to construct schema to gain a better understanding of the processed information (Kolfschoten, Lukosch, Verbauwhede, Valentijn & Vreede 2010; Sweller et al. 1998). In the context of germane load, schemas are generally constructed through processes including interpreting, exemplifying, classifying, inferring, differentiating, and organizing information (De Jong 2010). Because germane load is reflective of student effort to construct schema, it is generally linked to student interest and motivation that go into forming such schema (Shadiev, Hwang, Huang & Liu 2015). Although forming schema has been associated with germane load, a contrasting explanation is that germane load does not actually deal with schema formation, but rather a formation of a set of learning strategies employed by the students (Schnott & Kürschner 2007; Galy, Cariou & Mélan 2012). Regardless of whether germane load is linked to the formation of schema or the formation of learning strategies, the generally accepted position is that germane load represents how well the students understand content delivered to them (Ayers 2006). Leppink et al. (2013) reflect this notion through their construct that associates germane load with the understanding of specific types of instruction delivered to students. A goal of high quality instructional design is to promote high levels of germane load, ultimately creating a more positive learning experience (De Jong 2010).

2.3  Behavioral Intention

The theoretical framework of behavioral intention can be found in the theory of reasoned action, which describes what goes into the process leading to a course of action by an individual (Ajzen & Fishbein 1980). According to this theory, behavioral intention involves a cognitive decision to commit to a behavior, and that the decision regarding the behavior is a direct result of the intention itself. Additionally, the decision to commit to the behavior or not is influenced by what the individual perceives as the consequences of the behavior. Attitudes and subjective norms contribute to the decision of intention, where attitudes represent how positive or negative the individual feels about the behavior and subjective norms represent the social pressure one feels in committing to a specific behavior. Ultimately, based on the cognitive processes involved in making the decision to commit, behavioral intention is a representation of what an individual plans to do, based on those processes that lead to the decision. Additionally Ajzen (1991) describes that beyond attitudes and social norms, a person’s perceived ability to successfully complete a specific act plays a role in deciding on the intention. Known as perceived behavioral control, it highlights the importance of understanding something in order to commit to it. Students’ future behavioral intention to participate in e-learning has been seen as an important attribute for success within online learning environments (Giannakos, Jaccheri & Krogstie 2015). Instructors should be mindful of students’ intention to use e-learning, as it allows instructors to design useful online environments that promote continued usage of them in the future (Grandon, Alshare & Kwun 2005; Lee, Yoon & Lee 2009). E-learning environments should, therefore, be designed in a way in which students believe the design of such environments is contributing to their learning process. Research supports this, as students who have considered the e-learning environment helpful, have also indicated that they wish to continue to use such environments in the future (Liaw 2008). The notion of intention to use comes from Davis, Bagozzi, and Warshaw’s (1989) technology acceptance model, which promotes perceived usefulness and perceived ease of use of technology to determine intention to use the technology again in the future.
Perceived usefulness represents the students’ perceptions of how much the technology being used will aid in his or her performance. Perceived ease of use represents the degree to which students feel the technology will minimize effort.

2.4 Effects of Instructional Design on Behavioral Intention

Acknowledging that perceived usefulness and perceived ease of use of e-learning are predictors of intention to use, it is important to design instruction that leads to such perceptions among e-learning users (Davis et al. 1989). This sentiment is echoed by researchers who claim a need for design strategies that promote factors contributing to future behavioral intentions (Lee 2010; Wiggins 1998). Although it makes sense to promote future behavioral intentions through specific instructional design methods, there is limited empirical evidence supporting this notion. Liu et al. (2009) investigated future behavioral intention levels of students who received online course design aimed at promoting interaction with peers and instructors. The findings showed that course design significantly affected future behavioral intentions through increased levels of perceived usefulness and perceived ease of use. The results are useful for student-centered instructional design with a focus on interaction, as student perceptions of such design led to higher levels of future behavioral intentions. Cheng et al. (2011) looked at how instructional design affects future behavioral intentions among students using an e-learning system, with an emphasis on perceived individual learning support as part of the instructional design. Within this context, instructional design has been shown to be effective with regards to user acceptance of e-learning systems, as the results showed that the use of such instructional design was positively related to the students’ future behavioral intentions. The limited amount of research has shown positive effects of instructional design on future behavioral intentions, but more research is needed to compare yet-to-be examined design techniques that may also affect student future behavioral intentions. Specifically, examination of learning support and the role it plays in future behavioral intentions can be extended to include the ways in which Anderson et al.’s (2001) model support student learning through effective planning of the course. Furthermore, some in class design elements like the use of more diverse media has been shown to have a positive effect on student’s future behavioral intention (Costley & Lange, 2017).

2.5 Effects of Instructional Design on Germane Load

Proper use of instructional design leads to higher levels of germane load (Cierniak et al. 2009; Sweller et al. 1998). Ways of promoting germane load may not only be through the presentation style of the materials but also through clear instructions of how to successfully complete tasks related to the material (Huang, Liu & Tsai 2013). Instructors need to also provide clear instruction in a way that avoids explanations that are either redundant or irrelevant to the learning process (Chandler & Sweller 1991). Furthermore it has been shown that more tightly controlled instructional design elements lead to greater levels of student learning and satisfaction (Costley & Lange 2016). Based on previous research, it is apparent that instructors need to present material in a way that captures attention, as well as design instruction with clear explanations of how to successfully complete tasks. Employing these types of instructional design techniques has been shown to be beneficial to increasing levels of germane load. In the case of online learning communities it has been shown that when instructors efficiently and effectively facilitate the online learning experience students perceive higher levels of learning (Akyol & Garrison 2008). Shea et al. (2003) showed that a variety of instructional behaviors, including design and organization also led to higher levels of student learning in an online learning environment. Such design and organization examined by Shea et al. (2013) includes Anderson et al.’s (2001) instructional design model that focuses on setting the overall plan of the course.

2.6 Effects of Germane Load on Behavioral Intention

Limited research has been found that specifically connects germane load to future behavioral intentions. Relationships between germane load and future behavioral intentions can be inferred through the examination of perceived ease of use, and the role it plays on future behavioral intentions. Germane load has been shown to be a result of imposing less cognitive strain on the students (Cierniak et al. 2009; Leppink et al. 3013; Schmeck et al. 2015). Because of this, it is reasonable to assume that students, who experience less cognitive strain within their working memory, also perceive higher levels of ease of use because less effort is needed to gain an understanding of concepts presented in an e-learning environment. Therefore, it is reasonable to conclude that high levels of germane load, created by ease of use, contribute to future behavioral intentions.
Although there is a lack of supported evidence to tie germane load to higher levels of future behavioral intention to use MOOC-like courses, research does exist that indirectly connects cognitive load to intention to use mobile devices to complete specific tasks (Coursaris, Hassanein, Head & Bontis 2012). Based on research that shows visual and auditory distractions lead to higher levels of extraneous cognitive load, Coursaris et al. (2012) examined the effect of increased cognitive load imposed on mobile phone users while performing specific tasks with their devices. The increase of cognitive load was represented by various visual and auditory environmental distractions. The results showed that users who experienced an increase in cognitive load due to auditory and visual distraction differed from the group that did not receive such distractions with regards to their levels of perceived efficiency of the mobile device. Additionally, higher levels of efficiency were related to higher levels of satisfaction. Finally, those users that were satisfied with the experience also showed higher levels of future behavioral intention. Overall, the results concluded that an increase in cognitive load caused by environmental distractions had a negative effect on perceived efficiency, which in turn, also had a negative effect on user satisfaction and ultimately intention to use mobile devices. Although Coursaris et al. (2012) did not investigate germane load levels as they relate to future behavioral intention, it does show an indirect relationship between cognitive load and future behavioral intentions.

2.7 How Germane Load Mediates the Relationship between Instructional Design and Behavioral Intention

Limited research was found that showed an effect of instructional design on future behavioral intention through mediation of germane load. Liu et al. (2010) has found important relationships between the three variables that show how they are interconnected. In their study, the development of a user-interface within an online learning community was examined as part of effective instructional design. The results showed designing a user-interface that focuses on the reduction of cognitive load leads to high levels of behavioral intentions to use online community learning in the future. Although no mediation was found, the results of their study did show that when designing the user interface, steps should be taken to reduce cognitive load, which should result in higher levels of future behavioral intention. Research has also shown that perceived usefulness of the technology mediates the effect of perceived ease of use on intention to use (Lee et al. 2009; Venkatesh & Davis 2000). Based on previous research, if such design is effective in reducing levels of extraneous cognitive load, higher levels of germane cognitive load will be evident as a result, and possibly promote student intention to use e-learning again in future learning situations. The current study attempts to take findings like these a step further and connects higher levels of germane load to future behavioral intention. Furthermore, rather than looking at effective use of user-interface as part of instructional design, the current study focuses on more detailed instructional design decisions used to clearly communicate to students ways in which they can succeed.

3. Methods

3.1 Contextual background

The participants in this study took Open Cyber University of Korea (OCU) classes in the first semester of 2016. While the OCU was founded in 1997, it was not until 1998 that classes were opened for students to attend (Jung & Rha 2001). A network of traditional face-to-face universities fund the OCU, enabling their students to take advantage of the variety of classes provided by the OCU. Further to this, the OCU also offers degrees to fully online students (Jung 2000). According to the OCU, they provide the largest form of MOOC-like courses in South Korea with 23 brick-and-mortar universities, 400 courses, which serve approximately 120,000 students every year (About OCU n.d.). The students involved in this study were attending face-to-face classes at their traditional university while also attending classes at the OCU.

The universities, which form part of the OCU, provide both the content and design of the courses (Jung & Rha 2001). There is generally little student-to-student interaction in OCU classes, though some classes offer offline meetings while others have offline assessment. To manage the OCU, a council of representatives from the member universities creates policy and deal with day-to-day operations (Jung & Rha 2001). Furthermore, a team of programmers, instructional design professionals, and an evaluation team help create, maintain, and improve the learning environments used at the OCU. According to the OCU homepage, the OCU was selected as the best open online consortium OCU in Korea based on 21 evaluation indicators, including student’s willingness to learn, student loyalty, faculty professionalism, and appropriateness of professional personnel (About OCU n.d.).
As will be mentioned in more detail in paragraph 3.3, 10 students from a national university in South Korea were interviewed about their views and involvement in the OCU. After these interviews and a preliminary survey, a final survey was compiled. This survey was in a Google Sheets form and was posted on the main administration board of the OCU in April 2016. Before the survey was posted, the administration of the OCU checked that the survey met their ethical requirements and that it was acceptable for students to participate in the research. Students were asked to respond to the items in the survey, based on how they experience the class they were taking that semester. Students who took more than one class were only allowed to respond to the survey once. A total of 1475 out of approximately 60,000 students completed the anonymous survey at the beginning of May 2016, immediately following midterm assessment. However, 161 surveys were incomplete for the purposes of this study and were therefore removed from the analysis, leaving 1314 responses to be used in this analysis. Of the 1314 participants, 679 (52%) were females and 635 (48%) were males. The oldest participant was 63 and the youngest was 19, with an average subject age of 23.5. The students who participated in this study took a wide variety of classes at the OCU.

3.2 Models

The hypotheses examined in this research can be shown using the path diagrams found in Figures 1a and 1b. Figure 1a illustrates the total effect of instructional design on students’ future behavioral intention from the OCU. In keeping with Hypothesis 1, this figure suggests that high levels of instructional design are positively associated with future behavioral intentions. However, this research proposes that the relationship between instructional design and students’ future behavioral intentions can be better understood through the inclusion of a third mediating variable, germane load. Through the inclusion of this mediating variable, we are able to obtain a more nuanced understanding of how instructional design affects future behavioral intentions by disaggregating the total effect (Path c) into two distinct effects-direct effects (Path c) and indirect effects (Paths a and b). These effects are illustrated in Figure 1b. First, as Figure 1b shows, at least a degree of instructional design’s effects on future behavioral intentions will occur indirectly-first, higher levels of instructional design will increase levels of germane load (Path a), and, in turn, higher levels of germane load will increase students’ future behavioral intentions (Path b). This indirect relationship is addressed by Hypotheses 2 and 3. The balance of instructional design’s total effect upon future behavioral intentions is likely to occur via a direct relationship between these two variables as shown by Path c’ in Figure 1b.

To better understand the relationships discussed in the previous paragraph, this research makes use of Baron and Kenny’s (1986) three equation method for modeling mediation. This study also follows the process used in Porumbescu (2017).

Step 1: The dependent variable should be regressed on to the independent variable to ascertain if the independent variable is a statistically significant predictor of the dependent variable. Independent variable → dependent variable.

\[ Y = \beta_{10} + \beta_{11}X + \epsilon_2 \]

\( \beta_{11} \) is significant.

Step 2: The mediating variable should be regressed on to the independent variable to check that the independent variable is a statistically significant predictor of the mediating variable. If there is no relationship at this stage, then clearly the mediator does not mediate anything. Independent variable → mediating variable

\[ Me = \beta_{20} + \beta_{21}X + \epsilon_2 \]

\( \beta_{21} \) is significant.

Step 3: The dependent variable should be regressed on to the mediating variable and the independent variable to check that the mediating variable is a statistically significant predictor of the dependent variable, and the relationship between the independent variable and dependent variable from step one, is significantly reduced or absent.
\[ Y = \theta_{30} + \theta_{31}X + \theta_{32}Me + \varepsilon_3 \]

\( \theta_{32} \) is significant

\( \theta_{32} \) should be smaller than the original relationship between the independent and dependent variables \( \{\theta_{12}\} \)

Another way of looking at this would be to consider that there are four criteria that must be met for mediation to have occurred: (a) there must be a statistically significant relationship between the independent and dependent variable without the mediator, (b) the independent variable must have a statistically significant relationship with the mediator, (c) the mediator must have a statistically significant relationship with the dependent variable, and (d) the relationship between the independent and the dependent variable decreases or disappears when controlling for the mediator.

![Path Diagram of Relationships](image)

3.3 Instrument development

Korean cyber universities and the OCU specifically lack a great deal of research into their learning environments. For this reason a series of interviews were designed and administered before creating the instruments used in this research. Instrument development began with a series of short qualitative interviews with 10 students who had been part of the OCU. The initial purpose of this questioning was to discover the nature of student-to-student interaction and how that was affected by the learning materials that were part of the OCU, particularly the lectures. However, none of the interviewees had any online interaction with other students, so we decided a broader set of research questions would be more appropriate. In relation to studying on the OCU, Kim’s response was typical, “I just watched the videos and did the exams, there were other things but I didn’t do them.” This type of opinion, and the fact that all interview participants said that there was little instruction or activities outside the video lectures in the OCU meant that it was decided that research would focus on general aspects of instructional design and the quality and variety of the video lectures.

Once the interviews were finished, 92 students were given a broad survey about the OCU to complete. The survey covered issues such as the amount of cheating in the OCU, instructional design, automated feedback systems and video lectures. The results of the survey raised several important issues regarding instruction and
student perceptions of the instruction on the OCU. For that reason, a second study was prepared. That study would be larger in that more students would be involved. Also, it would be more specific and focus on the instruction in the OCU and the students perceptions of that instruction. It is the results of the second larger study that will be used in this paper. These questions included items about instructional design, germane load, future behavioral intentions, the quality of lectures, and the OCU’s automated feedback system. These issues were focused on as the students interviewed mentioned these as the most salient features of the OCU’s learning environment as well as the interviewees’ responses. Within the Korean online learning context, direct instruction is a key feature of the education experience (Han, 2012). This is likely because of cultural norms, in which there is an expectation that students are simply the receivers of knowledge doled out to them from instructors (Lim, Kang & Park, 2016).

The survey contained 12 items that directly relate to this study. Five were used to generate the instructional design construct, four were used to generate the germane load construct, and three were used to generate the future behavioral intentions construct. The initial survey was given to 10 potential respondents, and, after completing the survey, the respondents gave feedback on the appropriateness of the items. In response to this feedback, the items remained largely the same, though there were some slight changes to make the items more appropriate when translated into Korean.

There were five items used to generate the level of instructional design used in this paper’s instrument. The items were measured using a likert-type scale ranging from 0 to 10, with 0 being strongly disagree and 10 being strongly agree. They were developed by Shea et al. (2003) and based on the instructional design and organization part of teaching presence from Anderson et al. (2001). In Anderson et al., five different indicators are used: establishing netiquette, establishing time parameters, setting the curriculum, designing methods, and utilizing the medium effectively. Shea et al. (2003) designed the items to be reflective of the online instructional design indicators provided by Anderson et al. (2001). The students responded to these items based on the instructional design aspects they faced within their classes in the OCU. The five items were presented as follows: Overall, the instructor for this course clearly communicated important course outcomes (for example, provided documentation on course goals). Overall, the professor for this course clearly communicated important course topics (for example, provided a clear and accurate course overview). Overall, the instructor for this course clearly communicated important due dates/time frames for learning activities that helped me keep pace with the course (for example, provided a clear and accurate course schedule, due dates, etc.). Overall, the instructor for this course helped me take advantage of the online environment to assist my learning (for example, provided instructions on how to navigate or use the online system). Overall, the instructor for this course helped students to understand and practice the kinds of behaviors acceptable in online learning environments (for example, how to communicate with the professor or students online). Cronbach’s Alpha for the five items was calculated to be .909, which was deemed high enough to be used as a single construct representing instructional design.

To create the germane load scale, four items were used and measured using a likert-type scale ranging from 0 to 10, with 0 being strongly disagree and 10 being strongly agree. The items came from Leppink et al.’s (2013) paper on The development of an instrument for measuring cognitive load. In Leppink et al.’s (2013) paper, the three main types of cognitive load - intrinsic, extraneous and germane - are discussed. In their research, exploratory factor analysis was used and the four items representing germane load were found to be an actual representation of how instruction and explanation contribute to learning. The fact that the loadings for germane load represented a robust factor, separate from intrinsic load and extraneous load, supports the triarchic theory of cognitive load, which according to DeLeeuw and Mayer (2008) allow for different aspects of cognitive load to measured separately. Because germane load was found to represent the contribution of instruction and explanation to learning, regardless of the intrinsic and extraneous load factors, the current study used the germane load construct as an independent measure of how instruction and explanation contribute to learning. Additionally, justification for use of the germane load construct in an online setting is provided by Debue and Van De Leemput (2014), who adapted Leppink et al.’s (2013) items to determine if various ways of using hypermedia within an online context would have an effect on cognitive load. Their germane load items were found to have an appropriate level of internal consistency to use as a single construct. Furthermore, through factor analysis, the germane load factor was shown to be a sufficient representation of the items, which were modified to reflect the online context. The current paper uses Leppink et al.’s (2013) items to measure germane load with slight modification to focus on the lecture sections of the OCU classes. This was done in accordance to Leppink et al.’s (2013) claim that rewording text to match the
context of a specific study is an acceptable modification to the items. The items used in the current study are as follows: The lecture really enhanced my understanding of the topic, the lecture really enhanced my knowledge and understanding of the of the class subject, the lecture really enhanced my understanding of the concepts associated with the class subject, the lecture really enhanced my understanding of concepts and definitions. To assess internal reliability of the germane load construct, Cronbach’s Alpha was found to be .962, similar to .82 found by Leppink et al. (2013), and which is very high and appropriate for research of this type.

For the future behavioral intentions construct, there were three items used. The scale was focused around behavior that the student would do in the future, as related to their intention towards the lectures. The three items were measured using a likert-type scale ranging from 0 to 10, with 0 being strongly disagree and 10 being strongly agree. These items were adapted from Sørebø, Halvari, Gulli & Kristiansen’s (2009) paper on user’s continuation of use of education technology. Sørebø et al.’s (2009) items were designed to reflect research that focuses on student intentions to continue using e-learning platforms. The items used in this study were slightly altered to represent OCU lectures, which are presented in video format containing various instructional design aspects delivered by the instructors. The three items were: I intend to continue watching the video lectures, I intend to use the videos as the main source of information throughout the semester, I don’t want to watch any more lectures. Cronbach’s Alpha (.905) found with the items of the present study were similar to the .86 Cronbach’s Alpha found by Sørebø et al. (2009). This internal reliability was used to justify combining the three items into one construct. These items can be considered to have content validity in that they have been drawn up through investigation of the subject domain as shown by their connection with other research into student’s future behavioral research mentioned above. Furthermore, two experts in online learning and student behavior in the OCU reviewed the items before the survey was distributed. According to Foxcroft, Paterson, Le Roux & Herbst (2004), these two factors combined together establish content validity.

4. Results

Descriptive statistics are shown in Table 1. The mean for students’ future behavioral intentions was 5.60. This implies that students have a neutral opinion of the classes they took online and the likelihood of those classes to inspire further use of the lectures for study. The mean for instructional design was higher at 6.26. This shows that students have a slightly positive view of the levels of instructional design in the classes that they took. This suggests that students feel they are given an appropriate amount of information about the format and delivery of their classes. Finally, the mean value for germane load was 6.31, which shows a slightly positive view of how the students’ felt they learned overall from the classes they took from the OCU.

<table>
<thead>
<tr>
<th>Table 1: Correlations of the Main Variables</th>
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<tbody>
<tr>
<td>Minimum-maximum values</td>
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<tr>
<td>-------------------------</td>
</tr>
<tr>
<td>(1) Age</td>
</tr>
<tr>
<td>(2) Gender</td>
</tr>
<tr>
<td>(3) Design</td>
</tr>
<tr>
<td>(4) Germaine load</td>
</tr>
<tr>
<td>(5) Future behavioral intentions</td>
</tr>
</tbody>
</table>

$p = < .05$

Table 2 shows the results of the three regression equations used in the mediation analysis for this study. All variables shown in the analysis in Table 2 are standardized. In all three equations, the $F$ values are statistically significant ($p <.01$), and the adjusted $r^2$ values range from .15 to .39. These values suggest that the equations used as a part of this research are statistically significant and explain variation in the data as well.
The first model, equation 1, shows that higher levels of instructional design are positively associated with students’ future behavioral intentions scores. (Path c: total effect); the mediating variable (germane load) is not present in this regression. This result provides support for the idea that increasing the quality of instructional design will have a positive effect on students’ intention to study and to use education resources in the future. Referring back to Baron and Kenny’s (1986) first criteria for mediation, the first criterion that the relationship between the independent and dependent variable be statistically significant ($p < .01$) is satisfied.

The second model, equation 2, shows that students’ germane load is positively correlated with levels of instructional design. This suggests that increasing the levels of instructional design will increase students’ levels of germane load. The fact that this equation (Path a) is significant satisfies the second criterion for mediation. Models 1 and 2 both offer strong evidence for the significance of instructional design in student outcomes.

The third model has two main findings of interest. First, Model 3 shows that students’ level of future behavioral intentions is positively correlated with their levels of germane load ($p < .01$), which is shown in Path b of Figure 1b. To this end, it was found that the greater students’ germane load, the higher their future behavioral intentions. This satisfies the third criterion for mediation. The second finding of interest from model 3 is that, when controlling for germane load, the relationship between instructional design levels and future behavioral intentions disappears ($p = >.05$). This is referred to as complete mediation and satisfies the fourth criterion for mediation, and establishes that this model meets all the criteria for mediation. When a model is completely mediated, the inclusion of the mediation variable (Path c) completely removes the relationship between the independent and dependent variable.

These three models and 4 paths, give strong evidence of a mediation effect (Path $c'$). This implies that the correlation between instructional design and students’ future behavioral intentions is illusory (Path c) and is best understood as instructional design affecting students’ germane load (Path a), which in turn affects students’ future behavioral intentions (Path b).

<table>
<thead>
<tr>
<th></th>
<th>Equation 1</th>
<th>Equation 2</th>
<th>Equation 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>future behavioral intentions (Path c)</td>
<td>.23*</td>
<td>.47*</td>
<td>.03</td>
</tr>
<tr>
<td>germane load (Path a)</td>
<td>.52*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Future behavioral intentions (Paths b &amp; c')</td>
<td>.39</td>
<td>.31</td>
<td>.39</td>
</tr>
<tr>
<td>Instructional design</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>germane load</td>
<td></td>
<td>.52*</td>
<td></td>
</tr>
<tr>
<td>Constant</td>
<td>3.73</td>
<td>3.44</td>
<td>2.14</td>
</tr>
<tr>
<td>F value</td>
<td>12.78</td>
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<tr>
<td>Adjusted $r^2$</td>
<td>.15</td>
<td>.31</td>
<td>.39</td>
</tr>
<tr>
<td>$N$</td>
<td>1314</td>
<td>1314</td>
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</tbody>
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Note $* = p < .01$

5. Discussion

The results support hypothesis H1, which predicted that levels of instructional design would positively correlate with future behavioral intentions. This is important in light of research that promotes the use of instructional design to continue using e-learning (Lee 2010; Wiggins 1998). Although research has promoted instructional design to increase future behavioral intentions, past research lacks the investigation of specific instructional design features included in Anderson et al.’s (2001) model. Relationships were found between cognitive load and instructional design that focused on interaction between the students and development of
social ties (Cheng et al. 2011; Liu et al. 2009), but not on the development of instructional design used to set the overall plan of the course. Specifically, this study found a relationship between future behavioral intentions and instructional design that set the overall plan of the course by clearly communicating course topics, objectives, goals, due dates, and how to use the online system. These instructional design decisions likely contributed to a useful learning experience, creating an interest among the students to continue using e-learning in the future. Based on these results, conclusions can be made that e-learning instructional design should focus on transparent ways of presenting the curriculum within a course in order to promote future use of such a course.

Hypothesis H2 was supported by the results of this study, in that levels of instructional design were positively correlated with germane load. This is consistent to research promoting instructional design that leads to higher germane load (Cierniak et al. 2009; Sweller et al. 1998). Research has looked at ways of doing this through instruction designed to minimize irrelevant or redundant information, as well as to avoid creating a split attention effect among the students (Chandler & Sweller 1991; Mayer & Moreno 1998). This study, however, appears to be the first to examine the relationship between germane load and ways in which instructors set the overall course. Providing students with clear instructions of how to use the e-learning system, as well as clearly communicating course topics, goals, and establishing time lines most likely contributed to keeping the students focused on information directly related to the intended learning process of the class, further leading to an enhanced understanding of what was being taught. This is important for instructors who wish to design instruction that enhances levels of germane load.

The results of this study also support H3, in that levels of germane load were positively correlated with levels of future behavioral intention. Although no research was found connecting the two, the results from this study are not surprising because germane load is directly linked to learning and student understanding of delivered instruction (Cierniak et al. 2009; De Jong 2010; Kolfschoten et al. 2010; Shadiev et al. 2015; Sweller et al. 1998). It is reasonable to assume that, if students perceive an overall positive learning experience through understanding of instruction, they would most likely want to continue with that type of learning in the future. Furthermore, like germane load, elements of future behavioral intentions are reflective of learning. Perceived ease of use and perceived usefulness have been found to contribute to learning, as well as actual intention to use (Lee et al. 2009). Because germane load also has a relationship with learning, it would be reasonable to assume that it would also contribute to future behavioral intentions. Although other research has tied cognitive load to future behavioral intentions, this appears to be the first study to connect levels of germane load to levels of future behavioral intentions.

Finally, the results of this study support H4, in that the effect of instructional design on future behavioral intentions was mediated by germane load. It is clear through past research that future behavioral intentions is positively affected by instructional design (Cheng et al. 2011; Lee 2010; Liu et al. 2009; Wiggins 1998). However, previous research lacks investigation into what is mediating such an effect. Through the results of this study, it can be concluded that higher levels of germane load contribute to the relationship between instructional design and future behavioral intentions. This makes sense because if students’ germane load levels are increased through effective use of instructional design, they will most likely intend to use e-learning in the future. The results from Liu et al. (2010) allude to this idea, in that when students received instruction designed to reduce overall cognitive load, they showed higher levels of intention to use. Rather than simply promoting lower cognitive load inducing instructional design to promote continuance of usage however, the present study actually examines the mediating effect that germane load specifically has on students’ future behavioral intentions. This is important because it provides empirical evidence that higher germane load mediates the relationship between instructional design and future behavioral intentions, providing instructors with justification to promote germane load by implementing instructional design geared to set the overall plan of an e-learning course. Additionally, these findings are particularly important in the context of MOOC-like courses due to the high dropout rate occurring within MOOCs. Using Anderson et al’s (2001) instructional design model may encourage students to continue using MOOCs due to increased levels of germane load.

6. Conclusion

Using survey analysis of students who participated in formal online learning in Korea, this study looked at relationships between the following variables: instructional design and future behavioral intentions, instructional design and germane load, germane load and future behavioral intentions, as well as the
mediating effect of germane load on the relationship between instructional design and future behavioral intentions. The relationships were all positively correlated and germane load was found to be a mediating variable between instructional design and future behavioral intentions. Using Anderson et al.'s (2001) model, instructional design was viewed as a way of communicating important information to students about the overall plan of an e-learning course. The results show the importance of delivering such instructional design to promote understanding of course instruction to a point where students will continue using e-learning in the future. The typical goal of instructional design is to promote better understanding of concepts so that effective learning can occur (Cierniak et al. 2009; Sweller et al. 1998). In the present study, the instructional design decisions to establish clear instructions of how to successfully use the e-learning course appear to have contributed to a better understanding based on high levels of germane load. Therefore, it is important for instructors who want to promote e-learning use in the future to also communicate a clear overall plan of the course in a way that will effectively contribute to the learning process.

Although relationships were found that can be helpful in the design and implementation of e-learning, there are some limitations. The relationships found in this study can be further supported through the design of specific experimental conditions that may give a clearer overall picture of what is actually going on within the e-learning environment. Also, further investigation into other aspects that may be affecting cognitive load levels would contribute to a better understanding between the relationships. Additionally, a qualitative approach to this study may provide more detailed information about how the specific instructional design decisions relate to increased levels of germane load and further contribute to students’ future behavioral intentions. This study, although useful for MOOC-like courses occurring in Korea, would also be useful in other regions of the world to see if cultural variations influence the results. Although there are some limitations, the fact that relationships were found between all of the variables and the fact that germane load was found to be a mediator of the relationship between instructional design and future behavioral intentions is useful for instructors who seek ways of promoting a positive learning experience and intention to use.

References


Community in Online Higher Education: Challenges and Opportunities

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Abstract: Exploring the challenges and opportunities associated with the concepts of community and communication in online higher education, this paper reconsiders the intention to replicate face-to-face learning and teaching strategies in online learning environments. Rather than beginning with the assumption that face-to-face education is the prototype for quality, the authors appraise the online learning environment as a unique medium which, by its nature, necessitates unique communication, community-building, teaching and learning strategies. This paper proposes an in-depth analysis of the potential unique affordances associated with online learning contexts as existing in their own right. The concepts of community and communication are explored in relation to online Communities of Practice (CoPs). The nature of face-to-face and online learning contexts are considered, especially in the light of the possibility of redefining “face-to-face” within the online realm, in addition to physical learning contexts. The paper identifies unique ways in which online communication (in the context of learning) is different from face-to-face communication, and consequently four ways in which this can be an advantage for students; namely, there is a measure of social egalitarianism, emphasis on verbal/written proficiency, time for reasoned response, and social agency. The paper provides grounding for further research into strategies that forge rich online learning experiences and suggests an empirical study as a next step.

Keywords: online community, Computer Mediated Communication (CMC), Communities of Practice (CoPs), nonverbal communication

1. Introduction

The advent of new technologies has facilitated the possibility of education that is outside the face-to-face synchronous classroom; asynchronous education, to be consumed at the convenience of the student. While online learning is arguably limited in its availability to students who have access to technological facilities necessary for this mode of learning, it does present unique opportunities as well as challenges. Research in traditional face-to-face classroom environments demonstrates the merits of collaborative active learning and learning communities that form due to peer-engagement (Buchenroth-Martin, DiMartino, & Martin, 2017; Rojas-Drummond & Mercer, 2003; Vygotsky, 1933/1978). The face-to-face, physical, interpersonal contact that imbues the sense of a learning community in a traditional classroom has been reported as being scarce in the online learning mode (Akyol & Garrison, 2008; McInerny & Roberts, 2004; Swan, Garrison, & Richardson, 2009). The dilemma facing the modern educator, who is often expected to teach in both on-campus and online learning contexts, is the online application of learning theories that acknowledge the importance of social constructivist learning theories (Herrington & Standen, 2000; Swan et al., 2009).

Many educational institutions have, however, attempted to re-create the relational dynamics of a physical classroom in an effort to create that sense of community in online classes. Such efforts include forums, synchronous chats with tutors and/or fellow classmates, personalising online course functions, and the use of designated social media (such as blogs, wikis, Facebook sites), to name a few (Cochrane & Withell, 2013; Huertas, Casado, Córcoles, Mor, & Guerrero-Roldán, 2007; Mbati, 2013). In other fields such as public relations and human networking, the role of social media has also been instrumental in enhancing organisational learning (Leak, 2016; Qi & Chau, 2016), regulating and empowering communication (Burleson, 2016) or even posing threats to organisations and governments (Chandramouli, 2011). Andreatos (2012) reminds us of the benefits of the self-directed nature of many of these social media tools for modern learners, either individually or in teams, and the value of individuals being able to test their understanding and knowledge with the online community which is often not as easy to do in face-to-face contexts. Similarly, the study by Murchú and Sorensen (2004) has further validated the online option for the delivery of a masters program as such a course enables students to “build on the ability to work together, pool resources and accelerate learning” (p. 1). The benefits of online courses, and online activities and tools have been reported as improving the quality of learning, increasing engagement and encouraging motivation of students (Imlawi & Gregg, 2014; Parkin, Hepplestone, Holden, Irwin, & Thorpe, 2012). Educators and researchers have reported on the potential value
of online communities as hubs of learning and their potential to foster centres of learning that engage groups of learners and individuals alike (Garrison, 2006; Lowenthal, 2010; McDonald, 2014). While the value of creating the feeling of community in an online learning environment is sought by modern educators, the extent to which these strategies are effective in cultivating “community” in an online context is a question that must be explored further.

Notwithstanding the many studies that can be found to support claims that effective learning can occur in online learning contexts, Means, Bakia and Murphy (2014) remind us of the “contradictory studies concerning the effectiveness of online learning” (p. x) and the problem with research studies that do not clearly outline the course aspects that the researchers are attempting to investigate and evaluate. In this light, our paper attempts to put forward a discussion of a specific aspect of learning that purports to impact a sense of community and, subsequently, a sense of online learning community. Additionally, amidst the many claims of the advantages and potential value of online learning, some literature continues to report low course completion rates and high dropout rates in some contexts, especially for MOOCs (Jordan, 2014; Khalil & Ebner, 2014), whereas others cite a reversal of such trends (Shea & Bidjerano, 2014).

It is our position that the first step in building online communities is to acknowledge that, at our current level of technology, we fall far short of capturing the richness and complexity of face-to-face communication in online learning. In fact, attempting this is an effort that detracts us from building effective online learning experiences. However, online communication offers unique opportunities that can and must be used toward the goal of building a sense of community amongst online students. Andreatos (2015), in his discussion of the use of MOOCs for individual and organisational learning, even goes as far to suggest that online courses, are essential (not just an alternative to face-to-face learning) for the contemporary professional to remain engaged in lifelong and continuous professional learning. While our paper discusses the affordances of both online and face-to-face collaboration and the sense of community it promotes, we do not posit that online community-building tools and activities should seek to fully replicate the attributes of face-to-face collaboration; rather such tools provide a different experience from the collaborative learning experiences offered by face-to-face learning scenarios.

In order to explore these issues, however, we must first address what we mean by “community”, after which we discuss how the concept of community is developed in general and in learning-specific communities using the CoP framework. Aspects of communication including social dynamics, agency, nonverbal and verbal cues and communication response in educational contexts for learning purposes are also explored. Lastly, we conclude with a commentary about the unique nature of online communication for learning purposes and suggestions for future research.

2. What is Community?

“Community” is a word that is used liberally in the educational context. Generally speaking, there is a distinction between geographical communities and relational communities (Gusfield, 1975). The former refers to clusters of people sharing and inevitably interacting in a geographical space such as a town or neighbourhood, and the latter refers to groups of people who are drawn together in a relationship due to common interests or goals (even if they do not share a geographical space) such as a disciplinary academic organisation, religious group, or other interest group. In as much as a community is composed of a group of people with shared interests and/or proximity, community has a social (group) and psychological (individual) element to it.

In an early work, McMillan and Chavis (1986) propose that community consists of a sense of belonging amongst members, a sense of agency or ability to have a say/influence, a sense of fulfillment of their needs, and an emotional connection amongst members. Koh and Kim (2003) take the notion of community further into the virtual space and propose that virtual community has three dimensions, namely, “(1) membership—people experience feelings of belonging to their virtual community, (2) influence—people influence other members of their community, and (3) immersion—people feel the state of flow during virtual community navigation” (p. 77). More recently, Bowers and Kumar (2017), in their comparative analysis of students’ perceptions of teaching and social presence in face-to-face and online learning environments, have noted the potential of online courses to develop a stronger sense of “presence” than face-to-face courses: “results indicate that students’ perceived stronger teacher and social presences in the online section compared to the
face-to-face section” (p. 1532). While face-to-face communities have been compared to online communities in the past, such recent research has begun to emphasise the unique nature of online communities as being more significant than the attempt to replicate or transfer face-to-face experiences to online contexts. Interestingly, in the field of counselling, Hanley, Ersahin, Sefi and Hebron (2016) found that students accessing counselling services tended to use online services in different ways from face-to-face services. While many researchers debate the benefits and limitations of face-to-face versus online learning contexts, many prefer a blended approach which employs a combination of learning strategies and resources from both face-to-face traditional and online contexts (Torrisi-Steele & Drew, 2013; Twelves & Arasaratnam, 2012-2013). Thus, it is the different affordances of each context, including face-to-face, blended and online, that appear to be of more significance to recent educators who work in either of these contexts.

Virtual communities, while sharing some qualities, are different from physical communities. In educational contexts where learners and teachers work together to achieve learning, or where groups of interested individuals band together to investigate an issue, such learning and teaching groups have been referred to as Communities of Practice (CoPs). McDonald and her colleagues have studied the phenomena of Communities of Practice (CoPs) in educational contexts, including online or digital CoPs (for example, McDonald, 2014; Reushle & McDonald, 2012). They have built upon Wenger and his colleagues’ (Wenger, 1998a, 1998b; Wenger, McDermott, & Snyder, 2002) view of a CoP as being made up of a domain of knowledge, a community of individuals who are united in shared practice, a community which confirms an individual’s identity as well as the group’s competence. McDonald and her colleagues’ work has highlighted the value of the way in which CoPs "provide a context for sustained professional conversations around identified domain and practice issues" (McDonald & Star, 2006, p. 4). Such benefits are easily applicable to a range of educational contexts such as undergraduate education, postgraduate education, professional learning and training.

While some of the barriers to sustaining virtual CoPs have been identified such as the difficulties in sharing knowledge through online technologies and their transient nature, as compared to some more organically formed CoPs (Hanisch & Churchman, 2008), other researchers have identified more positive features of virtual CoPs. For example, Barnett et al. (2012) found that trust can be built online between participants in virtual CoPs and that virtual CoPs work well if the participants work towards a specific goal. Furthermore, Truman (2013) found that some virtual communities developed online collaborative problem solving capacities. The interplay of social interaction and the formation or definition of selfhood in an online context has also been studied, to an extent, within online communities. For example, Koole’s (2010) work on the place of self in online communities within online learning networks has established that “a sense of self is inherently connected to one’s sense of belonging within a community (ies)” (p. 241), and Crampton and Ragusa (2015) found that students believed that a sense of belonging and connection in an online educational context impacted their academic success.

Belonging is one of the fundamental aspects of membership in a group (Furman, 1998; Strayhorn, 2012), including virtual groups of students within distance learning courses (Crampton & Ragusa, 2015) or students engaged in blended learning contexts which incorporate online and on-campus course components (Masika & Jones, 2016). Relational communities form due to shared interests, as Gusfield (1975) notes. Within the context of faith-based education, for example, it can be presumed that colleges presumably inculcate students with particular values, and the extent to which one feels part of the faith-based learning community is arguably influenced by the extent to which one subscribes to these values. It must be noted, however, that it is possible for one to not subscribe to a particular faith while sharing the values of that faith. In other words, an educational institution that operates with a Christian ethos, for example, would appeal to students who want elements of spirituality and morality to be an integral part of academic curriculum and culture, even though they may not personally profess to be a Christian. A student of another faith (or no religious affiliation) could thus still feel a sense of belonging to a faith-based college if s/he, at least to an extent, shares the values of that community. Support, camaraderie, and connection, all characterise one’s belonging to a particular group.

We propose that intellectual connection is also an important element in a learning community, an aspect of community that Wenger (1998b) refers to as a domain of knowledge, also explored by McDonald and her colleagues in an online context (McDonald, 2014; McDonald & Star, 2006; Reushle & McDonald, 2012). By intellectual connection we mean the ability to exchange and express ideas without feeling under-stimulated or challenged beyond one’s capacity. The knowledge that one is able to make a difference in the community to which one belongs is an important aspect of one’s sense of affiliation with that community (McMillan &
Agency, one could argue, is a fundamental aspect of perception of freedom and as such an essential component of a learning community in which all members feel free to influence and be influenced. The ability to have some say in one’s own learning process and to know that one’s ideas are making a difference in the learning community are important aspects of feeling intellectual connection. In fact cognitive presence, along with social presence and teaching presence, is described by Garrison and Cleveland-Innes (2005) as a required component of a community of inquiry, especially to ensure the community is purposeful and the learning is meaningful. The sense of belonging and sense of agency in community indicate that there is an element of relationship to community, whether physical or virtual. And human relationships develop through communication.

3. (Computer Mediated) Communication

Interpersonal communication is often characterised as a dynamic process of sending and receiving messages within a socio-cultural context which, along with the personalities involved, influences the way in which messages are perceived. Communication has verbal and nonverbal components, both of which contribute to the experience of communication. Nonverbal cues play an important role in not only complementing verbal messages but also substituting for them, and in some instances contradicting them. When verbal communication contradicts the accompanying nonverbal message, the nonverbal message is perceived as the more accurate one (Jones & LeBaron, 2002).

In online learning interactions, the aspect of communication that suffers the most is nonverbal; the online environment being described by Hosler and Arend (2012) as “void of the tonal, visual and verbal cues found in the traditional classroom” (p. 148). Emoticons are an effort to replicate some version of nonverbal expressions. While video chats enable access to facial expressions and tone of voice, technology is yet to replicate the subtle nuances communicated by proxemics (for example, standing close to another person to communicate solidarity or intimidation) or haptics (giving someone a hug, for example). In terms of learning, nonverbal cues in communication have been claimed to impact learning outcomes for students, especially when conflict arises (Okon, 2011). Babad (2007), for example, found that nonverbal communication gestures such as students’ perceptions of teacher enthusiasm and teacher immediacy. Further, there is evidence to suggest that teachers’ nonverbal cues (when communicating with the student in a mode where these cues are accessible) play a significant role in influencing student performance in online learning (Niari, Manousou, & Lionarakis, 2016).

Nevertheless, despite claims by some researchers about the value of nonverbal communication for teaching and learning purposes (Babad, 2007; Hosler & Arend, 2012; Okon, 2011), and while there is general acceptance that nonverbal cues assist face-to-face communication in general, York (2015) claims that “There is inconsistent data on the effect of nonverbal communication used by instructors and the impact on student learning within the higher education environment” (p. 1). However, his study that investigated the role of nonverbal immediacy in relation to student learning in a higher education context did clearly conclude that “instructors’ nonverbal immediacy effects student learning”, implying that “professional development programs in higher education could benefit from providing nonverbal communication training to instructors” (p. 5). How such a finding could be applied or considered in an online learning context has yet to be fully investigated, especially if the affordances of video conferencing are utilised in which students and teachers can view one another’s facial expressions and gestures, albeit via digital means. Typically, however, technology-dependent communication, in fact, fails significantly short of replicating the tangible and rich communication possibilities offered by face-to-face learning interactions. No matter the economic and pragmatic imperatives to concede that online communication adequately replicates face-to-face communication, an honest appraiser cannot help but acknowledge that technology-mediated communication (in its current form) cannot replicate face-to-face communication.

This is not to say, however, that there aren’t interpersonal and relational advantages to technology-mediated communication. In face-to-face communication, we are subjected to all social expectations that accompany such an interaction. In other words, when you see the person with whom you are communicating, you cannot help but make certain assumptions about the person (based on his/her appearance, smell, posture,
mannerisms) and have certain expectations of that person based on those assumptions. Inevitably, your expectations dictate how you respond to that person, which in turn influences how that person responds to you. In an online forum, often used for learning purposes, on the other hand, you are presented with an opportunity to interact at an intellectual level – at least to an extent. As long as you are literate and able to articulate your ideas in written (typed) form, you have the opportunity to communicate your ideas and interact with others without the hindrance of preconceptions based on appearance, smell, or mannerisms. Competence in online communication is based on a different set of skills in which some people may excel, despite other perceived shortfalls that may debilitate their face-to-face communication.

4. The Social Uniqueness of Online Communication

Research in computer mediated communication (CMC) has identified certain factors that influence competency in CMC, such as knowledge of how to communicate in a computer-mediated context and the motivation to engage in CMC (Bunz, 2005), and predispositions to CMC in terms of apprehension about or aversion to using technologies (Kelly, Keaten, Hazel, & Williams, 2010). In online and blended education, the types of interactions may include asynchronous online forums, synchronous textual and audio/video chatting, email, and phone conversations, to name a few. In the way of introduction, the lecturer might have a pre-recorded video greeting. Students may be given the opportunity to share brief profiles, including a photo. Perhaps there is a round of introductory forum posts for the class members to get to know one another. These types of interactions are distinct from synchronous face-to-face communication in a number of ways and they are often employed in courses that are facilitated in a completely online mode or a blended mode incorporating elements of both face-to-face and online education.

First, unlike in face-to-face communication, each individual has a certain measure of control in how his/her self is presented to the rest of the group. In other words, one could select a flattering photograph, position one’s self in a certain way in front of the camera if video chatting is available, and can dispense with divulging other physical characteristics such as height, smell, markers of affluence (such as expensive attire), and even age, to an extent. Social expectations of dress code and even personal hygiene are typically moot in many forms of online communication. To the extent that one’s physicality pre-disposes others’ responses to him/her (Arasaratnam, 2011), online communication serves as an equalising medium.

Secondly, nonverbal codes play a significant role in face-to-face communication. Frequency of eye contact, posture, proximity, use of gestures, and tone/volume of voice, all play a role in pre-empting how one is perceived (Lewis, 2007). In asynchronous online communication such as forum posts, none of these elements are relevant. The most socially awkward and reclusive person could be the most vocal and assertive in presenting his/her opinions, if s/he is confident in written articulation. The obsolescence of nonverbal skills presents opportunities for self-expression of some individuals who may never have that opportunity in a face-to-face classroom. Leong (2011) even suggests that online learning environments can “enhance opportunities for social presence and cognitive absorption” (p. 24) which may improve students’ attitudes to their learning.

Thirdly, in asynchronous online learning forums, real-time conversation turn-taking skills are obsolete. One could carefully form one’s thoughts before sharing with a group, without the pressure of interjecting into a dynamic rapidly moving conversation. Anyone who is self-conscious about their voice, accent, language skills, or inability to interrupt, is relieved of this type of social pressure in a written forum. Even in synchronous online communication (audio, video, and/or textual), there is greater opportunity for participants to interject their thoughts because they have the opportunity to message the lecturer or raise their hand to be visible to the whole group. Asynchronous communication also allows for thoughtful considered responses to others’ ideas over time, unlike face-to-face communication.

Finally, there is a measure of independence and agency in socialising in online communication that is not present in face-to-face communication or face-to-face learning contexts. In face-to-face classrooms, friends often sit together or perhaps friendships form over time and students cluster together. A student might feel left out if s/he is not part of such a group. In an online classroom, however, clusters or friends are not so readily visible. Individual classmates may email each other privately to form friendships – or choose not to form friendships – without the social pressure of fitting in. The very nature of online education that can be isolating and disengaging to some (Hun Lim, Morris, & Kupritz, 2007) can also be liberating to others who do not perform well in face-to-face socialising.
In sum, there are at least four distinct ways in which online communication is different from face-to-face communication: it is, to an extent, an equalising medium (socially egalitarian), it relies heavily on written communication rather than nonverbal (verbal/written proficiency), it does not necessitate refined conversation turn-taking skills (time for reasoned response), and it alleviates social pressure of fitting in (social agency). These distinctions are also relevant in online learning contexts, especially those in which online interactions and communications feature as core learning activities.

Having identified some unique aspects of communicating online, it is also necessary to identify some of the unique skills required in online communication. Apart from the necessity of being proficient in the use of relevant technology, online communication typically favours those who are articulate in written-communication. Further, frequency of communication is also associated with likeability and overall sense of community (Dawson, 2006). Hence those who are habitually connected to online technologies have an edge over those who ‘log on’ only at certain pre-scheduled times. The written communicator must also engage with the art of expressing emotions that are usually expressed through nonverbal cues in face-to-face communication.

Sherblom, Withers, and Leonard (2013) identify four influences on the likelihood of students’ participation in online discussions. These influences reiterate previously observed uniqueness of online communication. First, students need knowledge of how to participate in CMC, particularly developing familiarity with the peculiarities of this medium. Secondly, students need skills in CMC strategies. Just as face-to-face communication requires certain skills, so does CMC. Thirdly, students need to overcome CMC apprehension. The authors note that this does not necessarily have to do with fear of technology, but rather communicating in an unfamiliar context (i.e., participating in a ‘classroom’ discussion is different from texting a friend) using a different medium. Fourthly, students are influenced by motivation (or lack thereof) to engage in online discussions. The authors observe that if lecturers are familiar with these four influences, then they can implement deliberate strategies to encourage students to engage in meaningful online communication and interaction.

Optimising students’ experiences of online learning should therefore take advantage of the uniqueness presented by this mode of communication. In the next section we present some findings from previous research in cultivating communities online, and explore how these findings may be optimised in practice, in relation to the four distinct ways in which communicating online is different from face-to-face communication.

5. Social Dynamics in Online Learning

Prior research in online learning has identified several findings that are salient to the present discussion. Many of these previous studies, however, are based on the premise of replicating the types of learning communities in face-to-face classrooms, to enable online students and faculty to participate in the benefits of such communities. Based on our premise that the richness of face-to-face communities cannot be replicated online but that online learning provides unique opportunities absent in face-to-face learning, we now review the findings of previous studies with the goal of delineating these in light of our premise. The discussion is structured around the four ways in which online communication is different from face-to-face communication.

6. Socially egalitarian

We noted that online communication facilitates a measure of egalitarianism because of the lack of immediate access to physical and other socio-economic markers that inevitably influence social perception in face-to-face communication. One of the known instruments in online community research is Rovai’s (2002) Classroom Community Scale (CCS) which consists of two sub-scales, namely “connectedness” and “learning.” Connectedness taps into feelings of belonging, shared values, emotional and intellectual connection. The learning dimension identifies the unique aspect of a classroom as a community formed by the common goal of learning, including incorporating the interactions of both faculty staff and students. Connectedness or sense of belonging is a demonstrably significant part of having a sense of community. However, in face-to-face interactions, often there is an initial phase of introductions and getting to know one another, during which those who are perceived as attractive and/or socially competent have an advantage over others. Kraus (2006) proposes that:
People do not simply choose affiliations; they have to negotiate them with others and are positioned within them by others. Their distance to some collective identities or their closeness to others must be expressed by them – and affirmed or rejected by present others. This does not entail the individuals not disposing of concepts of belonging which are available in a specific situation, but rather that belonging must be negotiated, tested, confirmed, rejected or qualified again and again and not simply shown. (p. 109)

This implies that the formation of one’s sense of belonging to a community is a process in which others actively participate. In online communication, students have the opportunity to start on somewhat equal footing in this process of connecting without being disadvantaged by factors that may debilitate them in face-to-face communication. McInerney and Roberts (2004) suggest that the lack of belonging experienced by some online learners in the form of isolation has the potential to be the difference between success and failure for many students. Similarly, faculty feelings of isolation impact on the performance of faculty staff (Dolan, 2011). If lecturers are cognizant that online communication could be a socially egalitarian platform, they could facilitate the maximisation of this advantage. For example, lecturers could encourage students to engage in an introductory exercise in which each student posts a profile picture that is the view outside their window rather than of themselves. This way, students could communicate about an interesting fact about one another before knowing what the other person looks like.

7. Verbal/written proficiency

We observed that nonverbal codes play an extremely limited role in online communication. It follows that students rely almost entirely on their written and occasional verbal proficiency to communicate. This could be liberating to students or teaching staff whose written proficiency far outweighs relational and nonverbal proficiency. While many lecturers have successfully used live video chats and similar forms of communication to replicate face-to-face communication as closely as possible (Ball & Leppington, 2013), we propose that the absence of nonverbal codes does not necessarily have to be seen as a disadvantage in online learning. This is an opportunity for lecturers to provide clear and instructive guidelines for ‘written’ decorum in forum communication, for example, and facilitate the active participation of those students who may have been awkward in a face-to-face classroom. Dawson (2006) notes that increased opportunities for online student interactions increase the sense of community amongst them. While these interactions may include live video chats, the lecturer still has greater opportunity to moderate the discussions and involve students in a way that is not always possible in face-to-face classrooms where shy students self-select out of an active discussion and may feel further embarrassed if called upon. The immediacy of being ‘in public’ is diminished online – thus arguably less challenging for shy students.

8. Time for reasoned response

One of the dynamics in live interactions is the participants’ ability to ‘jump into’ a conversation and voice their opinions. Some do this better than others. Active participation in a face-to-face group discussion necessitates confidence, assertiveness, and a reasonable command of the language. Even in dyadic conversations, the timing of communication is such that when a question is asked, one is expected to respond within a very short amount of time (typically under a minute) to keep the conversation flowing. This dynamic does not always lend itself to reasoned responses or responses that are preceded by extended reflection. Further, in-class group discussions often tend to be dominated by a few vocal students (unless appropriately moderated by the lecturer) and exclude others. Students with an accent or with limited language skills, for example, may be shy to voice their opinions in a group. There is evidence to suggest that even amongst students who are fluent in English, some international students are uncomfortable diving into a group discussion due to cultural norms of conversation-taking or politeness (Arasaratnam, 2002).

Asynchronous online forums allow for students to present reasoned responses without the social pressures that are prevalent in face-to-face communication. Additionally, written communication eliminates accents and allows participants to express ideas without being inhibited by differences in speech. Students do not have to feel that they are interrupting someone, when expressing an opinion. The time available for reasoned responses in online forums has the potential to encourage in-depth discussions informed by periods of individual reflection that may not always be possible within the time constraints of a face-to-face session.
Lecturers too have the ability to provide reasoned responses to questions, unlike having to ‘think on their feet’ in a face-to-face classroom. Additionally, lecturers can be deliberate in providing feedback for most if not all comments in a forum discussion if they choose, unlike in a face-to-face discussion. Limon and Boster (2003) demonstrate that positive performance feedback increases group members’ perception of cohesion and belonging. Taking this to the classroom level, this could be in the form of feedback from the lecturer to student groups in regards to their assigned group tasks or collective forum participation. Although, just as in face-to-face learning contexts, lecturers who dominate online communication can reduce the amount of interaction or, at least, students’ willingness or motivation to interact (Salmon, 2013).

9. Social agency

We observed earlier that online interactions present the opportunity for learners to choose their friends (and have the option of being chosen as a friend) without the pressures of infiltrating pre-existing clusters of friends that are often present in face-to-face settings. Students can choose to target certain classmates with whom they want to communicate further via email based on shared ideas, without the hesitancy of holding back just because they are always surrounded by the popular students, for example. Research shows that students studying by distance perceive that their sense of connection with their fellow learners impacts the quality of their learning, especially in terms of how a social identity is formed (Crampton & Ragusa, 2015). Online communication lends a measure of freedom in the types of people with whom a student can connect. Schrader (2015) articulates this as follows:

...with technology, the classroom is broader and participation more equalized. The moral implication of participation amongst equals are more likely to be achieved via computer and technology mediated social networking. Each person has equal access (if possessing the technology) to participation. Technology potentiates active diverse communities of learners who may be judged more on the content of their contributions than on the color of their skin, socioeconomic status, or other feature (p. 29).

With this freedom, however, students need guidance in forming online relationships. Walther and Bunz (2005) identify six rules to facilitate trust, liking, and performance in virtual groups. First, they suggest that members of the group should start communicating with each other straight away, soon after joining the particular group. Secondly, members should communicate frequently with each other. Third, in a group project where tasks need to be completed, the authors propose that members should multi-task the functions of organising and executing the tasks (instead of first organising what needs to be done, then allocating tasks, and then executing the tasks). Fourth, members of the group should explicitly acknowledge that they have read other members’ posts on a forum or other online communication medium. Unlike in face-to-face environments where acknowledgement of messages can be given nonverbally and contextually, the online environment necessitates more intentional communication in written forums to ensure that the lack of a textual response to an online message is not interpreted as a lack of acknowledgement of the communication. Fifth, and related to the previous point, members of the group should specify how they are responding to another person’s message. The authors observe that, unlike in a face-to-face environment where silence can be interpreted within the context of nonverbal cues, in an online environment a non-response may be difficult to interpret. Finally the authors suggest that online groups should set deadlines for relevant tasks and faithfully adhere to them, as a way of building trust between group members. If, for example, a task is to complete a group project as part of an assessment, then agreeing on deadlines for each member to accomplish minor tasks that lead up to the completion of the project (and adhering to them) would serve to build trustworthiness and help the group members rely on one another.

10. Conclusion and Next Steps

McLuhan (2005) once observed that the medium is the message. Communication is indelibly influenced by the medium through which it happens. Online learning is a unique experience, no doubt shaped by the medium through which the teaching and interactions are shared. To understand “community” in an online learning environment, one must heed McLuhan’s words and understand the nature of this different medium through which communication happens. It is neither practical nor logical to replicate strategies for fostering community in face-to-face classrooms, in an online learning environment. The unique medium necessitates unique strategies. Identifying the specific ways in which the uniqueness of online communication provides certain advantages, is a step toward identifying the strategies that could be used to cultivate community in online
there may be opportunities for redefining the term “face-to-face” to encompass online learning contexts (with the assistance of video conferencing facilities in which teachers and students can see each other) and for this term not to be solely applied to physical learning contexts. Online course environments do not simply offer an opportunity for face-to-face learning activities to be transferred, converted or replicated in an online context, as has been documented by many researchers (Ball & Leppington, 2013; Davis, 2001; Ko & Rossen, 2004). Rather we espouse that the online learning context is unique and not necessarily the ‘poor cousin’ of on-campus learning that continually requires defence and justification. In fact, in some cases it may be a viable alternative to, and improvement on or replacement for face-to-face learning.

While this paper has briefly explored some of these strategies, an empirical study is needed in which students’ sense of community in an online course is measured before and after the implementation of intervening strategies. A pre-test/post-test model to survey students’ sense of community in an online setting prior to and after the implementation of one or two specific community-cultivating strategies would provide us with valuable information toward implementing initiatives that provide online students with the rich experience of community – strategies that do not necessarily involve the replication of face-to-face methods. Findings from such studies may provide evidence to support or refute the ways in which online learning communities afford different or similar benefits from physical, face-to-face learning communities. We hope that this paper will serve as a stimulus for such studies.

References


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