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Editorial – Volume 20, Issue 1

Rory McGreal
Co-Editor

Welcome to this first edition of IRRODL for 2019. I would like to wish all of our readers and their families a very happy, thought-filled and prosperous year. This year IRRODL brings significant changes as our co-Editor of many years, Dianne Conrad, has resigned. She will be missed. Her efforts have been instrumental in turning IRRODL into a leading journal in the open and distributed learning field. We would like to thank Dianne for her leadership and wish her all the best in her retirement.

In the meantime, we have been fortunate to procure the services of an excellent academic and distance educator Dr. Dietmar Kennepohl as interim Co-Editor. Dr. Kennepohl is a professor of Chemistry and former Associate Vice President Academic at Athabasca University. Nearly all of his teaching experience has been in a distributed and online setting and for this, he holds both university and national distance teaching awards. As a chemistry teacher he has a long history of both developing and delivering lab kits, virtual labs, and in other ways meeting the challenges of science "at a distance." Dr. Kennepohl is also a well-published and sought-after presenter at local, national, and international conferences, on relevant topics including learning design, learning outcomes, assessment, PLAR, transfer credit, distance and online education, and emerging educational technologies. His co-edited open access book, *Accessible Elements: Teaching Science Online and at a Distance* was winner of the Charles A. Wedemeyer Award. His latest book, *Teaching Science Online: Practical Guidance for Effective Instruction and Lab Work* (2016) is part of the distance education series edited by Michael G. Moore. I am confident that with his participation and the continuing efforts of our experienced IRRODL Manager, Serena Henderson, that IRRODL will continue to be an effective instrument for publishing open and distributed learning research in the coming year.

I would also like to thank all our Editorial Board members for their continuing support. Unfortunately, we lost a board member and leading figure in open education with the passing away of Professor and former Rector Magnificus of the Open University of the Netherlands, Fred Mulder. His passing represents a major loss to the open education community and to our journal.

I would also like to welcome several new members to the IRRODL advisory board. These include a truly international group: Professor Marti Cleveland-Innis is local from Athabasca University and also a guest professor at the Royal Institute of Technology in Sweden; Dr. Catherine Cronin from the National Forum for the Enhancement of Teaching and Learning in Higher Education is from Ireland; Dr. Laura Czerniewicz is Director of the Centre for Innovation and Learning at the University of Cape Town; Dr. Fengliang Li is at the Institute of Education at Tsinghua University, China;distinguished Professor

Charlotte "Lani" Gunawardena is a participant in the Organization, Information and Learning Sciences (OILS) program at the University of New Mexico, USA; Professor Sana Harbi is Dean of the Higher Institute of Finance and Taxation at the Université de Sousse in Tunisia; Professor Paul Prinsloo is at the University of South Africa (UNISA); and Professor Katherine Wimpenny is at the Centre for Global Learning, Education and Attainment at Coventry University, UK.

Another "thank you" goes out to all of our +500 reviewers from 2018. Due to their efforts and diligence, we were able to publish 80 articles in 2018. A list of 2018 reviewers is available here.

Starting this year, IRRODL shall no longer be accepting submissions describing teaching interventions or surveys on pedagogical approaches that make no reference to student achievement, performance, or retention. An educator is a person, who helps others to acquire knowledge, competences, outcomes, skills, or values. If there is no evidence that such learning acquisition takes place, there is no proof of the educational value of the intervention. Pedagogical research in education must demonstrate that students actually learn something, or not. Negative results that show that a particular intervention resulted in "no achievement" can also be important. Studies on student engagement, attitudes, and satisfaction are only useful for educators insofar as they promote real learning (or not). This is not to argue that the focus of the research must always be on student outcomes, competences, achievement, etc., but rather to suggest that if an investigation into teaching/learning has another focus, there should also be some reference to whether or not learning took place. If there is evidence of actual learning by students (or student retention for example), then research on affective variables such as student engagement, empathy, attitudes, satisfaction, etc. can shed light on these educational fundamentals. What does it matter if a study examines Moore's "transactional distance" or Garrison's "community of inquiry" or constructivism or connectivism or student attitudes, etc., if the research does not also demonstrate that students actually learned something (or not)? These approaches or methodologies can be shown to be useful for educators insofar as they promote real learning. Without any evidence of learning, however, the research is not relevant to a journal about learning.

A study may show that the students and the teacher were all happy with the experience and the students may believe that they have learned something (Kirkpatricks level 1), but without any mention (in whatever form) of actual achievement, the approach/methodology, or the perception of students/teachers is of little, if any, value. However, when combined with data on student achievement/mastery (or not), this research can become important and worthy of attention.

I am beginning to believe that this surfeit of research that ignores actual learning can be traced to the ubiquitous dissemination of support for "learner-centredness." This view places most, if not all, of the educational emphasis on the learner rather than on a focus on learning. This extreme focus on the "learner" has resulted in many researchers all too often ignoring "learning," to the point where entire research interventions do not even mention it. For example, in the pedagogy associated with student satisfaction or teacher caring -- Is empathy always believing the learner? Isn't knowing when you are being played by the student also empathy? Couldn't student achievement be affected positively or negatively independent of student satisfaction? As another example, learning communities may increase interactivity, but does the interaction have an effect, either positive or negative, on student achievement? If it does have a positive effect, then how can we improve learning through more or better quality interactions? If there is no positive effect on achievement, we may ask ourselves, why are we doing this? Are there other factors that do increase learning that should be focused on?

Can we become more "learning-centred" where instructors and researchers take a systemic approach, not ignoring the learner, but also possibly (depending on the research focus) including the teacher, the technology, the administration, the learning environment, and even the society – and most importantly the acquisition of learning? Evidence of learning can take many forms; it need not be confined to objective tests or course grades. Performance and skills assessment can be used. Can the learner perform a specified task or tasks? Are learners confident and skilled enough to develop and test a solution to a real problem? Are there identified quality improvements in the skills? Has the learner adopted scientific attitudes? Given a problem, can the student employ critical thinking skills to achieve a resolution?

To be clear, this insistence on reference to student achievement only refers to articles on student interventions and does not include papers that are based on non-pedagogical issues. Other open and distributed education articles (e.g., OER, administration, leadership, retention, etc.) will continue to be considered for review.

After this rather long preamble, I would like to provide a short introduction to this 2019 first edition, which begins with a research analysis, followed by articles on a DE physics lab and a virtual agent. Mid-career adults and health professionals are the subject of the next two articles, while high school parents' engagement is examined in the next one. Learning achievement and performance is the focus of the following articles. Texts, OER, and MOOCs round out this issue ending with a report on personalisation and learning analytics. Finally, Research Notes complete this issue with reports on OER in the small island state of Tonga and training in Greece.

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An Analysis of the Journey of Open and Distance Education: Major Concepts and Cutoff Points in Research Trends

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Abstract

In an effort to understand trends in open and distance education more comprehensively, this study aims to identify the research trends, major concepts, and cutoff points in the articles published between 2009 and 2016. From five major peer-reviewed journals, a total of 989 articles were analyzed through a systematic literature review process using content analysis. The articles were coded based on the following three categories: level, topics, and sub-topics. The results indicated the followings: (1) emerged main themes in the articles were foundations of open and distance education, instructional process, and effects of applications; (2) there was an upward growth in the publishing of the articles on massive open online courses, open educational resources, and students' perspectives; (3) new pedagogical approaches and online learning design played a triggering role in the research topics; and (4) technological and pedagogical developments between 2011 and 2012 had an influence on the tendency of the articles. In addition, we explored cutoff points so that they may provide insights and valuable hints for researchers to design new studies in open and distance education field. Discussions about the gaps in the state-of-the-art trends and directions about future research were also included.

Keywords: open and distance education, review study, research trends, content analysis

Introduction

Systematic review studies and content analysis can provide researchers with a guideline: shed light on further research and encourage initiatives by synthesizing papers in any field. As a roadmap, these studies provide insightful knowledge about research trends and important topics in the field (Shih, Feng, & Tsai, 2008). They provide an opportunity to follow up a clear research direction for researchers. Since the field of open and distance education (DE) is a growing area, review studies in this field can help to understand trends and research topics. Considering media, platforms, and pedagogical models, systematic reviews in open and DE field are increasing. However, there are still a few review studies that focus on the topic trends, cutoff points, and gaps in open and distance learning research. In this regard, this study aims to review current topic trends and explore potential research directions in the field. In doing so, it is hoped that the study will contribute to a deeper understanding of advancement in the field of open and distance learning by providing valuable suggestions for future research and practice.

Open and Distance Learning

As a kind of governmental and official learning, open and distance learning takes place in diverse contexts through major educational elements by linking pupils, supplies, and teachers to one another via various communication media (Moore, Dickson-Deane, & Galyen, 2011; Simonson, Smaldino, Albright, & Zvacek, 2011). Keegan (1996) defined open and distance learning as an umbrella for online learning, internet-based learning, e-learning, and so on. In the definition, interactive communication technologies, which form the learning environment, are the focal point. In this sense, with the rapid developments in technology from postal service to a broad internet network, people have encountered different forms of open and DE over the years. For the last three decades, a dramatic shift has occurred in the open and distance learning field. Open learning, e-learning, online learning, web-based learning, internet-based learning, and distance learning have often been studied and reviewed in the context of open and DE for years (Lowenthal & Wilson, 2010).

Previous research studies investigated the state of the research in the field and the rise and fall of the paradigms from the diverse viewpoints. Review studies fall behind the changes in this fast changing field (Petticrew & Roberts, 2008); therefore, this systematic review study analyzed various studies in primary journals to outline the situation of open and DE. In line with this aim, we analyzed the previous review studies first. For instance, Lee (2017) noted the remarkable developments including new technologies or new ways of using technology in the past 20 years.

A Quick Look at the Field Over the Past 30 Years

There have been major developments in the field of open and DE over the past 30 years. Figure 1 provides an at-a-glance view of these developments beginning in the 1990s.

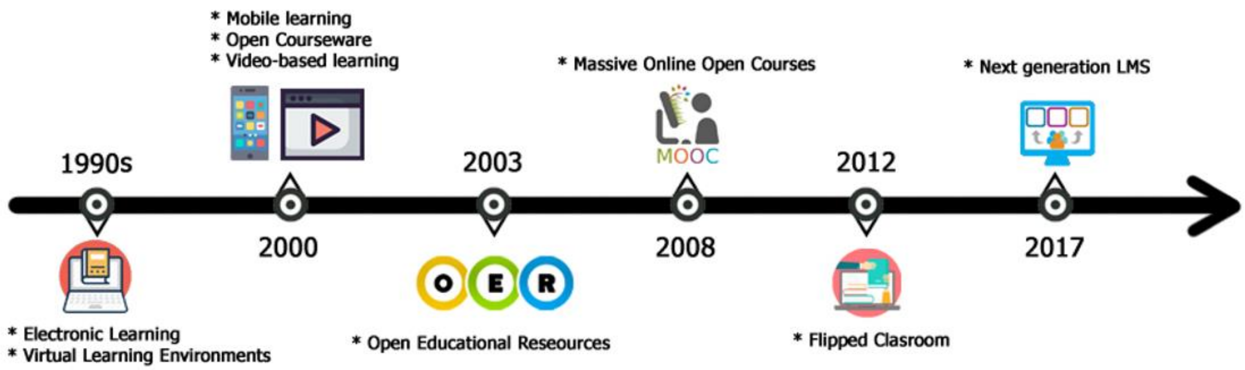

Figure 1. The emergence of computer and internet technologies.

Figure 1 begins with the emergence of computer and internet technologies in the 1990s. After that, the spread of computer and internet technologies led to a number of transformations in the field of open and DE. Following this spread, the concept of e-learning, which is supported by electronic hardware and software as a synchronous and asynchronous tool, emerged. With the development of Web 2.0 technologies in 2004, users gained the ability to use online content to produce their own content. In particular, with the introduction of synchronous technologies (e.g., chat rooms, instant messaging, and video conferencing) at the basic level, human feel or real-life experience was added to the online experience of DE. Considering the fact that technology brings about high learning effectiveness, quality of interaction, and more learner-centered approaches in education (Bates, 1997), these developments in Figure 1 can be considered valuable in creating learner-centric environments for open and DE.

After the early 2000s, with the emergence of mobile technology, m-learning developed in education, which provides learners with more flexible, independent, and individualized learning opportunities enabling them to learn independent of time and place. This flexibility has led to a significant turnaround for learners and instructors. In addition, a significant increase in research on video-based learning, especially after 2007, attracted attention for a while in open and DE applications (Giannakos, 2013). In this period, Massachusetts Institute of Technology (MIT) introduced the "OpenCourseWare model" to the field of open and distance education by opening up approximately 2000 of their courses online (Atkins, Brown, & Hammond, 2007). The idea of openness gained a different dimension in 2003 when the Open Educational Resources (OER) movement emerged. In line with these developments, a large demand for online learning brought important issues to light regarding student support and access to educational resources for open and distance learners. For this reason, the emergence of OER in 2008 have allowed researchers to implement distance practices in a different way by accessing them.

In order to meet the needs of online learners and instructors easily, the institutions have begun to use Learning Management Systems (LMS). LMSs were introduced as integrated systems that enable managing instructional materials, monitoring both learners and teachers, and individualize instructional processes. At the beginning, LMSs were only capable of presenting the course content in the form of basic presentations, but with the advances in learning technologies, LMSs have been transformed into their new forms. In recent years, a new kind of LMS, called *next-generation LMSs,* has provided new services for administrating content, learners, and interactions (Adams Becker et al., 2017). This may be considered as a paradigm shift in the field of open and distance learning. Next-generation LMSs suggest flexible configurations and a more personalized and formative evaluation structure.

Additionally, it was the first time that video-based instruction had been implemented throughout a course. For example, the chemistry teachers Jon Bergmann and Aaron Sams, ensured that the students who missed the class were able to access all issues discussed in the class by using videos (Tucker, 2012). Following this development, researchers have started to evaluate the effect of both technological and pedagogical dimensions of online learning on learning outcomes. Researchers still keep studying to explore new ways to design and utilize open and online courses in a distributed learning environment.

Review Studies on Open and Distance Education Field

Looking through various lenses, some review studies put forth developments in the field of open and DE. For instance, one review study including the studies in DE from 1990 to 1999 pointed out that the research studies are dominated by the design issues, learner demographics, active learning strategies and interactions. So there is a need for focusing other issues about DE (Berge & Mrozowski, 2001). Researchers analyzed studies based on Sherry's (1996) categorization system that constructed 10 research issues as follows: 1) redefining the roles of key participants; 2) technology selection and adoption; 3) design issues; 4) strategies to increase interactivity and active learning; 5) learner characteristics; 6) learner support; 7) operational issues; 8) policy and management issues; 9) equity and accessibility; and 10) cost/benefit trade-offs. They concluded that most of the studies in the field of DE focused on the impact of individual technologies (Berge & Mrozowski, 2001). In a recent study, Zawacki-Richter, Alturki, and Aldraiweesh (2017) categorized research issues into 15 research areas within three main levels: 1) *macro level* (DE systems and theories), 2) *meso level* (management, organization, and technology), and 3) *micro level* (teaching and learning in DE). Based on their findings, they explored three periods relevant to research areas for the last 15 years: 1) online learning and DE institutions (2000-2005), 2) widening access to education and online learning support (2006-2010), and 3) the emergence of MOOCs and OER (2011-2015).

Although various perspectives guided the review studies, the characteristics of publications provided a key role in the effect of these reviews. In addition, the journals taken into account in the reviews were another factor in making these reviews considerable. In this light, a continuous supply-demand cycle between the researchers, the practitioners, and the organizers remains dynamic considering the rapid changes of distance learning technologies and practices.

Need for Study

As an evolving interdisciplinary field, the DE field is attempting to conform to steady changes in technology and pedagogy. As educational change is inevitable and pertinent, we are endeavoring to discover and organize the most appropriate method for open learning and DE in the current learning environment. With the growing demands of instructors and learners, it is imperative to grasp trends and concerns of DE to keep up with these developments. As an evolving interdisciplinary field, DE is trying to conform to these steady changes. Accordingly, this study may pave the way to perceive and clarify recent DE dynamics through academic reports by supplying an inclusive silent evidence list in this field (Hodder, 1994). By making the research trends visible, research gaps can be located and future research can be planned to enable the shift. Understanding this shift may help instructional designers, instructors, or policymakers for short and medium term planning in this area.

Problem

This review study analyzes the research and educational implementation trends in DE. In the context of five major open and DE journals, we focused on the main research topics in publications and examined how the manuscript's scope or coverage changed between 2009 and 2016. In order to address the most common research areas and to determine the potential gaps in DE research, the following questions were formulated:

1. What are the trends in research topics of distance learning research articles published from 2009 to 2016?

2. What are the major concepts and cutoff points in the research articles reflecting the development of DE?

By answering the research questions, this paper will make a contribution to the description of the field of DE through organization, designing, implementing, and evaluating.

Method

In order to ensure a systematic review process, we conducted a content analysis by following steps suggested by Cooper (2010) and Oliver (2014). First, we formulated the research problems, then we defined the criteria for searching the literature and a strategy for extracting necessary information from studies, analyzed the findings, interpreted the evidence, and at the end, we reported the findings. Content analysis was implemented because editing, classification, comparison of texts, and gathering theoretical results from texts were performed through content analysis (Cohen, Manion, & Morrison, 2007). Content analysis presents important structures for the types, qualities, and distinguishing features in text structures by numerical definitions, providing a bridge between numerical formatting and qualitative analysis (Bauer, 2003). In addition, in this research, similar data were transformed into an interpretable form by combining them in a systematic way with specific concepts and themes through content analysis.

Sample

The research sampled articles published between 2009 and 2016 to reveal research trends in DE emerging from scholarly publishing in five popular journals: American Journal of Distance Education, Distance Education, European Journal of Open, Distance and E-Learning, The International Review of Research in Open and Distributed Learning, and Open Learning: The Journal of Open, Distance and e-Learning. The following criteria were taken into consideration in the selection of the relevant journals:

- To focus only on open and DE publications,

- To be in the status of an internationally recognized journal that is searched by leading databases in the field of education (SSCI, ERIC, DOAJ, EBSCO), and

- To have at least 10 years of publication history.

Some other studies have also been published in other key journals about educational technologies. However in this study, the journals directly having the scope of open and distance learning have been particularly selected to reveal the changes in the topics of DE. For instance, IRRODL, one of the major journals in DE area, publishes articles including both theoretical and practical issues of DE through various perspectives. The year 2009 was taken as a cutoff point because previous review studies were considerably available up to this time. On the other hand, Web 2.0 technologies, LMS, and synchronous environments, which developed after 2009, are believed to have radically shifted the structure of DE (Nasiri & Mafakheri, 2015). All research articles (N=989) published in the five selected journals between 2009 and 2015 were reviewed. Figure 2 illustrates the publication dates and journals reviewed.

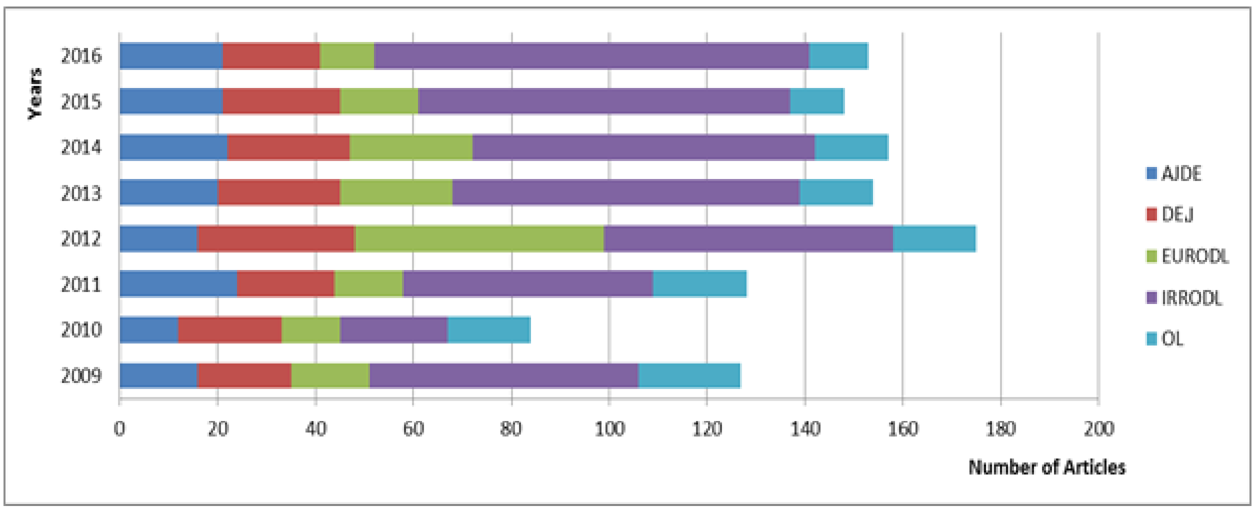

Figure 2. Distribution of the articles by the journals and years.

Process

By developing themes established in the frame of the related literature and the criteria determined by the researchers, the content of the articles in selected journals were coded according to these themes and were reported on using descriptive analysis.

Although many review studies focus on the abstract sections of the studies, the abstracts alone were considered insufficient for the desired analysis in this study. To address this, the authors chose to review titles, keywords, method sections, and full-text manuscripts where deemed appropriate. The articles were analyzed within the framework of the classification scheme developed by the researchers (Figure 3). The algorithm below is followed during this classification.

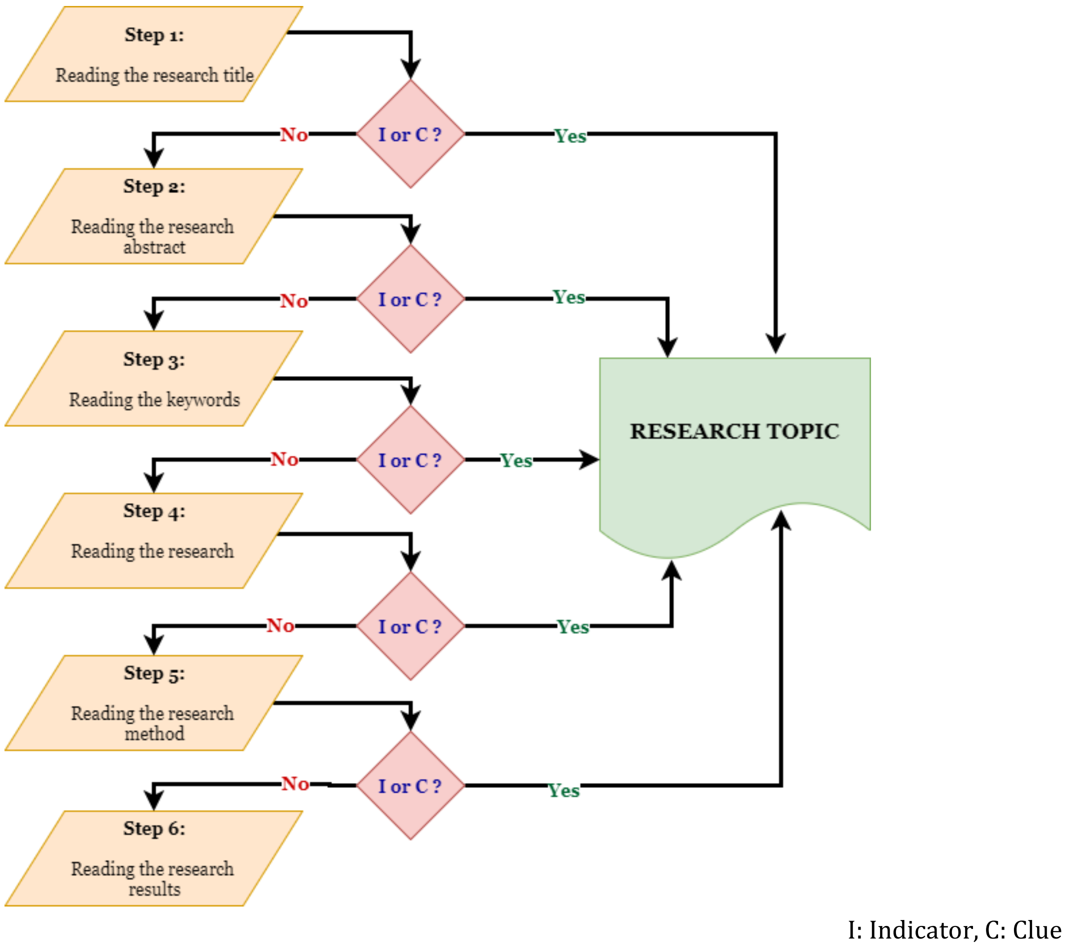

Figure 3. The research topic determining the process.

In the process of analyzing articles, the initial analysis was carried out together with two faculty members who were experts in the field in order to assist the researchers and ensure a correct analysis. In order for the analysis to be carried out in a systematic manner, each researcher reviewed the articles they had examined as shown in Figure 3. In this review process, the research title was read in the first step if any indicator (I) or clue (C) for the predetermined topic in the title was specified. In the case when the researcher could not determine any clue or indicator in the title, the steps shown in the figure were put in process.

The classification of the articles was completed by the researchers in three stages through Google Documents to make it easier to work together. In the first stage, each researcher made the necessary markings on the web-generated table of the data for the articles s/he examined. In the second stage, the researchers made data entries on the tables about the articles they analyzed and these data were then checked by other investigators. In the third stage, an attempt to resolve any differences in opinion was completed through the consultation of expert researchers, providing the internal validity and reliability for the study. When some of the manuscripts addressed more than one topic or reflected more than one major concept, all of the related cells were assigned. The initial inter-rater reliability at the end of the process was calculated as 0.8.

Data Analysis

Two lecturers and three PhD students worked together in the content analysis. The contents of the articles were read and categorized by the researchers as displayed in Table 1.

Table 1

Subject Field Decision Process

Criteria	Sample	Topic
Title	Mobile Usability in Educational Contexts: What have we learnt? (Kukulska-Hulme, 2007)	Mobile Learning
Abstract	"This paper considers electronic interaction between learners and module facilitators and draws on a small study that evaluated the experiences" (Morgan, 2006, p.1).	Interaction
Keywords	Interactive computer learning, virtual schools, online learning, e-learning (Russell, 2006).	Virtual
Introduction	"As UT embarks on this ambitious project, it can draw on many experiences and lessons learned from its history….These lessons are based on earlier experiences with web-based administration and instruction over two decades"(Luschei, Dimyati, & Padmo, 2008, p. 165).	Web Applications
Method	"Higher total scale scores on this scale indicate more positive perceptions toward online course communication and collaboration" (Bernard, Paton, & Lan, 2008, p.4).	Communication & Collaboration
Results	"Finally, most faculty members interviewed were generally satisfied with their work" (Ariadurai & Manohanthan, 2008, p.9).	Instructors Perspectives

Results and Discussion

As demonstrated in previous studies, the results of this study indicate that distance education technologies are expanding at an extremely rapid rate. It is observed that with the development of the DE tools for asynchronous and synchronous communications, learner-centered education approaches are increasingly used in DE. Hence, several technologies are described and explained for "whats" and "hows" of the design and application of DE activities in real time and blended forms. It was observed that a large quantity of explanatory or descriptive studies in the defined period dealt with attitudes, interests, or assessments of experienced colleagues in the field of distance education. It was also seen that quantitative, qualitative, or mixed research designs were conducted in the DE field similar to many other research fields. However, since we are specifically interested in the topic trends, we omitted the methodologies of the studies and all studies were considered at the same value. From a different perspective, we considered the DE development process as a typical research process, which includes theory, implementation, and results. In accordance with this, we searched for the topics in order to define the trends and the cutoff points.

The Trends in Research Topics in Distance Learning

The investigated studies were evaluated according to the main themes in the journals and shown in the graphs according to the numbers included in the topics. The topics that are considered to be closely related to each other in the main themes were colored in the form of sub-themes. In this way, the trends of the main topics in DE studies over the years are outlined in Figure 4.

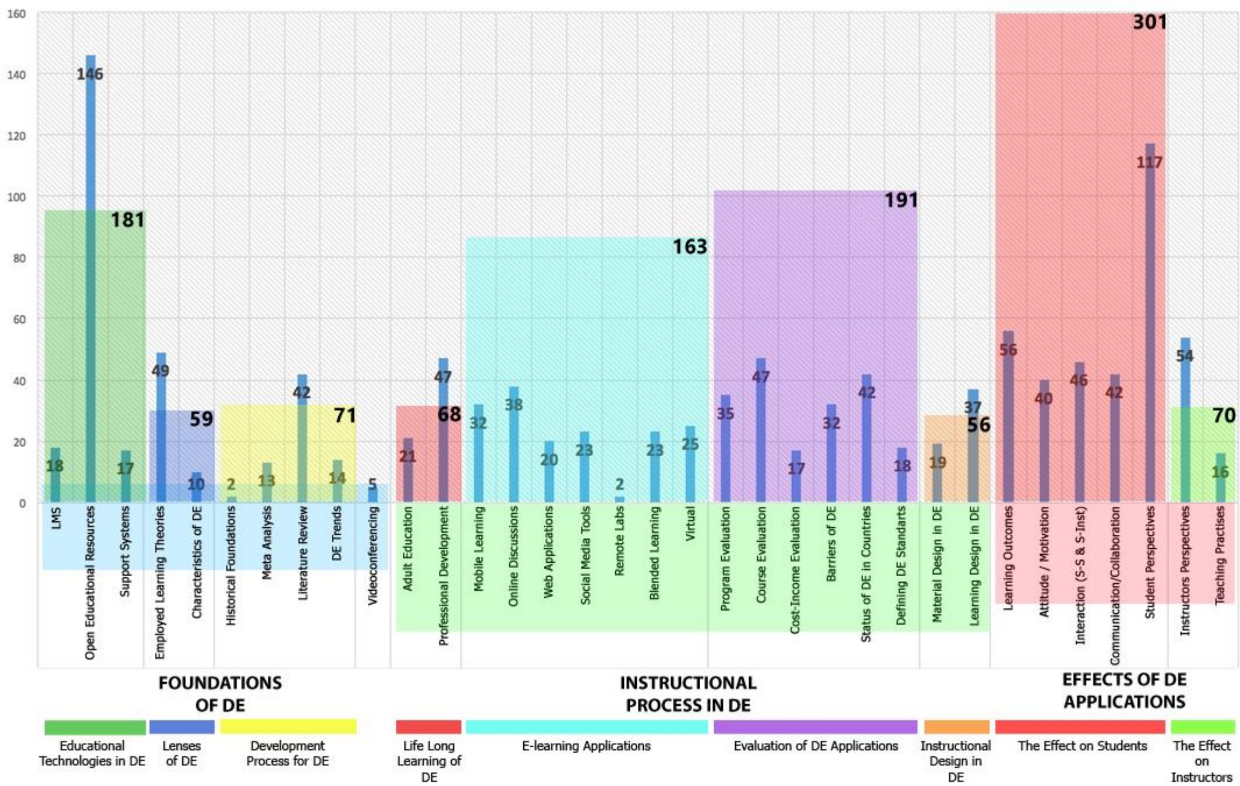

Figure 4. The trends in research topics in distance learning articles published from 2009 to 2016.

Figure 4 indicates that when studies related to the Levels of Foundations of DE between 2009 and 2016 were analyzed, the Open Educational Sources studies were observed to be more prevalent than all other themes (n=146). Similarly, this theme was also identified as open educational resources (OER) in the study conducted by Bozkurt et al. (2015), which determine the research trends in DE studies between 2009 and 2013. In the study, 861 articles were analyzed by keywords and it was determined that OER was the first among 40 most commonly used keywords. Considering that keywords are descriptive in terms of articles, it can be said that the theme of open educational sources is, and remains, one of the trend topics in distance learning. Another notable finding is that more papers related to employed learning theories (n=49) and literature review (n=42) were published after the studies on open educational sources. In another study about the DE trends between 1998 and 2007 (Davies, Howell, & Petrie, 2010), Employed Learning Theories theme was included in the study under the subject of DE theory and a small number of studies were found to have been conducted at that time. However, in recent years, there has been a considerable increase in the research conducted within this theme. Even if the number of articles is relatively low in our review, this result is consistent with the findings reported by other research on distance educational trends published in recent and partly different journals between 2009 and 2013, and 2008 and 2015 (Bozkurt et al., 2015; Bozkurt, Akgün-Özbek, & Zawacki-Richter, 2017). In addition, an emerging and frequently studied field in the macro level under the title of *Theories* and *Models* was identified by these researchers.

In addition, it is noteworthy that the studies on historical foundation and video conferencing between 2009 and 2016 were significantly limited when compared to other studies. This suggests that the development of distance education technologies is used in the application of some technologies (video conferencing) but it is limited in the research area. When the sub-headings of instructional process level in DE between 2009 and 2016 were examined, it was found that articles on professional development (n=47), course evaluation (n=47), and status of distance education in countries are clearly more than other themes. However, it is noteworthy that the topics studied on the instructional process at the DE level are distributed in a balanced manner, and the number of remote labs (n=2) publications seems to be very low. Although it appears possible to reflect different student or teacher experiences, remote labs do not seem to attract much researcher attention. Similarly, in this framework, in a systematic review of online learning environments, Martin, Ahlgrim-Delzell, and Budhrani (2017) suggest that studies discussing online learning environments within countries are increasing and there is a need for research on remote labs.

During the eight-year period, the most frequently studied subjects under the effects of DE applications level were found to be related to the student perspectives (n=117), followed by learning outcomes (n=56), and instructor perspectives (n=54). During this period, the topic of teaching practices (n=16) was found as the least studied topic. Similarly Davies, Howell, and Petrie (2010) pointed out that student perspectives were the most studied topic in DE. In the same study, the instructor perspectives theme was evaluated in the context of faculty issues and it was determined as one of the most frequently searched topic areas.,

Overall, our review found that the main themes were foundations of DE, instructional process, and the effects of DE. The basic frameworks dealing with interactions, communications, people, or organizations such as transactional distance, the community of inquiry, andragogy, or industrialization, are taken into consideration in many of these studies. The number of studies carried out in these areas is close to each other; however, the distribution of them differs according to years. The research status of the identified themes over the years is shown in Figure 5, Figure 6, and Figure 7.

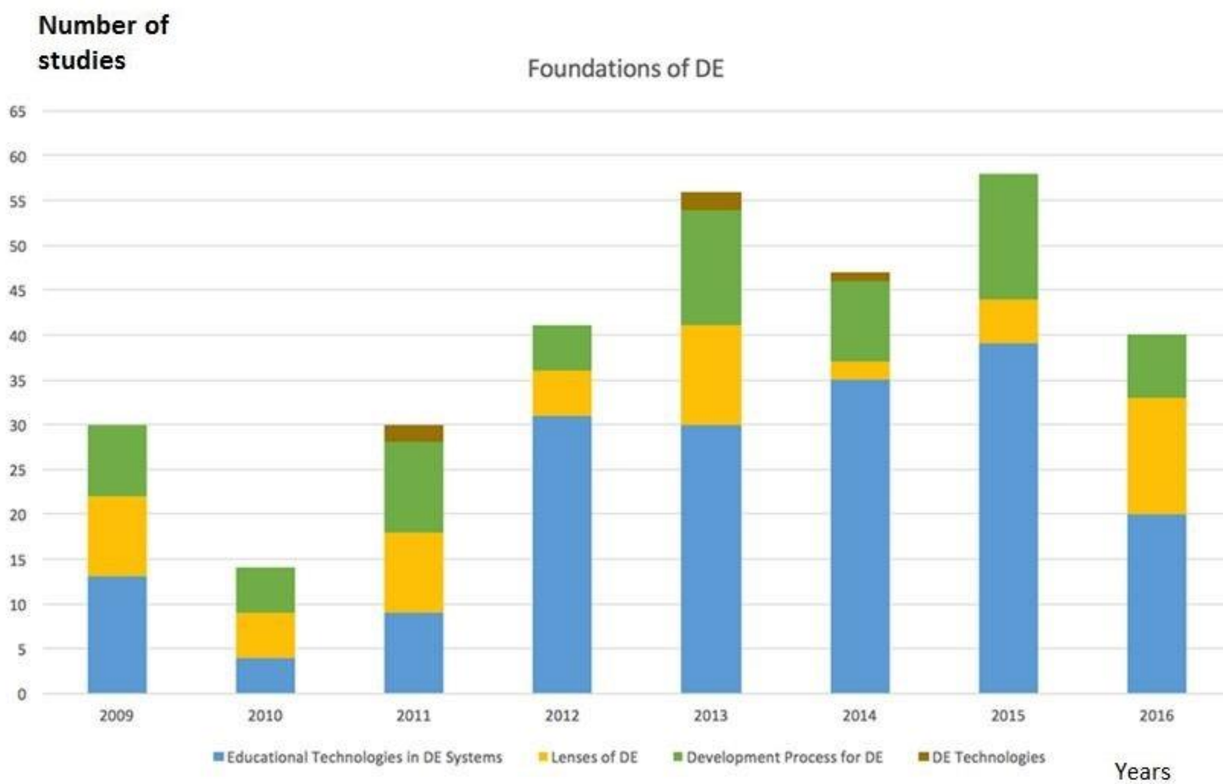

Figure 5. Trends in the main theme of Foundations of DE.

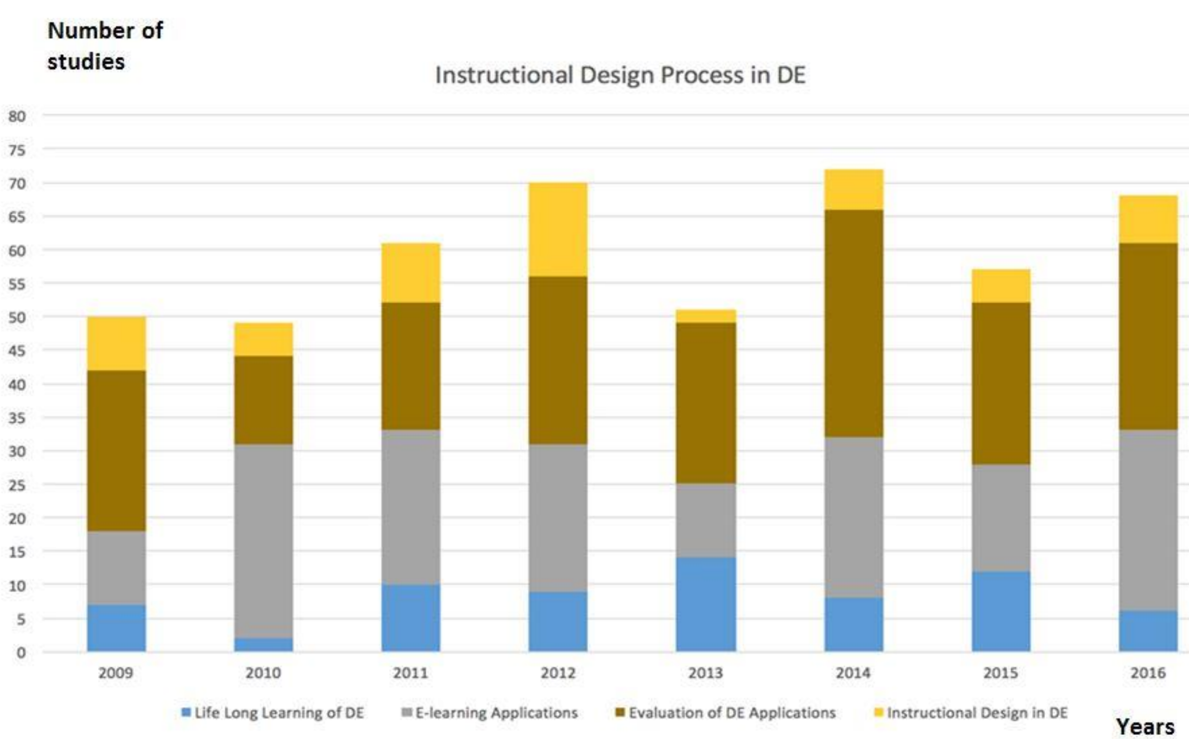

Figure 6. Trends in the main theme of Instructional Design Process in DE.

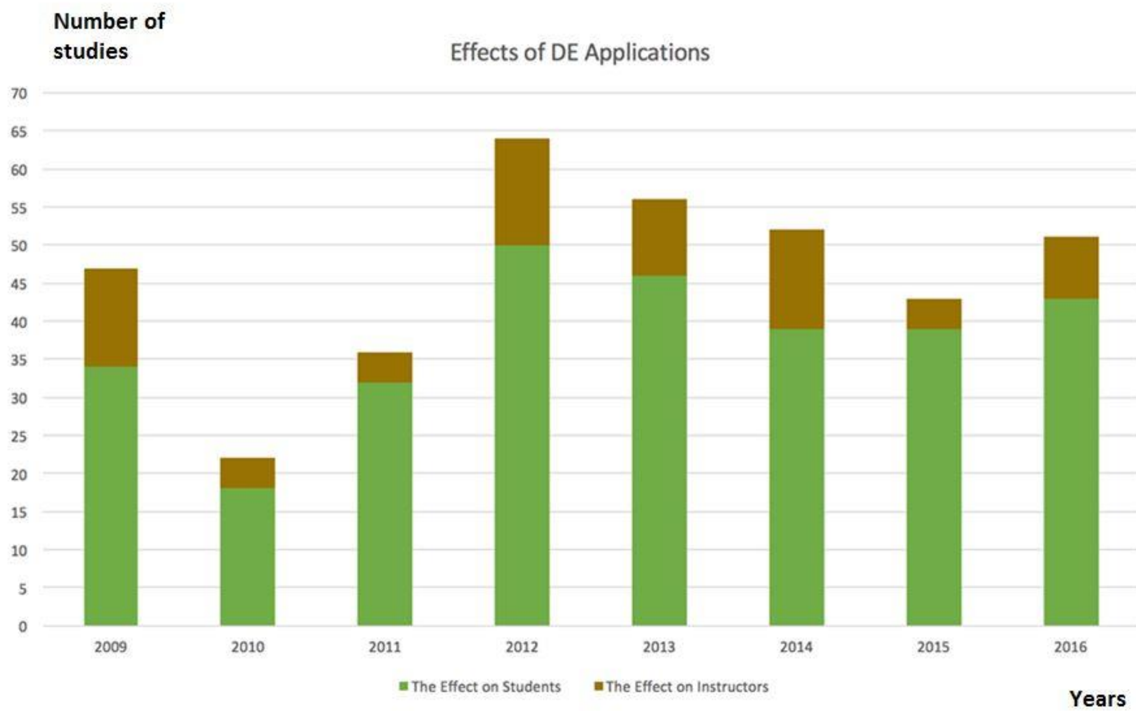

Figure 7. Trends in the main theme of Effects of DE Applications.

As seen in Figure 5, when examining the studies between 2009 and 2016, it was found that the instructional process in DE topic with its sub-topics is the most frequently studied topic (n=478). On the other hand, foundations of DE, together with its topic and sub-topics, are less studied than the other levels (n=316). When the conducted studies were evaluated in the context of topics, the effect of DE on students was determined as the major studied topic (n=301). Surprisingly, DE technologies draw attention as the least studied topic (n=5). On the other hand, open educational sources and student perspectives seem to be prominent studies compared to other sub-topics.

Major Concepts Studied in the Development Process of DE

Considering the sub-themes, we also determined the ratios of the topics in the whole. Hence, Figure 8 shows sub-topics studied extensively.

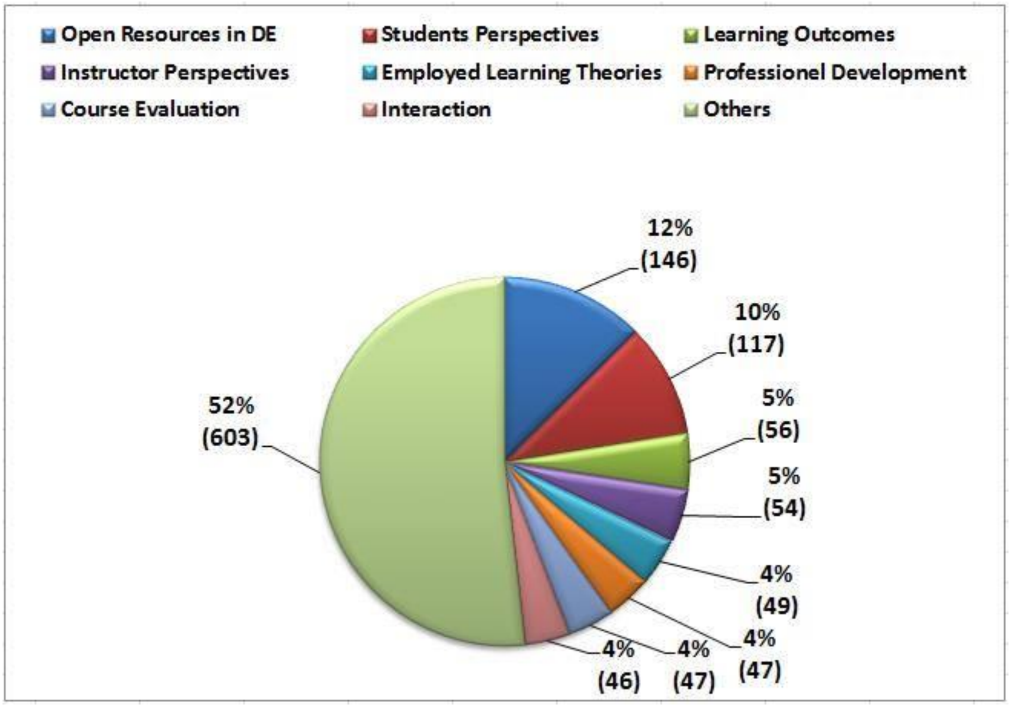

Figure 8. The major concepts studied in the development of DE.

Figure 8 indicates that open source in DE is one of the dominant sub-topics (n=146) followed by student perspectives sub-topic (n=117). It is seen that these two subjects are much more studied in the field of DE than the others between the years of 2009 and 2016. Additionally, interaction (n=46), course evaluation (n=47), and professional development (n=47) are the least studied topics. Similar to the findings of the study, Bozkurt et al. (2015) observed that open educational source keywords were most commonly referred between 2009 and 2013. Similarly, the study of Bozkurt, Keskin, and de Waard (2016) showed that MOOCs increased rapidly after 2012. In addition, Davies et al. (2010) drew attention to the fact that the most frequently studied topic in the theme of DE between 1998 and 2007 was student issues. In this study, this theme is called the students' perspective. Although this study observed only a few studies on interaction, Bozkurt et al. (2015) noted that the number of studies on interaction is high.

Cutoff Points in the Period of 2009-2016

Reviewing the literature on open and DE in terms of the topics can contribute to the understanding of key characteristics that shape the developing trends in open and DE. Therefore, the identification of cutoff points that explain the studies in the field of open and DE has constituted an important part of this study. Zawacki-Richter, Bäcker, and Vogt (2009) examined research trends in DE from 2000 to 2008 and found that studies focused mostly on interaction and communication patterns in computer-mediated communication, instructional design issues, learner characteristics, and educational technology. Although trends are addressed in this study and other studies (Bozkurt et al., 2015; Davies et al., 2010), no definitive evidence has been put forward regarding their evaluations of the transitions to other topics.

When the studies discussed in this review study are taken into consideration based on the topics, it is interesting to note that the number of studies on educational technology in DE systems has a significant increase since 2012 (n=31) than the previous year. The rise of open educational resources with MOOCs, which started to become widespread throughout the world in 2011, can be seen as a source of this increase. In fact, MOOCs first emerged in 2008 with the increase in using open educational resources and practices movement. After 2008, the most commonly known commercial and/or free platforms like Coursera, edX, and Udacity were introduced, with a high interest in MOOCs. Therefore, in this period, widely used MOOCs brought together many open research questions for creating effective MOOCs and understanding the effects of MOOCs (Diver & Martinez, 2015). Moreover, the importance of MOOCs and OER was highlighted with the publishing of special issues. As an example, IRRODL published five special issues on MOOCs and OER from 2011 to 2015. The titles of the special issues which are closely related to higher education are as follows: European perspective on MOOCs (2015); OER, Opening access to knowledge (2013); and, Prior, experiential, and informal learning in the age of information and communication technologies (2011). In this context, focusing on the studies about MOOCs and OER, the study titled as "MOOCs, OERs and interactive learning" summarized the developments in DE for the time period between 2010 and 2014 through an analysis of titles and abstracts of publications in the journal Distance Education (Zawacki-Richter & Naidu, 2016). Similarly, another review study by Zawacki-Richter, Alturki, and Aldraiweesh (2017) was published by considering the articles in the journal of IRRODL about the five-year (2011-2015) emergence of MOOCs and OER period. Moreover, Horizon Report has predicted that open content will play an important role through the same period (Johnson, Laurence, Levine, Smith, & Stone, 2010). In this five year period, one reason for the increasing in the research studies related to MOOCs is drawing attention to OER and open content. As a consequence, the openness idea in these years can be considered as a remarkable change in DE. Hence, the emergence of MOOCs and OER was taken as a cutoff point in the journey of DE.

Studies at the level of the effects of DE applications on learning and teacher-impact-related studies showed a significant increase in 2012 (n=64) compared to 2011. This increase is consistent with the increase in 2012 in other topic studies that continued until 2016. When examining the studies of teachers, which peaked in 2012, the focus was observed to be on learners' characteristics, learner and instructor perspectives, and the relevance of DE applications to learning. This result is in accordance with a recent review study by Zawacki-Richter, Alturki, and Aldraiweesh (2017) indicating that learner characteristics and instructional design were important research areas between 2011 and 2015. On the other hand, our result indicates a shift in the understanding of how to use emerging technologies for open and distance learning around the year 2012. In this case, the widespread use of emerging technologies and advanced platforms has created a significant gap between the potentials of these technologies and how these technologies affect the learning processes pedagogically (Bishop & Elen, 2014; Veletsianos, 2010). In addition to the prevalence of new technologies, how to effectively design learning and instructional processes for effective contributions to a students' learning has been an important question in the development of open and distance learning (Simonson, Smaldino, & Zvacek, 2015). In this context, the triggering role of the pedagogical approaches (flipped classroom, connectivism, self-directed learning) and learning design comes to the forefront. Overall, designing learning environments and evaluating learning performances were the focus points in the year

2012 (Kovanović, Joksimović, Gašević, Siemens, & Hatala, 2015). Therefore, "online learning design and pedagogy" might be regarded as an important topic for 2012.

On the other hand, there is a significant decrease in the studies on the foundations of DE in 2016, yet only a gradual decline of the theoretical studies on DE. One of the reasons for the decrease in the number of these kinds of studies is that the necessary definitions have been previously provided and approved by the researchers and the new DE theories or models are less needed. No publications were published in the journals in 2016 covering the foundations of DE, in the subtopics of the characteristics of DE, historical foundations, and DE trends. At this point, it can be predicted that the issues related to the foundations may decrease in the following years. In 2016, in contrast to foundations, surprisingly, there was an increase in the subtopics of the status of DE in countries and communication/collaboration. These findings indicate that studies about the comparison of DE in different cultures and cultural integration may increase. Also, one can assume that new evaluations about interactions and communications techniques in DE will be addressed more after 2016.

In the topics of e-learning application, it is seen that the number of studies in mobile learning and online discussion subtopics has increased consistently since 2011. One reason for the continuous increase in the research on mobile learning subtopic may reflect the wide application of mobile learning. In addition, another reason for the continuous study of online discussions is the tendency of researchers to evaluate the online environments through constructivist student-centered approaches. Moreover, the course evaluation studies were they continued to be studied between 2009-2016, however, the number of those studies were limited. This may be due to the researchers' emphasis provided on the quality of distance learning applications rather than the comparison of face-to-face and distance learning implementations.

In sum, MOOCs and OER, online learning design and pedagogy topics emerged in 2012, and the topics related to the theoretical perspectives in 2016 may be considered a change from 2009 to 2016.

Conclusion and Recommendations

The results from this systematic review generalize the findings in the main concepts and cutoff points from 2009-2016 to inform distance education researchers, instructors, and administrators in their future online learning efforts. We have critically discussed major trend topics regarding their cutoff points and major concepts related to studies on open and distance education. Despite the limitations, this study contributes to the open and distance education field by focusing on the theoretical and practical approaches in relation to the technological developments and expectations of learners, instructors, and institutions. Considering the findings of this research, the following implications may direct future research. This study presented the most frequently studied research areas such as open educational resources and student perspectives in the field, yet there has not been considerable research on study topics such as distance education technologies, support systems, teaching practices, and pedagogical approaches. Based on our results, we can say that additional research is needed to have a better understanding of the relation between paradigm shifts that occur in open and distance education and how to design and deliver online courses effectively.

Also, future studies could investigate online teaching skills and the effect of distance education on teachers more deeply by considering theoretical and practical changes in the last years. Although it may be considered that they might provide valuable insights into the instructional design for online environments, the number of studies in some topics, such as remote labs and virtual environments, is shockingly low. It is somewhat surprising seeing these topics ignored; therefore, they should be investigated fully to provide improvements in the field. It was seen that in a distance education research, we might use a quantitative, qualitative, or mixed research design as in many other social research fields. As qualitative and quantitative research design has some shortcomings, a more mixed research method may be provided to remove these weaknesses and to fully understand the history and future of MOOCs and open educational resource concepts. Since the distances are not so far away as before, it is seen that distance education technologies may take the role of typical educational systems. Nowadays, this idea is intensely discussed. Thus, maybe in near future, the legality of distance formal education and their standards may be a promising research area. On the other hand, some future research ideas may be based on online learning design and the use of learning analytics to create actionable knowledge that can contribute to pedagogical effectiveness in open and distance education courses. In conclusion, while not all journals could be included in this study, the results from a focused study on topics in specific distance education journals did provide insight for researchers by highlighting common gaps in the field.

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Can a Hands-On Physics Project Lab be Delivered Effectively as a Distance Lab?



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Abstract

In this article, we examine whether an inquiry-based, hands-on physics lab can be delivered effectively as a distance lab. In science and engineering, hands-on distance labs are rare and open-ended project labs in physics have not been reported in the literature. Our introductory physics lab at a large Canadian research university features hands-on experiments that can be performed at home with common materials and online support, as well as a capstone project that serves as the main assessment of the lab. After transitioning the lab from face-to-face instruction to a distance format, we compared the capstone project scores of the two lab formats by conducting an analysis of variance, which showed no significant differences in the overall scores. However, our study revealed two areas that need improvements in instruction, namely data analysis and formulating a clear goal or research question. Focus group interviews showed that students in the distance lab did not perceive the capstone project as authentic science and that they would have preferred a campus lab format. Overall our results suggest that the distance project lab discussed here might be an acceptable substitute for a campus lab and might also be suitable for other distance courses in science.

Keyword: distance education, distance labs, introductory physics, smartphone physics, hands-on experiments, capstone project, project labs

Introduction

There is broad consensus among educators that laboratory experience is an important part of science education (National Science Teachers Association, 2019; American Association of Physics Teachers, 1998); therefore, it stands to reason that distance education programs need to offer science labs that are suitable for distance learners. However, experiments performed in traditional teaching labs are not easy to transfer to the online environment because they often use scientific instruments and other specialized equipment. One obvious solution to this problem is to hold the laboratory portion of an online course on campus, either as weekly or bi-weekly labs or as an intense one-week experience (also known as a power lab), in which students perform all of the labs in a course (Cancilla & Albon, 2008; Lyall & Patti, 2010). However, weekly labs on campus are only practical for students living nearby, and this blended format is typically offered as an alternative to on-campus courses for students looking for more flexibility in their schedule. Power labs are more suitable for distance courses with a significant fraction of students living far from campus, but they may be impractical for many distance students due to travel and lodging costs as well as scheduling (Lyall & Patti, 2010; Brewer, Cinel, Harrison, & Mohr, 2013).

For over two decades now, course designers and researchers have implemented lab formats that distance students can complete at home (Ma & Nickerson, 2006; Brinson, 2015). Labs based on hands-on experiments at home, virtual lab experiments (Pyatt & Sims, 2012; Waldrop, 2013; Rowe, Koban, Davidoff, & Thompson, 2017), computer simulations, video-based experiments (Waldrop, 2013), and remote-controlled experiments (Kennepohl, 2009) have been part of online science courses for some time now, and there is growing evidence that students learn at least as much in these formats as in traditional hands-on, face-to-face teaching labs (Brinson, 2015). Nevertheless, there is still a need for more research that describes and evaluates different formats of distance labs (Kennepohl, 2009).

According to Brinson (2015), there were only 56 comparison studies published from 2005 to 2014 that reported learning outcomes of distance labs and/or compared distance labs to face-to-face teaching labs. The vast majority of the reviewed studies compared quiz or exam grades, while surprisingly small numbers based their comparisons on lab reports or practical lab exams. Moreover, some of the comparison studies had a limited number of participants (Casanova, Civelli, Kimbrough, Heath, & Reeves, 2006, chemistry; Lyall & Patti, 2010, chemistry) and/or examined non-traditional student populations that differed from the more traditional student populations that typically access on-campus (face-to-face) labs (e.g., Reuter, 2009, soil science; Rowe et al., 2017, chemistry). Most of the physics examples in Brinson's review were based on remote experiments or virtual labs, and not on hands-on distance labs, so they are not relevant to our concerns. We refer to a remote experiment as an experiment in which the students conduct an experiment with equipment that is at a different location and only accessible via the internet, whereas a hands-on distance lab is a distance education lab in which the students perform hands-on experiments at home. A virtual lab refers to a computer simulation of an experiment.

As Brinson (2015) did not include hands-on distance labs in his review (to avoid confusion with traditional hands-on face-to-face labs), we will briefly discuss nine relevant studies of such labs. Most of the hands-on distance labs we found in our search of the literature relied on lab kits that students were required to purchase or borrow from their institutions. Examples of physics labs or labs in courses with significant physics content are described by Abbott (1998), Turner and Parisi (2008), Al-Shamali and Connors (2010), and Mawn, Carrico, Charuk, Stote, and Lawrence (2011). In other sciences, examples of distance labs with lab kits are presented by Reuter (2009) for soil science, Lyall and Patti (2010), Brewer et al. (2013), and Rowe et al. (2017) for chemistry, and Hallyburton and Lundsford (2013) for biology. Lab kits have the advantage of being well tested and safe, which is a major concern in chemistry (Lyall & Patti, 2010; Brewer et al., 2013). However, they add logistical issues and cost (Al-Shamali & Connors, 2010; Turner & Parisi, 2008).

Hands-on distance labs are usually chosen to provide students with an authentic lab or real-world experience (Cancilla & Albon, 2008; Lyall & Patti, 2010; Brewer et al., 2013). In cases when students can take a course either face-to-face on campus or as a distance course, the distance lab must provide a similar experience as a hands-on lab on campus (Lyall & Patti, 2010). In addition, Brewer et al. (2013) list acceptance of their distance courses for transfer credit by other institutions as one of their main considerations. However, resistance to non-traditional labs is still prevalent. For example, Brinson (2015) reported that in the United States the National Science Teachers Association and the American Chemical Society explicitly discouraged replacing traditional hands-on, face-to-face labs with non-traditional labs.

Traditional face-to-face labs are often seen as an opportunity for students to practice inquiry skills and scientific process skills (NSTA, 2019), which may be another reason for choosing a hands-on format. However, in reality, this is rarely the focus of the lab (see discussion by Holmes & Wieman, 2018). For virtual labs, Brinson (2015) reports only four published examples that measure inquiry. Three of these studies (Klahr, Triona, & Williams, 2007; Morgil, Gungor-Seyhan, Ural-Alsan, & Temel, 2008; Tatli & Ayas, 2012) reported equal or better learning outcomes for virtual labs as for corresponding hands-on labs. The fourth study (Lang, 2012) found that students did not perceive that the research design skills learning outcome was achieved in either lab format. For hands-on distance labs, Mawn et al. (2011) have demonstrated that students can engage meaningfully in inquiry tasks and develop scientific process skills.

Our hands-on lab did not use a lab kit; rather, it was similar to the “kitchen chemistry” approach (Casanova et al., 2006; Lyall & Patti, 2010) in its use of common household items. The kitchen chemistry approach is scalable to large enrolment courses and adds (almost) no cost for students or the institution. We mainly chose this approach because it supported our main pedagogical goal: enabling students to design, execute, and analyze an experimental project on their own. The decision to use simple equipment is informed by our previous experience with lab formats in which microcomputers, sensors, and other relatively sophisticated equipment were used to perform fairly precise measurements that confirm known constants or theories. We found that our students spent too much time learning how to use the equipment and troubleshooting it. They were often focused on measuring “precise” or “correct” data, but had difficulties in interpreting their data and relating it to the theories behind the experiments. Our new lab did not aim to measure known quantities; instead, it focused entirely on experimental design and data skills. Deciding how to conduct an experiment is an important part of experimental research, so we avoided predefined experimental procedures as much as possible. Our goals and design choices were influenced by the work of Reif and St. John (1979), who emphasized thinking skills and communications skills in their physics lab. Their lab design included flexible lab times and the possibility to do experiments at home to combat time constraints. Our lab also featured a capstone project in which students designed and performed an experiment to answer a research question of their choice, because we wanted our students to engage in authentic scientific tasks and see themselves as scientists.

Our approach aligned with the focus areas identified by the American Association of Physics Teachers for the undergraduate physics lab curriculum: constructing knowledge, modeling, designing experiments, developing technical and practical laboratory skills, analyzing and visualizing data, and communicating physics (American Association of Physics Teachers, 2014). Ideally, labs should feature authentic cognitive tasks and activities, similar to those an expert in the field would engage in (Wieman, 2015). Our lab emphasized three of the focus areas: designing experiments, analyzing and visualizing data, and communicating physics. Our choice was influenced by the work of Etkina, Murthy, and Zou (2006), who critiqued many physics labs for failing to give students a chance to formulate their own research questions or design their own experiments. There were, however, drawbacks to our approach and potential pitfalls, such as time spent on finding equipment and lack of close supervision, as we elaborate in our discussion.

The aim of our study was to determine whether students learn as much in an inquiry-based hands-on distance lab as in a similar face-to-face lab on campus. While our study focused on a physics lab, we believe that our lab format could be relevant to distance education or blended learning in other STEM fields, particularly in engineering. In the next sections, we describe the campus lab and distance lab formats, present a comparison of student performance in each, and conclude with a discussion of student perceptions of the distance lab.

Methods

Context

The lab was part of an introductory algebra-based physics course at a large Canadian research university. It was delivered in a face-to-face format on campus until 2014 and included some experimental tasks at home, as well as the capstone project that was also performed at home (Rieger, Sitwell, Carolan, & Roll, 2014). This format was switched to a distance format in 2015 and all lab activities were completed at home, while the lectures and tutorials (recitals) of this blended course took place on campus, as before. The campus lab and the distance lab formats had an identical lab design and the same activities. For the first eight weeks of the term, students underwent a skill-building phase in which they built up their “scientific toolbox”: planning and performing experiments, analyzing and graphing data, as well as estimating uncertainty and using basic statistics (average, mean, standard deviation, standard error). Since there was no extra credit associated with the lab, these weekly tasks were designed to take less than two hours to finish. Most experiments during the skill-building phase used simple equipment to reduce cognitive load and help students focus on understanding and analyzing experimental data, but a few experiments used automatic data acquisition. The objective was to demonstrate that even experiments performed with precise instruments and computers introduce uncertainty. For data analysis and graphing, students used their own spreadsheet programs (Excel, OpenOffice, Numbers).

During the last four weeks of the term, students worked on their capstone project. For their capstone projects, students were asked to formulate a research question, plan and perform an experiment to answer their question, analyze their data with the tools they learned in the course, and present their results in form of a written report. Students were not required to choose a physics topic, but they were instructed to propose a topic that required measuring experimental data with easily accessible equipment. For reasons of safety and ethics, all project proposals had to be approved by a teaching assistant or the course instructor.

Table 1 presents an overview and a brief description of all lab activities, including the capstone project. Some of the listed skills and major learning goals are related to inquiry tasks that students either performed on worksheets (campus lab) or online by filling in textboxes and answering multiple-choice questions (distance lab). The tasks also included review questions that connected to the activities of previous weeks. Differences in materials used in the campus lab and the distance lab are indicated in Table 1 by CL and DL, respectively.

Table 1

Overview of the Lab Activities

Week	**Topic**	**Skills and major learning goals**	**Experiments and materials**
1	Introduction to Uncertainty	Identify sources of experimental uncertainty; design an experiment and collect data; calculate the mean value.	Average speed of paper planes. <u>Materials:</u> letter-sized paper, stopwatch, tape measure (or ruler and tiled floor).
2	Histograms	Present data in form of a histogram; analyze and interpret histograms; create histograms from students' own data and from other data sources.	Use of spreadsheet software: calculate mean values and check for minimum and maximum values in a large dataset. <u>Materials:</u> students' own computers and spreadsheet software, large dataset.

3	Quantifying Histograms	Compare distributions; calculate mean, standard deviation, and standard error; use standard error to express uncertainty; evaluate agreement between experiments.	Simple pendulum: vary mass or length of string, take multiple measurements to reduce uncertainty, determine whether varying length or mass influences the period of a pendulum. Materials: string, objects with known mass (or kitchen scale to measure mass), tape measure or ruler, students' own computers and spreadsheet software.
4	The Pendulum	Acquire data automatically; plan and design an experiment to reduce uncertainties with repeated measurements; answer a research question based on data analysis and uncertainties using mean and standard error.	Simple pendulum: vary mass, length of string, or amplitude, acquire data with a motion sensor/microcomputer (CL) or accelerometer in cell phone (DL), determine whether varying length or mass influences the period of a pendulum. Materials: computer with motion sensor (CL), smartphone with accelerometer app (DL), string, objects with known mass (or scale to measure mass), tape measure or ruler, videos (provided online) on use of accelerometer app and experimental set up (DL), students' own computers and spreadsheet software.
5	Static Friction	Determine the static friction force from the measured mass and the maximum applied force (CL) or the maximum inclination angle (DL); learn to draw and interpret scatterplots with spreadsheet software.	Dependency of static friction on mass. Materials: microcomputer/force probe (CL) or smartphone, bookshelf or similar smooth surface that can be tilted (DL) food storage container with known amount of water or other known masses (e.g., coins), students' own computers and spreadsheet software.

6	Trendlines	Create a scatter plot from a given dataset. Fit trendlines to the data and interpret fitting coefficients and R^2 values; decide on best fitting model for the given data.	Use of spreadsheet software to explore best-fitting mathematical representation for a given dataset. Materials: students' own computers and spreadsheet software, given dataset. Instructional video (provided) (DL).
7	Error Bars	Measure the average velocity of an object falling with significant air resistance; learn to draw and interpret graphs with error bars (with spreadsheet software).	Materials: large coffee filters (CL) or cupcake holders (DL), microcomputer/motion sensor (CL) or tape measure and stopwatch (DL), students' own computers and spreadsheet software. Instructional video (provided) (DL).
8	Summary and Review	Choose appropriate representations: Histograms vs. graphs; use of mean values vs. trendlines; state the corresponding uncertainties: standard error vs. uncertainties in fitting coefficients and R^2 values. Determine fractional energy loss for a bouncing ball and choose the appropriate representation for your result.	Appropriate representations in different experiments. Materials: contrasting cases provided online, ball, ruler or tape measure, students' own computers and spreadsheet software.
9 - 12	Capstone Project	Propose a research question; give and receive peer feedback; plan and conduct your experiment; analyze your data; write a brief report.	Students' choice. Project must be a research question that can be answered with an experiment. Project must be approved by a teaching assistant. Materials: common household materials or easily accessible equipment, students' own computers and spreadsheet software.

Differences Between the Two Lab Formats

The lab experiments were originally designed for the campus lab in which the skill-building phase during the first eight weeks was delivered face-to-face on campus. In class, students were engaged in worksheet-based learning tasks and clicker questions for predictions and follow-up, in addition to doing hands-on experiments. For the distance lab, all of these inquiry tasks were moved online and most peer activities were replaced by multiple-choice questions with feedback. All inquiry tasks were identical in both lab formats and were typically focused on experimental design ("What materials are you planning to use?" or "How many data points are you planning to take?"), data interpretation, and data analysis. Three of the experiments performed in the campus lab relied on computer-based data acquisition with motion sensors or force probes. In the distance lab, these were modified for use at home: In Week 4, students used their smartphones as a pendulum bob and acquired data with the built-in accelerometers to determine the period of a pendulum as a function of different parameters. For the friction experiment in Week 5, students in the distance lab used a smartphone app to measure the inclination angle at which an object started to slide down a tilted bookshelf instead of using a force probe (connected to a microcomputer) to measure the maximum force that can be applied to an object before it starts to move. In Week 7, students used stopwatches/smartphone timers and rulers instead of motion sensors to capture the falling motion of cupcake holders with air resistance. We emphasize here that even though these experiments involved computer or smartphone-based data acquisition, one of the key learning goals (as in all other weeks) was to quantify the experimental uncertainty in a meaningful way. Students used their own computers and software for data analysis and graphing tasks in both lab formats. In the distance labs, we provided technical support for these programs and for the more sophisticated smartphone experiments with a number of instructional videos, e.g., how to add trend lines and error bars in Excel, or how to set up a smartphone to record accelerometer data. In addition, students could get help from teaching assistants for all lab-related questions in an online discussion forum hosted on piazza.com. In the campus lab, teaching assistants were on hand to provide technical help and answer questions.

The most significant difference between the two formats was how the students learned in the lab. In the campus lab, students worked in pairs and were also encouraged to perform their capstone project in pairs. In the distance lab, students typically worked on their own at home during the first eight weeks. For the capstone project they had the option to work with a partner and approximately half of the capstone projects in the distance labs were done in pairs.

Methods

Participants

The participants in this study took either the fall offering of our introductory physics course in 2014, which included the face-to-face campus lab (control group) or the fall offering in 2015, which included the distance lab (treatment group). Each group consisted of approximately 750 – 800 students in three lecture sections that used the same teaching materials. The demographics of the course was very similar in the two years: 60% of our students were in science, 15% were in arts, and 25% were in other faculties. Approximately two-thirds of students in the course have identified as female and one third as male. The vast majority (79%) of our students have been first-year students.

Data Collection

The main research question of our study was:

> Can students learn as much in an inquiry-based hands-on distance lab as in a nearly identical face-to-face lab on campus?

As explained in the previous sections, the two lab formats had an identical design, the same learning goals and the same learning tasks. The only differences were in the lab equipment of three experiments to accommodate the delivery format. Therefore our hypothesis was that our students learned as much in an inquiry-based hands-on distance lab as in a similar face-to-face lab on campus. To test this hypothesis, we compared the learning outcomes in the two lab formats. Since the main assessment method in both labs is the capstone project, we collected data on student performance on the capstone project in the distance lab (treatment) and in the face-to-face lab (control). Accordingly our main research question can be formulated more specifically:

> 1a. Is the mean project score for the distance lab projects better or worse than the score for the campus lab projects, using the same grading rubric?

> 1b. Which of the seven categories in rubric scores (see below) separate the campus lab projects from the distance projects?

We also wanted to know how students perceived the distance lab and conducted focus groups in the spring of 2016. Our research question were:

> 2. Did students enjoy the freedom of performing all experiments at home on their own time?

> 3. Did they perceive working on the capstone project as doing authentic research or "doing science"?

For this study, which was approved by our institution's Behavioural Research Ethics Board, we used a sample of 57 project reports from the 2014 fall term (face-to-face labs) and 176 project reports from the 2015 fall term (distance labs). The sample data are summarized in Table 2.

Table 2

Overview of the Study Data

Year	Lecture format	Lab format	Project performed	Number of projects	Number of students	Course grade average	Fails
2014	F2F	F2F	In pairs	57	114	72.1%	10
2015	F2F	DIST	Individually/Pairs	153/176	152/342	74.1%/74.7%	5/19

To ensure interrater reliability from year to year, all projects, including those from 2014, were marked by eight graduate teaching assistants at the end of the 2015 fall term. The project reports were anonymized and section-specific information was removed to ensure that raters could not tell whether a project was completed individually or in pairs, and whether they rated a project from the 2014 campus lab or the 2015 distance lab. In addition, teaching assistants did not rate projects of students they potentially interacted with in the campus labs.

The rating was performed using a grading tool that was specifically developed for this course. The tool is a list of 24 rubric questions (see Table 3) that raters answer by choosing either "Yes (1/1)," "Partially (0.5/1)," or "No (0/1)." For a subset of questions (Questions 10 – 17), the option N/A was also available in cases where these questions do not apply or are not important for a project. Any N/A rating reduced the total achievable score by one so that those questions were not taken into account for the overall grade. All questions were weighted equally and the sum of the points was converted to a percentage to yield the students' overall project grade. The last four questions of the grading tool (21 – 24) were meant to distinguish projects that were exceptional.

Table 3

Capstone Project Assessment Rubric

Category	Rubric questions
C1 Clearly stated research question or clearly formulated goal	1. Is a research question formulated or a clear goal stated for the project? 2. Is motivation or general interest provided? 3. Is a hypothesis formulated or is there a prediction based on literature?

C2 Clear description of the experiment	4. Is the experimental method described in such a way that anyone could repeat it? 5. Is it clear what equipment is used?
C3 Sufficient data and quality of data	6. Is the data sufficient to answer the research question or goal? 7. Is a reasonable range covered by the data? 8. Is there an attempt to minimize uncertainty (repeated measurements)? 9. Is the experiment overall well designed (it has no significant shortcomings)?
C4 Analysis of data and appropriate graphs	10. Is the data presented in an appropriate way? 11. Are graphs, histograms, and tables clearly labeled? 12. Are results extracted from the data and clearly presented? 13. Are advanced analysis methods used (fitting coefficients, polynomials, slopes, etc.)?
C5 Estimating uncertainty	14. Is the output of advanced analysis methods discussed meaningfully? 15. Is there an attempt to estimate uncertainties? 16. Are standard deviations or standard errors used in a meaningful way? 17. Is there an attempt to use mean/STD/STE to discuss agreement?
C6 Clear conclusions	18. Does the summary refer back to the data? 19. Does it address the research question? 20. Are limitations of the project discussed?
C7 Outstanding Projects	21. Is this project particularly creative or unique? 22. Does the project show extraordinary effort in terms of data acquisition? 23. Does the project show superior analysis?

	24. Does the project show extraordinary effort in terms of background research or motivation?

Because the grading tool was developed at the end of the 2015 fall term, students in 2014 and 2015 did not see the detailed marking questions, but were given the same general evaluation categories. In particular, students were told that their project should have the following components:

- A clear and well-defined research question.
- A simple experiment that addresses the research question.
- Sufficient data.
- Valid estimation of uncertainties.
- Relevant and correct analysis (graphs, standard error, etc.).

A sample project was also provided to illustrate the general format and the key components a project report should have. In addition, students handed in a draft of their project reports for peer feedback a week before the final submission.

The consistency of the grading was determined by measuring interrater agreement. All teaching assistants were given the same subset of 15 project reports. These reports were mixed in with the other reports that each teaching assistant was assigned to grade (which were different for each teaching assistant). The teaching assistants were blinded as to whether project reports were used for the interrater agreement calibration or as part of their standard student assessments. Comparing the detailed rating of all calibration project reports, we found an average interrater agreement of 76%, i.e., the same rating (either 1.0, 0.5, or 0.0) was given on average 7.6 out of ten times. We found major discrepancies in only a few cases (1.8%), in which a few rubric questions that mainly received ratings of one also received ratings of zero and vice versa. The range of the interrater agreement for each of the 24 rubric questions varied between 60 and 96%. The lowest agreement (60%) was obtained for question 16: “Are standard deviations or standard errors used in a meaningful way?” This was concerning because estimating uncertainty was one of the major learning goals of the lab. Clearly, better instructions for teaching assistants with examples of how to interpret this question (in particular, the word “meaningful”) are required in future studies. Three more questions, all in the “outstanding projects” category (Questions, 21, 22, and 24), had relatively low agreement (less than 70%). For these rubric questions, we relied on the raters’ judgement and did not provide more specific instruction. Consequently, some teaching assistants interpreted these questions more generously than others. Given the involvement of eight raters, interrater agreement was satisfactory overall, but in the future, we would supply more detailed instructions and explanations for four of the rating questions. This could be addressed by providing annotated examples of project reports that demonstrate the difference between good and outstanding projects, as well as examples of meaningful versus incorrect use of standard deviations and standard errors.

In addition to performance, we were also interested in how students perceived the lab. We believe that designing an experiment and selecting equipment are authentic tasks that are part of experimental science. Did students see themselves as scientists when they did their capstone projects and performed their experiments at home? Did they enjoy the freedom of performing all experiments at home on their own time? To find out, we ran focus groups in the spring of 2016, just after the examination period of the spring term had ended. All 800 students from the 2015 fall term (Y2) were invited to participate in focus groups and 12 students volunteered and gave us their opinion of the distance lab. The focus groups were conducted on campus by two of us (S.A.R and G.W.R) with 2 – 4 participants and lasted for approximately 30 minutes. We did not ask the students for any identifying information, except for their faculty and year of study. The participants received a $10 gift card from our institution's bookstore for their input. The open-ended questions that guided the focus group interviews are listed in Table 4.

Table 4

Focus Group Interview Questions

Q1	What is your faculty (Science/Arts/etc.) and year of study?
Q2	Describe in general terms a few things you have learned in the labs.
Q3	Did you learn something in the labs that may be useful in other courses or outside of school?
Q4	Did you enjoy doing the labs at home?
Q5	Where do you see advantages and disadvantages of doing labs at home?
Q6	Do you think that you were doing science in your final project? Please elaborate.
Q7	Were you comfortable doing the labs at home or would you have preferred doing the labs in a teaching lab?
Q8	Is there anything else you want to tell us about your experience with the physics labs?

Statistical Methods

In consultation with the Applied Statistics and Data Science Group at our institution, we used ANOVA models to address our research questions related to students' performance in the two lab formats:

> 1a. Is the mean project score for the distance lab projects better or worse than the score for the campus lab projects, using the grading rubric?
>
> 1b. Which of the seven categories in rubric scores separate the campus lab projects from the distance projects?

To answer the first question, we used a two-factor ANOVA model to test the null hypothesis, i.e., that there is no significant difference between campus projects and distance projects. As our sample sizes were unequal, with a different number of campus projects and distance projects, we used a partial sum of squares. The dependent variable is the project percentage grade and the independent variables are the project type (distance or campus) and TA (we had eight teaching assistants grading the projects). We used a linear model to explain the project percentage grade from two main effects, project type and TA, as well as their interactions, TA × type. After ensuring that there were no significant interactions we used a model that contained only the main effects (TA and type), but not the interactions.

To answer our second research question, we built seven ANOVA models, one for each category. We followed the same procedure as for our first research question, but with the percentage score of the category as dependent variable. For both research questions, we worked with percentages rather than raw scores to account for the presence of N/As as a possible response to some rubric questions.

Although we have listed the data for projects completed individually in the distance lab in Table 2, for the comparison of the two lab formats (distance versus face-to-face) we only used data from projects that were performed by pairs of students. We discovered a small but significant effect in the 2015 data of whether capstone projects were completed individually or in pairs, with slightly better performance of the pairs; therefore, we excluded projects that were performed individually to eliminate a confounding of variables.

We also excluded the fifteen projects used for measuring the interrater agreement. We carried out the analysis using the R statistical software environment.

Results

Average grades for the distance lab projects and for the campus lab projects were almost identical. Figure 1 presents the results of our analysis.

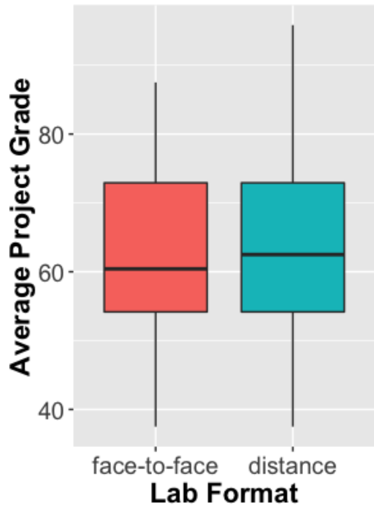

Figure 1. Average project grades in the two lab formats.

Our ANOVA showed no significant differences in the overall project marks between the campus lab projects and distance lab projects, $F(1, 229) = 0.14$, $p = .71$.

The data presented in Figure 2 addresses our research question, whether any rubric categories separate the campus lab projects from the distance lab projects (question 1b). Our analysis reveals significant differences in two of the seven categories, C1 (Clearly stated research question or clearly formulated goal), $F(1, 229) = 0.14$, $p = .00072$, and in C5 (Estimating uncertainty), $F(1, 229) = 0.14$, $p = .017$. The differences in all other categories were not statistically significant. It is worth pointing out that the scores in C7 are low by design, as this category is meant to identify excellent projects.

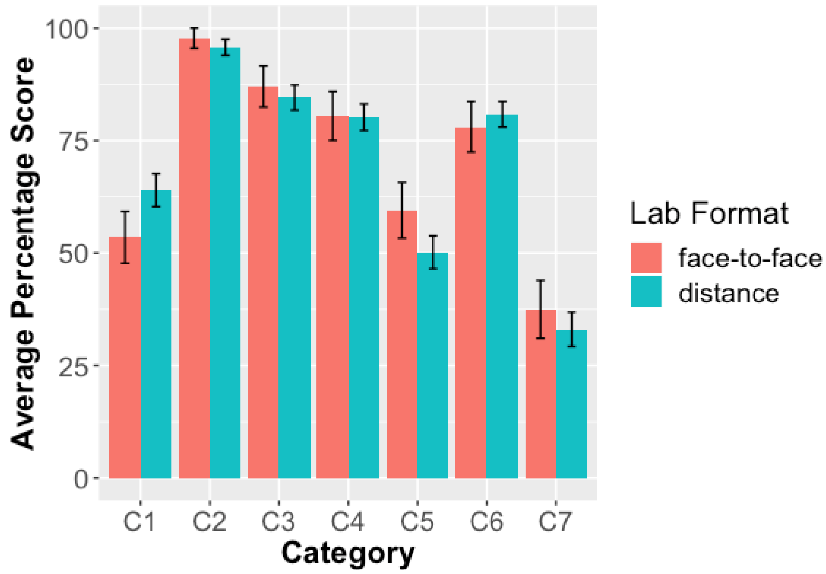

Figure 2. Average percentage scores in the seven categories of the project grading rubric (see Table 3). The error bars show 95% confidence intervals.

For completeness, the average scores for all 24 rubric questions for the 2014 students (campus labs) and the 2015 students (distance labs) are displayed in Figure 3.

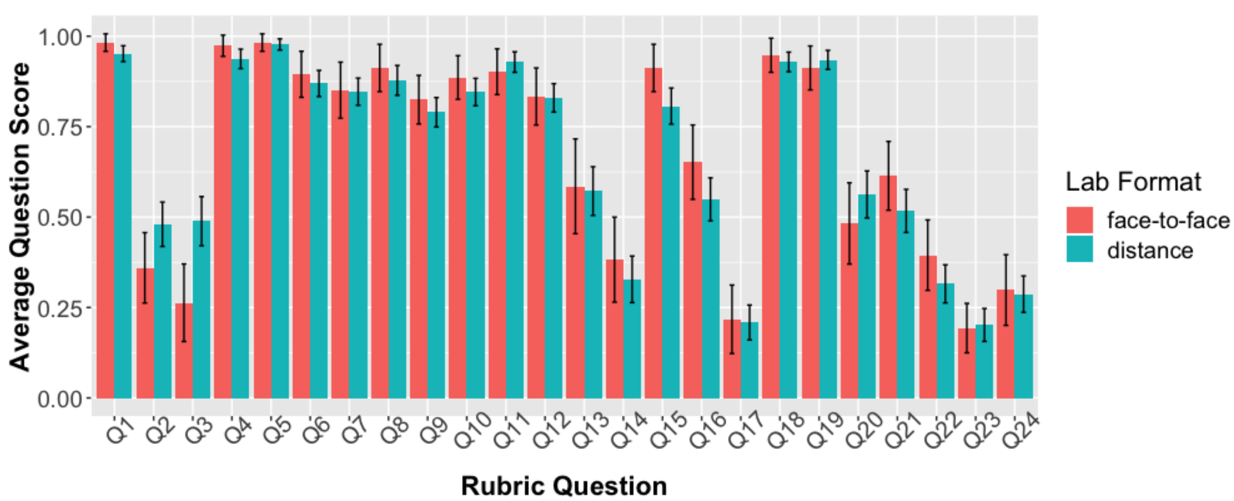

Figure 3. Average scores obtained with the project grading tool. The error bars show 95% confidence intervals.

The focus groups generated valuable insights into students' perceptions of the distance labs and answered our second and third research questions. Several students commented that the lab did not seem to be connected to the lecture. Students in the focus groups largely perceived the distance labs as "easy," but also as a nuisance: finding suitable equipment was sometimes difficult and several students mentioned being in a rush close to the due dates. Most students in the focus group would therefore have preferred doing the experiments in a teaching lab where equipment and support was immediately available.

Most students in the focus groups said that most of their learning took place during the capstone project, but they did not perceive the project as "doing science." For them, it was hard to come up with a "sophisticated" research topic and their basic projects felt "a bit childish" to them. Several students mentioned their perception that "real science" is done with sophisticated equipment that yields precise data. However, two of the 12 students we interviewed enjoyed doing the labs at home. These students mentioned the freedom to design their experiments and the flexibility to do the labs on their own time as benefits of the distance lab format. One student said that experiments at home felt "more real" and another student said that she felt that she was doing science when analyzing the data of her project. All of the students we interviewed appreciated learning to analyze and present their data with their own spreadsheet software.

Discussion

Our results allow for a fairly detailed comparison of student performance in our labs. While overall student performance was similar in the two lab formats, there were significant differences in two of the grading categories. We attribute the difference in C1 (Clearly stated research question or clearly formulated goal) to clearer instructions in the online documents provided for the distance lab. It is conceivable that students missed the importance of this part in the face-to-face introduction of the capstone project and perhaps did not pay close enough attention to the handouts. However, student performance in this category was not satisfactory in either lab format. We suggest that a lab report template with textboxes for the research question, hypothesis, goals, and motivation could address this problem.

The relatively low scores in C5 (Estimating uncertainty) are more concerning. They demonstrate that many students in both lab formats had difficulties applying the data analysis skills they were supposed to acquire in the first part of the labs. The observed difference in this category is not highly significant, but it seems that the campus lab format was somewhat more effective in teaching these more advanced skills. Although students who took the campus labs performed less well overall (Table 2), they performed better than distance lab students in this part of the assessment. Still, the results in this category were unsatisfying in both lab formats. We suggest that a scaffolding step is needed in which students can practice their data analysis skills before carrying out their capstone project. This could be in the form of a sample project where the data are provided and students are asked to perform the analysis and interpret the results.

All other categories show satisfactory outcomes with no significant differences between the two lab formats.

Before we discuss the results of our focus groups, we want to emphasize that we only interviewed students from the 2015 distance lab. A comparison of students' perceptions of two lab formats is therefore impossible.

The students in our focus groups gave mainly practical reasons related to time and finding equipment of why they did not generally enjoy the freedom of performing all experiments at home. Likewise, the lack of sophisticated equipment at home was given as the main reason of why they did not think they were performing an authentic scientific experiment for their capstone project. However, a look at the literature tells us that this perception cannot easily be remedied with better equipment.

In their work on student experiences in apprentice-style undergraduate research projects, Hunter, Laursen, and Seymour (2007) identified a number of factors that contributed to students' perceptions of becoming scientists and members of a community of practice. These were: working on an original research project, working closely with faculty and getting feedback from experts, presenting in group meetings and/or at conferences, learning how to operate sophisticated equipment, and making (small) contributions to the knowledge and progress in the field. The students involved in their study clearly perceived their research projects as authentic science. The absence of these factors helps explain why our capstone project did not offer an authentic scientific experience. Our lab (and probably most other introductory labs) would not be able to offer participation in original research, close collaboration with faculty, or regular group meetings. Moreover, although the experiments in our lab and the capstone project did not have any time constraints other than due dates, they took place during a busy term. In contrast, one of the undergraduate research students in Hunter et al.'s (2007) study described how they were able to take some time and "concentrate on one thing and figure it out" (p. 50). Given that the capstone project in our campus lab had the same constrains as in our distance lab, we assume that the students' perceptions of the capstone project in the campus lab were probably quite similar.

Nevertheless, we want to emphasize that engaging students in open-ended experiments and inquiry tasks is generally a good idea. In a recent paper, Holmes and Wieman (2018) present a summary of focus group interviews in which students described their experiences in traditional labs, project labs, and undergraduate research projects. Their study suggests that open-ended project labs like our capstone project engage learners in much more expert thinking tasks than traditional structured labs, but not as much as undergraduate research projects. The authors report that students view opportunities for making decisions as highly important.

We end this section with a discussion of the limitations of our study. The first limitation of our study is the fact that the two groups of participants were not from the same year. Although the same instructors ran the lab in both years, different teaching assistants were involved, which could have influenced the results. There were also minor differences in the performance of the two groups (Table 2). The second limitation of the study is that we only assessed the capstone project reports. We did not assess what students learned during the skill building phase, for example by administering a midterm lab test, which could have provided further insight into the differences between the two lab formats. The third limitation is that we did not run focus groups after the 2014 campus labs, which precludes a direct comparison of student perceptions. Although it is conceivable that students have similar views about the capstone project in both lab formats, there is no reason to assume that student perceptions of the skill-building phase are similar in the two lab formats.

Conclusion

In this article we presented an introductory hands-on project lab that could – after further improvements – be a suitable format for distance learning in physics and in engineering and a viable alternative to labs conducted on campus. It is currently run at a scale of 800 students with support and evaluation from teaching assistants and can potentially be scaled up further and used in MOOCs if the capstone project is peer-evaluated, which, however, has its own challenges.

The use of a new grading tool with 24 questions in seven grading categories provided us with a fine-grained assessment of student learning during the capstone project. Results show that overall students' learning outcomes were comparable between the campus and distance formats, but further improvements in the teaching of data analysis are necessary, in particular in the distance lab format. Focus groups revealed that students often did not perceive the capstone project as "doing science." It also appears that the flexibility afforded by the distance lab did not lead to increased student motivation. Students in our focus groups perceived the distance lab as "easy," but indicated a preference for doing experiments in a teaching lab where equipment and support is immediately available.

Should instructors consider adopting our distance lab format? The time constraints imposed by a busy term schedule cannot be changed for campus students and will always make it hard to carry out a capstone project. This challenge was present in both of our lab formats. We therefore suggest delivering our project lab as a stand-alone lab course that students could choose during a less busy term, for example the summer term. The distance lab format is particularly suitable for the summer term since it offers high flexibility in location and allows students to take this course even if they do not stay on campus for the summer. As we have shown in our study the distance lab format does not compromise learning and leads to the same overall performance as an identical lab delivered face-to-face on campus.

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Participation in Online Courses and Interaction With a Virtual Agent



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Abstract

Online learning environments could be well understood as a multifaceted phenomenon affected by different aspects of learner participation including synchronous/asynchronous interactions. The aim of this study was to investigate learners' participation in online courses, synchronous interaction with a conversational virtual agent, their relationships with learner performance, and the participation/interaction factor identification. To examine learner participation, we collected learning management system (LMS) log data that included the frequency and length of course access, discussion board postings, and final grades. To examine synchronous learner interaction, we collected learners' conversation logs from the conversational agent. We calculated the quantity and quality of discussion postings and conversations with the agent. The results showed that the frequency and length of course access, the quantity and quality of discussion postings, and the quality of conversation with the agent were significantly associated with the learner achievement. This study also identified two factors that comprise online learning participation and interaction: interaction quality and LMS-oriented interaction.

Keyword: online learning, learner participation, online interaction, conversational agent

Introduction

Enrollment in online courses has sharply increased, specifically in higher education (Seaman, Allen, & Seaman, 2018), boosting educational researchers' interest in online learning. Researchers in this field are redefining our understanding of presence in light of the ability of individuals to interact extensively online with learning content, instructors, peers, and the learning environment. At the same time, they acknowledge major challenges, such as low levels of learner performance, passive participation, and higher attrition rates (Levy, 2007; Stoessel, Ihme, Barbarino, Fisseler, & Stürmer, 2015). In a comparison study investigating the difference between face-to-face and online courses in higher education, on average 10% of online learners failed in courses whereas only 4% of face-to-face learners did (Ni, 2013). Thus, the expansion of distance education has both benefits and detriments.

Low learner participation is one of the most significant issues in online education. This could be caused by poorly designed interaction opportunities for learners. Research has shown that online learning can be as effective as face-to-face courses, but only if learners are provided well-designed interaction activities (Hawkins, Graham, Sudweeks, & Barbour, 2013; Joksimović, Gašević, Kovanović, Riecke, & Hatala, 2015; Picciano, 2002). Croxton (2014) found that purposefully designed and engaging interaction tasks played a significant role in learner persistence in online courses. Therefore, it is imperative that we design online learning environments to foster meaningful interactions for learners (Bettinger, Liu, & Loeb, 2016; Goggins & Xing, 2016; Hrastinski, 2008).

One of the challenges of encouraging learner participation through purposeful and engaging interactions is that current online learning activities are mostly designed in an asynchronous manner. It is difficult in a typical online course for an instructor to promote positive experiences of interaction for learners because these require immediate and quality feedback from the instructor. In asynchronous environments, it is also demanding to implement the kinds of seamless and continuous learning activities that would assist learners in carrying out real-world projects (Boling, Hough, Krinsky, Saleem, & Stevens, 2012). Although online courses can use synchronous activities such as online conferencing, there are concerns that synchronous meetings could diminish one of the major benefits of open and distributed learning: that learners can learn at any time (Song & Lee, 2014). Accordingly, much of the research in online learning has focused on learners' participation issues in asynchronous interaction activities, while there is a lack of studies on learners' synchronous interaction behaviors in the context of distributed learning environments.

Literature Review

A number of researchers have reported that learners' active participation in online courses is associated with high levels of learner performance and higher retention rates (Bettinger et al., 2016; Goggins & Xing, 2016; Hrastinski, 2008; Stoessel et al., 2015). Michinov, Brunot, Le Bohec, Juhel, and Delaval (2011) found that learner participation levels, measured by the number of messages learners posted to discussion forums, mediated the relationship between learners' procrastination and academic achievement. The researchers suggest that encouraging learner participation leads to the increased performance of online learners, especially those who have a tendency to procrastinate. Bettinger et al. (2016) also examined the effects of learners' participation on their online course performance and persistence. More active participation in discussion forums was associated with higher performance in the courses and lower dropout rates in the following academic term. Learners' active participation can therefore be considered a key factor in learning success in online courses.

Learner Interaction

With respect to the issue of learner participation, note that participation is intertwined with interaction. Generally, learner participation refers to "a process of taking part and also to the relations with others that reflect this process" (Wenger, 1998, p. 55). This broad definition includes two types of learner behavior (i.e., "a process of taking part," such as submitting an assignment or reading an assigned article) and interaction (i.e., "the relations with others," such as chatting with peers or having a discussion with peers). In this research area, the concept of learner behavior as a "process of taking part" has been employed as a narrower definition of learner participation rather than the concept of learner participation includes interaction. For example, the following studies showed that encouraging learners' active participation by providing more interaction opportunities is one effective approach that promotes success in online courses (Croxton, 2014; Hawkins et al., 2013; Joksimović et al., 2015; Picciano, 2002; Wu, Yen, & Marek, 2011). It seems that interaction is a factor that contributes to participation.

It should be noted that not all interaction activities promote participation and performance. Sabry and Baldwin (2003) explored relationships between learners' preferences and online interactions with information, with the instructor, and with other learners. One hundred eighty-nine undergraduate and graduate students completed a questionnaire that asked about their online learning interaction experiences. Learners were found to have different perspectives and preferences towards online interactions. Specifically, regarding frequency of use and perceived usefulness, learners in their study more often interacted with information than with their instructor and with other learners. Similarly, the effects of interaction on online learners' performance might depend on the content of interactions. Kang and Im (2013) investigated learner interactions and perceived learning in an online environment. Six hundred fifty-four undergraduate students responded to a survey that asked about learners' interactions with their instructor and their perceived performance. Kang and Im's exploratory factor analysis showed that instruction-related interaction factors had more predictive power for perceived performance than non-instructional interaction factors (e.g., social intimacy, social exchange of personal information). Thus, it seems that instructional content-related interaction has a more significant effect on learner performance than the other types of interactions. Still, further research is required to identify different types of interaction and their different roles in online learning.

In the previous studies (Goggins & Xing, 2016; Swan, 2001), the quantity of interaction has been considered a significant factor that predicts learning outcomes. Goggins and Xing (2016) examined learners' asynchronous interaction activities in a discussion forum in an online graduate course. The quantity of learner participation in the discussion (which was measured by the number of posts both written and read) was significantly correlated with achievement. In their investigation of 1,406 undergraduate students' perceptions of their online learning experience, Swan (2001) also found that students who were more active in online courses, higher levels of personal activity including higher perceived levels of interaction with the instructor and peers, reported higher levels of satisfaction and perceived learning and earned higher course grades. Swan found that frequent interaction with course materials was one of the most important aspects of online learning. Therefore, the magnitude of interaction might promote achievement of learning outcomes.

Asynchronous and synchronous interaction. Along with the importance of interaction quantity and content-related aspects, the synchronicity of interaction has been discussed in the previous studies (Baker, 2010; Johnson, 2006; Swan, 2001). Asynchronous interactions are beneficial for learners because they offer the time to find more learning resources, speculate about the topic, reflect on their learning, and elaborate their own knowledge (Johnson, 2006). Online discussion forums provide learners opportunities to reflect on peers' and instructors' contributions and consider their own arguments before sharing them. Conversely, asynchronous interactions often lack timeliness or immediacy. In learners' interactions with instructors, timely and immediate responses can reduce the psychological distance between them and promote learner achievement in online learning environments (Swan, 2001). Baker (2010) investigated undergraduate and graduate students' perception of affect, cognition, motivation, and their instructors' immediacy and presence in online courses. Immediacy of interaction was strongly associated with students' positive affective and cognitive status. Although asynchronous interaction activities such as discussion forums may partially support timely interaction, this requires an instructor's prompt facilitation and learners' immediate responses, which are not common in online courses.

If immediacy is key to positive interaction effects, synchronous interactions could be more effective than asynchronous interactions in certain contexts. However, synchronous interaction activities have not frequently been implemented in online courses because of the challenges they present. The instructor needs to ask all students to be online at a certain time and moderate large-scale online conversations (Yamagata-Lynch, 2014). This type of practical difficulty is one reason that few studies have examined learners' synchronous interaction activities in online courses (Giesbers, Rienties, Tempelaar, & Gijselaers, 2014). Accordingly, the roles, characteristics, and effectiveness of synchronous interactions in online courses have not been fully explored. Thus, because of the challenges, we need to get creative in our implementation of synchronous interaction for both research and practice areas.

Synchronous Interaction with Conversational Agents

Conversational virtual agents, or chatbots, are computer programs that communicate with users in natural language and so have been used for user-system interaction in many online spaces (Shawar & Atwell, 2007). By simulating human dialog patterns, they can conduct an interaction task through conversation with a user. One of the first conversational agent systems, ELIZA, was developed in 1966 by Joseph Weizenbaum. Users interacted with ELIZA in a synchronous manner. ELIZA simulated a therapist role in clinical treatment situations, analyzed what users typed, and created its responses based on predefined decision rules.

There are cases in which conversational agent systems have been used for educational purposes (Fryer, Ainley, Thompson, Gibson, & Sherlock, 2017; Heller, Proctor, Mah, Jewell, & Cheung, 2005; Jia, 2009). Abbasi and Kazi (2014) investigated the use of a conversational agent as an answer retrieval tool to solve programming questions. Seventy-two undergraduate students were randomly assigned to either a Google group that used the Google search engine to retrieve information, or to a conversational agent group that asked questions of the agent to retrieve information. Examining the pre- and post-test memory retention measurement, they found that the conversational agent group significantly outperformed the Google group on learning outcomes. This type of technology appears to facilitate interaction opportunities for online learners. Further, the use of conversational agents in a synchronous manner might prompt more in-depth investigation of the roles and effectiveness of synchronous interaction in online learning environments. Still, the use of conversational agents in online courses as a synchronous interaction activity tool for both research and practice is in its infancy. Because few studies have examined conversational agents as a synchronous interaction medium in educational settings, there is little knowledge of what roles this type of interaction might play in online courses.

Research Questions

The purpose of this study is to examine learners' participation in online courses, synchronous interaction with a conversational agent, their relationships with learner performance, and identification of the factors that comprise participation/interaction. Our research questions are:

1. What are the relationships between the learner participation in an LMS for online courses, learner interaction with a conversational agent, and learner performance?

2. What are the factors that comprise learner participation/interaction in online courses?

Methods

For this study, we adopted a quantitative single-case research design, and used correlation and factor analyses of learners' participation in an LMS, interaction with a conversational agent, and learner performance. The data for this study were collected from online courses at a mid-sized university located in the southern United States. Typically, a completely asynchronous model has been used for delivering the online courses via LMS. The courses were organized into 15 weekly themes and topic modules. The LMS content for the courses included a syllabus, announcements, reading assignments, supplementary reading materials, weekly discussion topics and questions, and related links.

Participants and Task

Fifty-six participants were recruited from four graduate courses in an instructional technology program. The courses lasted 15 weeks, with an introduction module in the first week and a review and final paper submission in the last week. Each of the 13 regular weekly modules included an asynchronous discussion based on each topic reading (e.g., journal paper, book chapter), conducted on an online forum in the LMS. Students were required to complete the 13 weeks of asynchronous discussion activity throughout the course term. In addition, students in all courses were assigned interaction with a conversational virtual agent that was designed to encourage the acquisition of content knowledge and logical argumentation skills. Students were asked to interact with the agent about instructional topics using reflection prompts such as "Why do we need to use educational multimedia?", "Are mobile Apps good for teaching?", "Peer review would be helpful?", "In your project, was the ISD (Instructional Systems Design) Step useful or effective?", and so on. Students were required to complete seven interaction sessions throughout the semester.

Conversational Agent

The conversational virtual agent system we used in this study was designed and developed to demonstrate the feasibility of the agent for better support of synchronous interaction in online courses (Song, Oh, & Rice, 2017). The conversational agent was an independent online application that was not embedded in the LMS; students could access the agent directly using a web browser, without logging into the LMS. Learners interacted with the agent through text-based chat. The virtual agent analyzed their input and replied to their questions and responses. As shown in Figure 1, the agent asks a question, and the learner answers the question. The agent initiates the question-answer interaction, for example, "Can you teach me the course, Educational Multimedia?" The agent also responds to the learner's answer; when the answer is short, the agent may ask "Would you please explain more about it?"

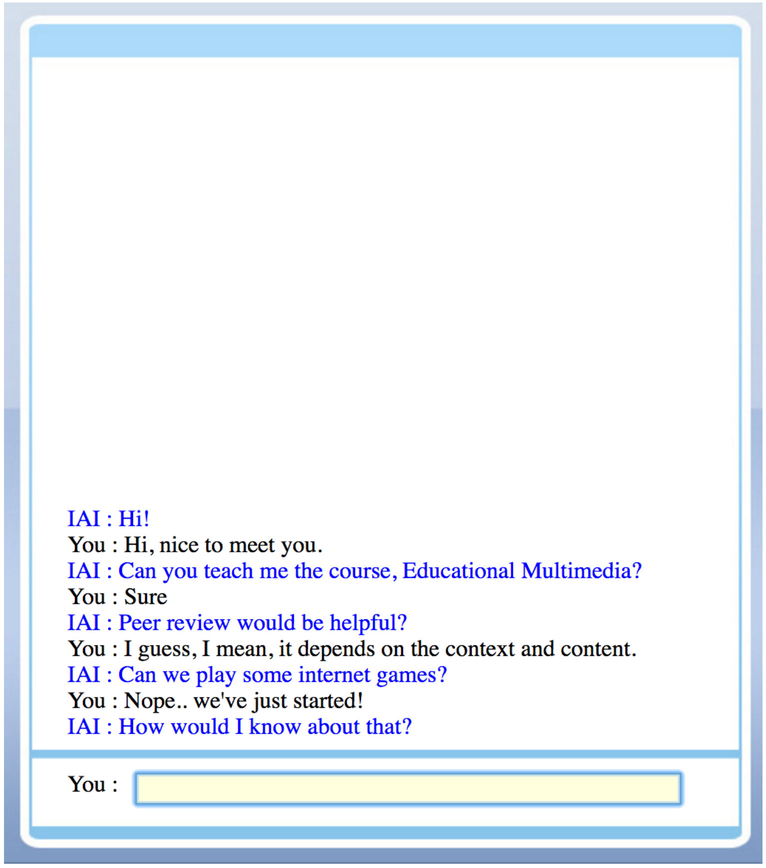

Figure 1. Screenshot of a learner interacting with the conversational agent system.

Data Collection

To examine learner participation, we collected participants' LMS log data, including the frequency of course access, length of course access, discussion board messages, and the final grade. We calculated the length of discussion board messages and rated their quality using procedures we will describe shortly. To examine synchronous learner interactions, we collected participants' conversation logs from the agent system, and also calculated their length and rated their quality. In total, we collected data on seven variables: System Access, Time Spent, Discussion Length, Discussion Quality, Conversation Length, Conversation Quality, and Final Grade.

Discussion and conversation quality measurement. We rated participants' discussion board messages and conversations with the agent using a scoring rubric. We used Bradley, Thom, Hayes, and Hay's (2008) adaptation of a coding scheme developed by Gilbert and Dabbagh (2005) to measure the quality of online discussion, and then modified it for our own context. We scored discussion board messages and conversations with the agent as follows:

- No Score (1 point): the participant's interaction is off-topic or incorrect;
- Reading Citation or Content Clarification (2 points): the participant directly quotes from or paraphrases the reading;
- Prior Knowledge (3 points): the participant uses prior knowledge from class or outside resources to support a statement or an understanding;
- Real World/Abstract Example (4 points): the participant uses examples that demonstrate the application of knowledge to a real-world context and/or analogies/metaphors to support a statement or an understanding; and
- Making Inferences (5 points): the participant demonstrates analysis, synthesis, or evaluation, and/or makes broader connections to society or culture.

An instructor from the participating courses and a research assistant separately coded participants' discussion board postings and conversations with the agent. Interrater reliability using the intraclass coefficient for the initial rating was .91. The raters resolved disagreements by consensus reached throughout five different discussion meetings. In the event the raters did not agree, the third author of this study was asked to consider each rater's justifications and make a final decision.

Results

We first calculated means and standard deviations of the seven variables (see Table 1). System Access and Time Spent had relatively large standard deviations, which means that there were large individual differences in learners' access to the LMS.

We found no statistically significant difference of all seven variables among the participating online courses (Final Grade: $F(3, 52) = .79$, $p = .51$; System Access: $F(3, 52) = 1.38$, $p = .23$; Time Spent: $F(3, 52) = .56$, $p = .64$; Discussion Length: $F(3, 52) = 1.00$, $p = .40$; Discussion Quality: $F(3, 52) = 1.16$, $p = .34$; Conversation Length: $F(3, 52) = 1.97$, $p = .13$; Conversation Quality: $F(3, 52) = .37$, $p = .78$), perhaps due to our small sample size.

Table 1

Means and Standard Deviations of Variables (N = 56)

Course	*n*	Final Grade (up to 500)	System Access (frequency)	Time Spent (hours)	Discussion Length (words)	Discussion Quality (up to 5.0)	Convers. Length (words)	Convers. Quality (up to 5.0)

		M (*SD*)	*M* (*SD*)	*M* (*SD*)	*M* (*SD*)	*M* (*SD*)	*M* (*SD*)	*M* (*SD*)
A	16	464.78 (28.69)	227.63 (53.96)	89.42 (46.21)	3,901.31 (904.42)	2.93 (.53)	2,308.56 (906.08)	3.06 (.62)
B	9	472.77 (25.90)	204.11 (63.31)	70.32 (42.77)	3,706.67 (639.10)	3.31 (.35)	2,955.00 (656.90)	3.19 (.24)
C	16	467.54 (24.97)	224.94 (58.30)	83.60 (48.44)	4,252.50 (964.52)	3.25 (.67)	2,326.50 (699.12)	3.23 (.73)
D	15	477.97 (22.13)	248.53 (36.76)	94.24 (36.76)	4,180.40 (877.46)	3.15 (.60)	2,237.53 (696.32)	3.28 (.59)
Total	56	470.38 (25.40)	228.68 (53.47)	85.98 (45.15)	4,045.13 (880.03)	3.14 (.57)	2,398.55 (777.82)	3.19 (.60)

RQ 1. What are the relationships between the learner participation in an LMS for online courses, learner interaction with a conversational agent, and learner performance?

To examine the relationships between learner participation and interaction, participation data from the LMS and the learner interaction data from the agent system were analyzed using a parametric correlation analysis. As shown in Table 2, Final grade has a correlation with System Access ($r(54) = .357$, $p = .01$), Time Spent ($r(54) = .297$, $p = .03$), Discussion Length ($r(54) = .423$, $p = .001$), Discussion Quality ($r(54) = .514$, $p < .001$), and Conversation Quality ($r(54) = .462$, $p < .001$), but not with Conversation Length ($r(54) = .133$, $p =.33$). System Access has a correlation with Time Spent ($r(54) = .286$, $p = .03$) and Discussion Length ($r(54) = .295$, $p = .03$). In addition, there is a strong correlation between Discussion Quality and Conversation Quality ($r(54) = .776$, $p < .001$). The sample size and the correlation analysis are discussed in terms of the factor analysis in the limitation section.

Table 2

Correlation of Learner Participation in Online Courses and Conversational Activity (N = 56)

	Final Grade	System Access	Time Spent	Discussion Length	Discussion Quality	Conversation Length	Conversation Quality
Final Grade	1						
System Access	.357* (p = .01)	1					
Time Spent	.297* (p =.03)	.286* (p = .03)	1				
Discussion Length	.423** (p =.001)	.295* (p = .03)	.215 (p = .11)	1			

Discussion Quality	.514** ($p < .001$)	.211 ($p = .12$)	.120 ($p = .38$)	.180 ($p = .19$)	1		
Conversation Length	.133 ($p = .33$)	-.037 ($p = .79$)	-.085 ($p = .53$)	-.018 ($p = .90$)	.232 ($p = .09$)	1	
Conversation Quality	.462** ($p < .001$)	.178 ($p = .19$)	.181 ($p = .18$)	.209 ($p = .12$)	.776** ($p < .001$)	.214 ($p = .11$)	1

* Correlation is significant at the 0.05 level (2-tailed).

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

RQ2. What are the factors that comprise learner participation/interaction in online courses?

To identify participation/interaction factors underlying participants' behavior, we used a Principal Components Analysis (PCA). For the factor analysis, the sample-to-item ratio is important for determining the appropriate sample size. Because the final grade is an outcome of participation, we did not include it in the factor analysis, so our sample-to-item ratio is 9.3 (56 samples divided by 6 items), well within the recommended range of 5-20 samples per item (Pituch & Stevens, 2016). The correlation was investigated in research question 1 (see Table 2). The determinant is .275, which meets the requirement (i.e., greater than .000001) for the assumption of a factor analytic solution (Beavers et al., 2013). The Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy is .60, which is considered suitable (i.e., greater than .50) for factor analysis (Tabachnick & Fidell, 2013). Bartlett's test of sphericity is significant ($p < .0001$), which means that the variables are correlated highly enough to provide a reasonable basis for factor analysis (Hair, Black, Babin, Anderson, & Tatham, 2010). All the initial communalities are greater than .40, which means that the sample size is not likely to distort results (Tabachnick & Fidell, 2013).

The initial eigenvalues showed that the first factor explained 35.9% of the variance, and the second factor 22.6% of the variance. Eigenvalues of the third, fourth, fifth, and sixth factors were smaller than 1. No items were eliminated because there was no item that failed to meet the minimum criteria of having a primary factor loading of .4 or above and no cross-loading of .3 or above. Because the first component explained 35.9% of the total variance, which was less than 50%, we conducted a PCA of all items using Varimax with Kaiser normalization rotations to assess how six variables clustered. All items had primary loadings over .5. Factors 1 and 2 were rotated, based on the eigenvalues-over-1 criterion and the scree plot. Table 3 displays the items and component loadings for the rotated components. After the rotation, the first component accounted for 31.0% of the variance, and the second component 27.5% of the variance. The two factors explain a total of 58.5% of the variance for the entire set of variables.

Table 3

Component Loadings for the Rotated Components (N = 56)

Item	Component Loading		Communality
	Factor 1	Factor 2	
System Access	.097	.718	.523
Time Spent	-.007	.695	.483
Discussion Length	.119	.647	.433
Discussion Quality	.872	.235	.816
Conversation Length	.586	-.322	.447
Conversation Quality	.858	.270	.809
Eigenvalues	2.151	1.359	
% of variance	31.012	27.491	

Figure 2 shows how closely related the items are to each other and to the two components. Factor 1 was labeled Interaction Quality due to the high loadings by Discussion Quality and Conversation Quality. Factor 2 was labeled LMS-oriented Interaction due to the high loadings by System Access, Time Spent, and Discussion Length. Overall, our analyses indicated that two distinct factors were underlying learners' participation behaviors in online courses including synchronous and asynchronous interaction activities.

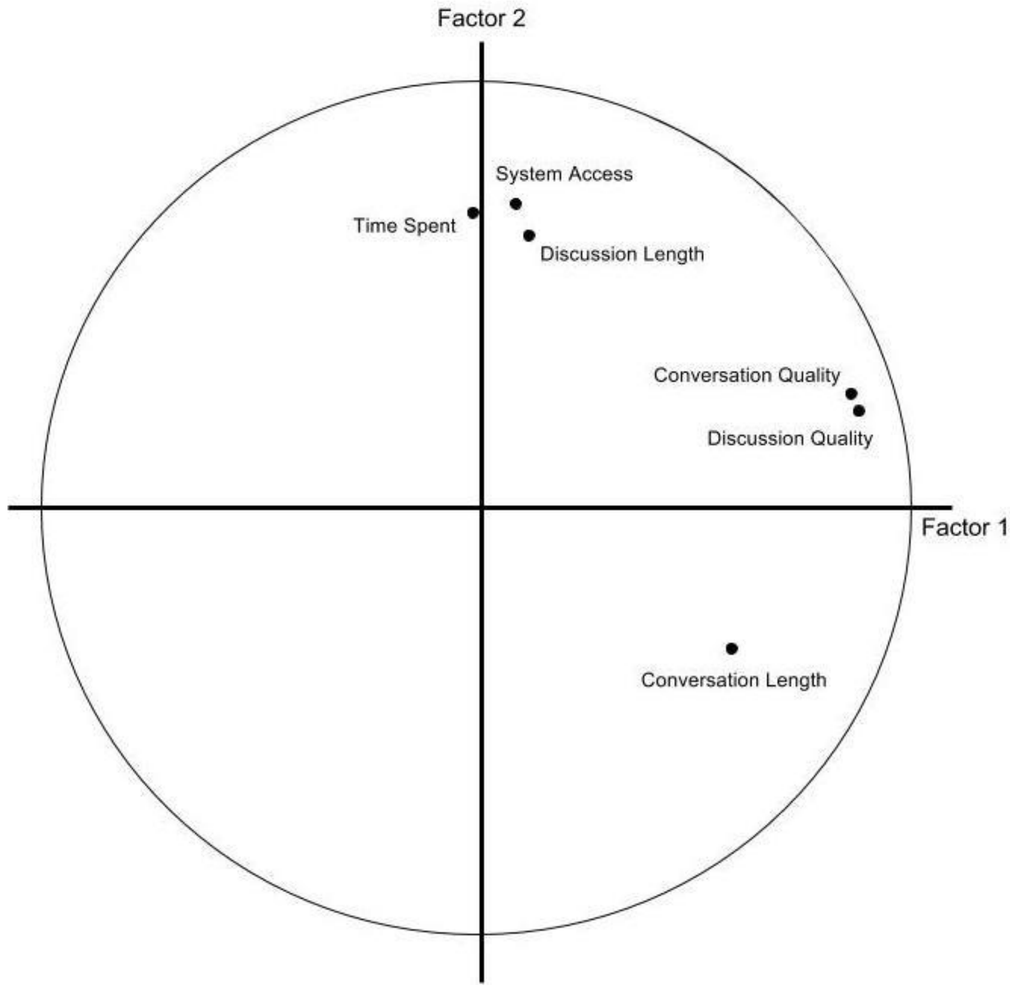

Figure 2. The component plot in rotated space.

Discussion

In this study, the frequency and length of course access, the quantity and quality of asynchronous discussion, and the quality of synchronous conversation with a virtual agent were significantly associated with the learner achievement. Overall, the results of this study support previous research findings that established a relationship between learners' participation/interaction in online courses and their learning performance (Croxton, 2014; Stoessel et al., 2015; Wu et al., 2011). In our study, the quantity of conversation with the virtual agent was not significantly tied to achievement. One possible explanation, drawing upon Garrison and Cleveland-Innes's (2005) findings, is that learners' performance depended more on the quality of interaction than on the quantity.

It was not surprising that the frequency of course access was significantly correlated with the length of course access and the quantity of asynchronous discussion. Participants had to access the LMS in order to participate in the discussion forums, but not conversations with the virtual agent. In addition, the quality of discussion board posts and the quality of conversations with the agent were strongly related. It seems that the learners' depth of learning is fairly independent of interaction synchronicity.

Learner participation is a significant factor affecting success in online courses (Bettinger et al., 2016; Goggins & Xing, 2016; Hrastinski, 2008), and learner interaction is seen as central to online learning participation. The concept of interaction is multifaceted, and different types of interaction have different effects on learners' participation, satisfaction, and performance (Jung, Choi, Lim, & Leem, 2002). Therefore, when aiming to promote learners' quality interaction for their active participation and enhanced learning performance, the confluence of different types and characteristics of interactional aspects should be taken into account. Our results indicate two factors that comprise learner participation/interaction in online courses. We called the first factor Interaction Quality, which includes the quality of discussion forum posts and conversation with the agent. We called the second factor LMS-oriented Interaction, which includes the frequency and length of course access, and the quantity of discussion forum posts. In our factor analysis, there was no clear discrepancy between synchronous and asynchronous interactions. Rather, interaction quality and LMS-oriented interaction emerged as the primary distinction among learner participation behaviors in online courses. Note that the quality of discussion board posts is included in the Interaction Quality factor, and the quantity thereof is included in LMS-oriented Interaction. This suggests that the same mode of interaction, in this case asynchronous communication, can have different roles in online learning.

Our findings also suggest that course topic-related communication between the learner and a virtual agent is practically applicable to online courses in a synchronous manner. Our participants successfully had a conversation with the virtual agent about course topics and materials. The instructional content-related communication with the conversational virtual agent might have a positive effect on learner performance and satisfaction, as previous studies showed that computer agent-based experiences offer the learner meaningful learning experience (e.g., Delialioglu & Yildirim, 2007; Garrison & Cleveland-Innes, 2005). We suggest this is because such interaction motivates the learner to express their opinions and encourages them to complete tasks.

Limitations

There are notable limitations in this study. First, our sample size was admittedly small. We found our sample size appropriate based on the context and the sample-to-item ratio; however, some would suggest that 50-100 is not a sufficient sample size (Comrey & Lee, 1992). Second, we were unable to perform course-level analysis due to the small sample size. Thus, more in-depth factor analyses and course-level analyses with a larger sample size are required for future research. Third, learners' final grades might not represent learner performance precisely, specifically in graduate courses. Graduate courses encompass diverse aspects including legitimate argumentation, logical discussion, reasoning, academic writing, and critical thinking that could not possibly be reflected in one specific score. We recommend future studies with the inclusion of different types of learner assessment methods and data. Fourth, a text-based chat might not fully serve as a synchronous interaction method. Just as people use language for human interaction, learners want to use spoken language to communicate even in online learning environments (Shawar & Atwell, 2007). Therefore, text-to-speech and voice recognition technologies might provide additional benefits, and verbal interaction with the agent should be investigated. Last, although our motivation in conducting the current study was seeking ways to remediate the higher attrition rate of online courses, we did not directly address retention. Outcomes such as course completion and attrition rates should be examined in future studies.

Directions for Future Research

The results of this study suggest that conversational virtual agents have potential for increasing meaningful interactions for learners in online courses. With the rapid expansion of computing power and artificial intelligence techniques, we can expect to see extensive application of these technologies in our daily lives, including in the field of education. It would be beneficial to the distance education field if we determined how best to incorporate intelligent agent systems into current online courses. Clearly, pedagogy using conversation agents in online learning environments deserves further investigation.

In this study, online learners experienced synchronous interactions with the conversational agent. Nonetheless, it is uncertain that the conversational agent provides any types of social interaction or social presence for the online learner. Social presence is an important concept in online learning process that encompasses online communication and interaction (Tu, 2002). In online learning environments, it seems that learners' academic performance correlates with the perceptual level of social presence (Richardson & Swan, 2003). Because the learner can share their opinions and exchange critical ideas through social interaction, social presence might be associated with the level of learner interaction, which would establish a meaningful learning experience (Garrison & Cleveland-Innes, 2005). In addition, learner satisfaction could be tied more closely to learners' perceptions of their social and interpersonal interaction than to knowledge demonstration (Dennen, Aubteen Darabi, & Smith, 2007). What we have not examined in this study is the virtual agent system's ability to provide social and interpersonal interaction opportunities for the learner. The social and interpersonal aspects of conversational agents need to be further examined.

Learners need immediate feedback from the instructor and timely support from peers and subject matter experts, which could best be supported through synchronous interactions. Most learners would expect the instructor to be available at all times and to respond to their questions and requests (Drange, Sutherland, & Irons, 2015). Still, asynchronous discussion methods have pedagogical benefits such as supporting learners' writing processes and providing reflection time (Andresen, 2009). For these reasons, a combination of synchronous and asynchronous communication has been suggested to promote online learners' participation and engagement (Giesbers et al., 2014). As researchers have suggested (Beldarrain, 2006; Ohlund, Yu, Jannssch-Pennell, & Digangi, 2000), synchronous and asynchronous interaction might be connected in a complementary mutual relationship. The reflective and collaborative properties of asynchronous interaction might be well supplemented by the immediate and timely attributes of synchronous interaction. In addition, active interaction in synchronous tasks lead to positive interaction in asynchronous communication (Giesbers et al., 2014). This mutual relationship requires further investigation. Since this research area requires the analysis of a large amount of data, learning analytics and data mining techniques should be employed (Song, 2018).

Conclusion

We conducted this study to better grasp learner participation and interaction in online courses. Learner participation is not simply represented as a quantity of interaction or the access to the learning space. Our results offer a representation of how learner behavior indicators in online courses are associated with each other, but we need to further investigate different types of synchronous and asynchronous interaction in different types of online learning environments, specifically the use of conversational agent systems.

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Mid-Career Adult Learners in an Online Doctoral Program and the Drivers of Their Academic Self-Regulation: The Importance of Social Support and Parent Education Level



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Abstract

Adult professionals enroll in online graduate programs and rely on social support and on their ability to self-regulate to be successful. The literature on academic self-regulation among emerging adults (traditional college age) is ample, but we do not know how social support interacts with academic self-regulation among adult graduate students at mid-career, particularly among those students who are first generation college goers. This study addressed the following questions: (1) To what degree do parental education level and cohort progression predict academic self-regulation? and (2) What sources of social support – family, friends, loved one (significant other), and classmates – are predictive of academic self-regulation for adult students in an online doctoral program? Findings include evidence that the influence of parental educational level on academic self-regulation persists through midlife. Also, that perceived social support from family, friends, and peers predicts academic self-regulation. We conclude with implications for the design of online programs.

Keywords: academic self-regulation, adults, doctoral, online, first-generation, social support

Introduction

Increasing numbers of mid-career adults enroll in online or hybrid doctoral programs while remaining in their communities yet they often do not complete those programs in spite of the ease of access afforded by distributed (usually online) programs. Their family and work contexts can lend social support for their graduate studies and simultaneously be a source of competing demands and distractions. Adult students, to be successful in a demanding online academic program, must manage their complex social resources and obligations effectively. It is well established that social support is important for college students in early adulthood (ages 18-24), but we suggest that the sources of social support that contribute to academic self-regulation are sufficiently different for the adult working professional studying online and so are worthy of investigation.

Over the past 20 years, persistence in postsecondary online programs has been a research focus (Lee & Choi, 2011; Verdinelli & Kutner, 2016), and persistence in online doctoral programs has been the subject of a few studies (Ivankova & Stick, 2007; Rockinson-Szapkiw, Spaulding, & Spaulding, 2016). Several studies have identified factors that contribute to academic success including emotional support, hope (Holder, 2007), self-regulation, and motivation (Artino Jr. & Stephens, 2009; Rakes & Dunn, 2010). But the sources of social support (SS) for adult, online, graduate students have not been explored, and the relationship of SS with academic self-regulation among mid-career adults enrolled in an online graduate program is unknown. With online programs serving older students and being more accessible to students whose parents did not attend college (Williams & Hellman, 2004), understanding the different sources of social support for mid-career adults can help educators in distributed programs build the necessary scaffolding. The purpose of this study was to explore the interactions of perceived social support, parent education level, and academic self-regulation among mid-career adult students in an online doctoral program.

Theoretical Framework

Self-Regulation Theory (SRT; Bandura, 1986) and Social Support Theory (SST; House, 1981) frame our study. The ability to self-regulate to achieve learning goals is critical to student success (Schunk & Zimmerman, 1997; Zimmerman & Schunk, 2008) in all academic pursuits and particularly in online programs (Williams & Hellman, 2004). Schunk and Zimmerman describe self-regulation as

> planning and managing time; attending to and concentrating on instruction; organizing, rehearsing, and coding information strategically; establishing a productive work environment; and using social resources effectively... [and] motivational processes such as setting performance goals and outcomes; holding positive beliefs about one's capabilities; valuing learning and its anticipated outcomes; and experiencing positive affects (e.g., pride, satisfaction) with one’s efforts. (p. 195)

Schunk and Zimmerman (1997) note that self-regulation is learned socially, and parents are the primary adult models and teachers of self-regulation in general. Parents’ influence extends into early adulthood and college (Shannon, Barry, DeGrace, & DiDonato, 2016) impacting students’ academic self-regulation even up to age 30, according to Williams and Hellman (2004). This suggests that parents’ contribution is through modeling (and other modes of teaching) of self-regulation related behaviors and attitudes prior to college as much as through the support they provide during the students’ college attendance. We sought to determine if this effect continued later in adulthood.

The role of parents is the link between self-regulation and social support theories. The multi-dimensional construct of SS includes different sources and types of social support. House (1981) described three types of social support: emotional, instrumental, and informational. These types of social support are woven together in the network of relationships that form the communities of belonging for adults and include online relationships (Olson, Liu, & Schultz, 2012). With SST, House suggested that an individual's well-being in the workplace is influenced by various types of support he/she receives from different sources (family, friends, loved one), through the moderation of workplace stress by social support. Some have applied SST to the academic success of emerging adults, establishing its importance for this group. With the stress that going back to school in an online graduate program causes professional adults as they juggle their various roles, time, and academic performance, an investigation into the role social support plays for them is needed. We framed our inquiry by extending SST to adult online graduate students, the sources of their social support, and how the support from those sources influences academic self-regulation.

Literature Review

The following section includes a brief review of research on academic self-regulation emphasizing online learning and a review of social support research as it pertains to our study.

Academic self-regulation. Andrade and Dugan's (2011) study on the validity of the Survey of Academic Self-Regulation (SASR) yielded the following factors: extrinsic motivation, intrinsic motivation, metacognition, personal relevance and control, self-efficacy, and self-regulation. It is not within the scope of this paper to do a complete review, but for a thorough treatment of self-regulated learning in higher education see the systematic review by de Bruijn-Smolders, Timmers, Gawke, Schoonman, and Born (2016). Specific to our purposes, academic self-regulation (ASR) for online learning is variously described and operationalized. In their study of first generation college students in an online undergraduate program, Williams and Hellman (2004) operationalized self-regulation for online learning to include the ability to (a) use electronic library resources; (b) remember information read online; (c) resolve computer and connectivity issues; and (d) participate in online discussions (discussion boards). They found that first generation students reported lower levels of self-regulation for online learning than their second-generation counterparts.

More recently, Broadbent and Poon (2015) conducted a meta-analysis of research over the previous 10 years on ASR in online higher education environments and found that

> online students who make good use of their time, are conscious of their learning behaviour (metacognition), are critical in their examination of content (critical thinking), and persevere in understanding the learning material despite challenges faced (effort regulation) are more likely to achieve higher academic grades in online settings. (p. 11)

Interestingly, Broadbent and Poon also noted that peer learning had the strongest effect size in relation to academic outcomes. They noted that the meta-analysis yielded nonsignificant results for peer learning due to the largest included study which used a measure of peer learning more appropriate for traditional learning settings. They recommended that peer learning be emphasized in online courses to include both passive and active participation in discussion boards.

Often, academic self-regulation correlates with students' perception of community within their online classroom and the adequacy of communication from professors (Dunn, Rakes & Rakes, 2014). Noting the importance of the social aspects of learning, Cho and Kim (2013) focused on self-regulation for online interaction in their study, arguing that there was sufficient evidence to support the relevance of online interaction to student outcomes including student satisfaction, perceived learning, and social presence (see also Richardson, Maeda, Lv, & Cascurlu, 2017). Cho and Kim used Moore's (1989) much-cited typology of interaction in distance education (student-content, student-instructor, and student-student interaction) to frame their inquiry into self-regulation for online interaction. Recognizing the importance of self-regulation of online interaction with both instructors and peers, they found that "instructor scaffolding for interaction with others" (Cho & Kim, 2013, p.73) was the strongest predictor of students' self-regulation for online interaction.

Academic self-regulation clearly has a basis in social learning beginning with parents. As such, parents' educational level has an influence on the academic self-regulation of young adult college students (Williams & Hellman, 2004). It is difficult to determine how many adult doctoral students in online programs are the first in their families to go to college, but according to the National Science Foundation (NSF; 2017) report on students in science and engineering doctoral programs, first-generation students made up 17.6% in 2016. While research on undergraduate first-generation students is plentiful (e.g., Pascarella, Peirson, Wolniak & Terenzini, 2004), there is little research on first-generation students participating in a terminal degree such as a Doctor of Education (Ivankova & Stick, 2007). Many students who are currently in a doctoral program and are first-generation experienced a lack of financial support as undergraduates, feelings of separation from the world of their parents even while not yet belonging to the world of the college educated, and they often take a longer time to complete their degree (Gardner, 2013). Rakes and Dunn (2010) found that online students often feel isolated from their peers and professors. This sense of isolation may be compounded for students who are first generation college students (1-GC) and are already experiencing emotional separation from their family of origin (London, 1992; London, 1996; Terenzini, Springer, Yeager, Pascarella & Nora, 1996). Furthermore, first-generation students may lack self-regulation skills important in pursuing a terminal degree, specifically in an online environment (Williams & Hellman, 2004). For adults, Williams and Hellman (2004) go on to suggest that social groups such as friends and family may have more influence than parents.

Social support. According to Lakey and Cohen (2000), social support from the social constructionist perspective contributes to individuals' ability to self-regulate. Extending this view of social support to online learning is appropriate given the constructed nature of the online environment itself and its mediation of relationships. Holder (2007) found that emotional support was one of a few variables that discriminated between adult online students who persisted and those who did not persist (along with self-efficacy, and time and study management). Chu (2010) studied the relationship of family support and internet self-efficacy among older adult learners (>50 years of age) and found that family support was critical, and emotional support was more important than tangible (informational) support.

Shannon, Barry, DeGrace, and DiDonato (2016) found that parents and peers were key sources of social support for the academic success of 18-24-year-old college undergraduates. These sources are likely different at mid-career as parents are no longer the primary source of social support, partially replaced by family and significant other. Bird and Morgan (2003) and Holder (2007) found that adult online students relied on family support.

Peers in the program (classmates) are a source of support, but in an online program, classmate interaction is mediated by technology and often muted with online students reporting isolation from their peers and instructors (Rakes & Dunn, 2010). As a case in point, Bianchi-Laubusch (2016) found that many students (42%) in one large asynchronous online program did not have a chance to communicate with their peers. To counteract this isolation, online programs designed to keep cohorts of peers together over time have been designed based on the working theory that peer support will increase as relationships develop (Tisdell et al., 2004). With the many communication tools available, there is evidence that peer relationships can grow over time increasing the likelihood of peers being a source of social support (Berry, 2017). Tisdell et al.'s (2004) study found that students did indeed find support through the developing relationship, as did Berry's (2017) qualitative case study of online doctoral students.

Instructor support remains important due to the instructor-centric nature of academic programs. Perhaps not surprisingly, in an interview study of six adult students in an online program, Song and Hill (2009) found that adult students relied on classmate and instructor support.

The importance of social support and the sources for that support for traditional age college students are well established. However, adults' social networks evolve over the life span and the sources of social support, so important for academic success, have received little attention for adults at mid-life. The most obvious difference is the diminished support role that parents play at mid-career. On top of that change, many students experience online learning as more isolating from peers and instructor than face-to-face learning. This brief review of the literature leaves us with questions about where mid-career adult students in online programs get their social support and if parents' education level continues to influence academic self-regulation of the mid-career adult graduate student.

Research Questions

We found little research on 1-GC graduate students in online graduate programs and how their sources of social support interact with academic self-regulation. We were also interested in learning if the cohort model was enabling classmate social support for students as they progressed through the program. The purpose of this multiple regression study was to determine to what degree parental education level, cohort progression, and perceived social support (PSS) of adult students in an online Doctor of Education (EdD) program predicted academic self-regulation. We also wanted to determine to what degree perceived social support (PSS) and parental education level interacted with academic self-regulation. The study addressed these questions for adult, professional students in an online doctoral program:

1. To what degree do parental education level and cohort progression predict academic self-regulation?

2. What sources of perceived social support -- family, friends, loved one (significant other), and classmates -- are predictive of academic self-regulation for adult students in an online doctoral program?

Methodology

For this cross-sectional prediction study, we used multiple regression analysis of data from an online questionnaire delivered to doctoral students from one online EdD Organizational Leadership program.

Population and Sample

To answer the research questions, we administered an online questionnaire to all 186 students from an online Organizational Leadership EdD program within a non-profit, private, faith-based liberal arts university in the southwest. These 186 enrolled students (population) consisted of approximately 33% African American, 15.2% Hispanic/Latino, 66% female, and a significant number of first generation college students. Although we did not have data from students about parental educational level prior to this study, we had informal reports of many students being first generation college goers (1-GC).

Students were asked to complete the online survey one year after the program's Summer 2015 launch date. The online questionnaire distributed through SurveyMonkey to the 186 online doctoral students resulted in a 49% response rate (n = 91). Four participants submitted incomplete survey data reducing the useable sample to 87. Females represented 67% of the survey respondents. Ethnicity of participants were as follows: 47% White/Caucasian, 35% Black/African American, 13% Hispanic/Latino, and 7% other. The average age of the survey participants was 44 years (M = 43.6, SD = 10.4).

Instrumentation

To measure academic self-regulation (ASR) we used the following scales from the Motivated Strategies for Learning Questionnaire: Goal Orientation, Meta-Cognitive Self-Regulation, and Resource Management: Help Seeking (MSLQ; Pintrich, Smith, Garcia & McKeachie, 1991). To measure social support, we used the Multidimensional Scale of Perceived Social Support (MSPSS; Zimet Dahlem, Zimet, & Farley, 1988) with its three subscales for different sources of support: family, friends, and loved ones. To address our interest in determining if the cohort model resulted in increasing levels of perceived social support (PSS) among peer students, we created a classmates subscale by modifying the friends subscale of the MSPSS. We based our measure of parent education level on Toutkoushian, Stollberg, and Slaton's (2018) discussion by using a scale measure from high school or less to doctoral degree rather than categorical first-generation and not-first-generation. We also gathered basic demographics to determine how representative our respondents were of the doctoral program's student population.

Results

Multiple regression analysis was used to measure to what degree the predictor variables of parental education levels (PEL), cohort progression and perceived social support predicted the criterion variable of perceived self-regulation. Thirty-one percent of respondents indicated neither parent had taken any post-secondary classes or training (see Table 1). This is the strictest measure of first generation college goers, according to Toutkoushian et al. (2018), and it exceeds the 17.6% of students in science and engineering Ph.D. programs in the United States who reported that neither parent had any post-secondary education (National Science Foundation [NSF], 2016). Table 1 highlights frequency information that pertains to the highest education level achieved by one parent. It is worth noting that 40.2% of students' PEL is less than an associate degree (high school or less, some post-secondary training, and some college classes) while 32.2% of students have a parent with a graduate degree.

Table 1

Highest Education Level Achieved by One Parent

Parent education level	Frequency	Percentage
High school or less	27	31.0
Some post-secondary training	6	6.9
Some college classes	2	2.3
Associate degree	12	13.8
Bachelor degree	5	5.7
Master degree	17	19.5
Doctoral degree	11	12.6
N/A	7	8.0
Total	87	100.00

Students in the doctoral program enroll in one seven-week class at a time for a total of six classes (18 semester credit hours) per calendar year. With that in mind, we used the number of seven-week classes completed, which we called doctoral program cohort progression, as a measure of time with cohort peers with zero serving as the minimum and eight as the maximum values. Of the respondents, the greatest number (26%) had completed just one class (see Table 2). Forty-six percent (46%) of responding students had completed two or fewer classes while students completing six or more courses made up only 18.4% of respondents. The remaining 35.6% had completed three to five courses.

Table 2

Participant Doctoral Program Progression by Classes Completed

Classes completed	Frequency	Percentage
0	2	2.3
1	23	26.4
2	15	17.2
3	8	9.2
4	13	14.9
5	10	11.5
6	7	8.0
7	8	9.2
8	1	1.1
Total	87	100

Multiple regression analysis was used to determine if the number of doctoral program classes completed and highest education level of one parent predicted students' academic self-regulation. The overall model significantly predicted academic self-regulation; accounting for 26.5% of the variance, $R^2 = .265$, $R^2_{Adjusted} = .229$, $F(2, 82) = 4.25$, $p < .018$. The doctoral program cohort progression predictor variable did not contribute to the model, as highlighted in Table 3. The assumptions of linearity and homogeneity of variance were met based upon data presented within the model's scatterplot of standardized residuals. The assumptions of independence (Durbin-Watson = 2.01) and collinearity (Highest Education Level of One Parent, Tolerance = .99, VIF = 1.001; Doctoral Program Progression, Tolerance = .99, VIF = 1.001) were also satisfied for this model. Shapiro Wilk test results of .457 in addition to the observation of the Normal Q-Q Plot addressed the assumption of normality for the criterion variable of academic self-regulation.

Table 3

Parent Education Level and Cohort Progression Standardized Coefficients

Model	Standardized coefficients beta	T	Significance
Parent education level (PEL)	-.263	-2.501	.014
Cohort progression	-.164	-1.555	.124

Note. Dependent variable: Academic self-regulation

To test how PSS from the various sources predicted academic self-regulation, we compared results from the MSLQ to the MSPSS. A multiple regression analysis revealed that PSS from doctoral students' classmates, friends, and family significantly predicted the students' academic-self regulation based upon the overall model, $R^2 = .264$, $R^2_{Adjusted} = .237$, $F(3, 81) = 9.699$, $p < .001$. Within this model, Classmates PSS served as a mediator variable to Friends PSS. Family PSS did not contribute to the model. An increase of one standard deviation unit within PSS Classmates resulted in a standard deviation unit increase of .467 within the criterion variable of academic self-regulation. Table 4 displays how Classmates PSS influenced doctoral students' academic self-regulation compared to Friends and Family PSS.

Table 4

PSS Family, Friends, and Classmates Standardized Coefficients

Model	Standardized coefficients beta	T	Significance
PSS Family	.022	.199	.843
PSS Friends	.073	.617	.539
PSS Classmates	.467	4.289	.000

Note. Dependent variable: Academic Self-Regulation

Data presented within the scatterplot of standardized residuals adhered to the linearity and homogeneity of variance assumptions for the PSS model. The assumption of independence was further met (Durbin-Watson = 2.229). Originally, a multiple regression analysis of four instead of three PSS predictor variables was used to predict academic self-regulation. The predictor variable, Significant Others PSS was removed from the model due to a collinearity violation with Family PSS. Table 5 shows the tolerance and variance inflation factor (VIF) figures that satisfied the assumption of collinearity for the three remaining PSS predictor variables; tolerance statistics being greater than .1 (Mertler & Vannatta, 2002) and VIF figures being less than 10 (Keith, 2006).

Table 5

PSS Family, Friends, and Family Collinearity Statistics

Model	Tolerance	VIF
PSS Family	.762	1.312
PSS Friends	.651	1.535
PSS Classmates	.765	1.307

Note. Dependent variable: Academic self-regulation

Discussion

The percentage (>30%) of students whose parents did not complete any education beyond high school did not surprise us, but it does stand in sharp contrast to the dropping percentage of first generation graduates of science and engineering doctoral programs (17%; NSF, 2017). This evidence supports the argument that the online doctoral degree is more accessible to underserved students than the traditional Ph.D. (in science and engineering).

The current findings provide evidence that the influence of parental educational level on academic self-regulation persists through midlife of adult children as argued by Kniffin (2007). One explanation is that the behaviors and attitudes that make up academic self-regulation are learned in early life and influenced by parents' education level through social learning in the home more than through social support while the student is in school (whether during emerging adulthood or at mid-life). This would explain why our findings (students' M age = 43.6) are similar to the findings of Williams and Hellman (2004) for students (M age = 29.64) who were first-generation college goers in an online undergraduate program. At mid-life, family, friends, and classmates are be more likely than parents to offer social support that would influence academic self-regulation, but the self-regulation behaviors learned early in life from the parents persist, apparently, even into mid-life.

The variable Friends PSS predicts academic self-regulation, but Family PSS does not. Our results are in line with those of Wilks and Spivey (2010) who found that friend social support moderated the negative relationship between academic stress and resilience for students in a social work academic program. The varying interpretations of family at midlife may contribute to the lack of differentiation in our results between family and significant other and to the PSS Family variable not contributing to the model. It is likely that family support would be limited to emotional support and instrumental support including helping the student manage time through caring for family obligations that the student might normally be responsible for.

Classmate social support is strongly predictive of academic self-regulation. This is not surprising given the shared experience of navigating a difficult, online, graduate program, but it highlights the importance of students working through the sense of isolation from peers that other researchers have reported (Rakes & Dunn, 2010). The support from classmates would encompass emotional, instrumental, and informational support specifically related to the content and logistics of the program. Program elements that enable peer classmate social support include a program orientation module, which has two discussion forums where new students connect followed by weekly asynchronous discussions on the application of theories and research.

Students' willingness to seek out more peer interaction when feeling a need for support could be related to students' academic locus of control (ALOC). Lee, Choi, and Kim (2013) found that ALOC was a strong predictor of persistence and dropout among students in online courses. Students who consider the social isolation of an online program to be contingent on their own efforts to socially engage with others would be more likely to increase their efforts to interact with their peers. On the other hand, if they bring an external locus of control to the online learning environment and then experience social isolation, they may be more likely to attribute the lack of peer support to the environment itself.

Our results support Broadbent and Poon's (2015) interpretation that peer learning was important in spite of its non-significant relation to academic outcomes in their meta-analysis. We would add that as parental social support decreases in mid-career, the social support students receive from peers becomes even more important. Thus, in academic programs designed specifically for working adults, designing opportunities for such support to flourish is important. One of the default instructional approaches to accomplish peer interaction is through group projects; however, our anecdotal experience with such projects in online environments is inconsistent. Prospective adult students regularly indicate their dislike of group projects. This is in line with limited previous research on the attitudes of adult online learners towards group assignments (Favor, 2012; Favor & Harvey, 2016; Favor & Kulp, 2015). Group assignments and other instructional activities (with their implied grade related risks) that promote peer interaction should be undertaken with care. Favor and Harvey (2016) tested a structured planning approach including a team charter that had ambiguous results but showed some potential.

The finding that cohort progression (measured by number of courses taken) does not predict academic self-regulation was unexpected. We anticipated that students would learn to self-regulate more effectively as they moved through the program. It is possible that students early in the program overestimate their ability to self-regulate. This flawed self-assessment is in line with Dunning, Heath, and Suls' (2004) findings in a systematic literature review on the weaknesses of self-assessment. Self-regulation may be particularly susceptible to the weaknesses of self-reporting. One could argue that the cohort group's self-regulation scores would become less inflated as it progresses. The students who are more self-aware, more accurate in their assessment of their self-regulation, and so rate themselves lower at the beginning of the program persist at a higher rate (Carver & Scheier, 1981).

Another possible explanation of the lack of growth in ASR is that the sense of social exclusion online students experience inhibits growth in self-regulation skill development. Baumeister, DeWall, Ciarocco, and Twenge (2005) found that individuals who experienced social exclusion self-regulated less than before. They suggested this might be due to the reduced motivation to focus attention on one's self when the rewards for doing so – social connectedness and belonging – are withheld. If this is the perception, it would explain why some online students do not become more self-regulating over time. A solution would be to increase students' awareness of the opportunities to connect with peers and instructors online to belong to a community of inquiry. Students with more awareness of the opportunities to connect socially could see the link between self-regulating behaviors (regulating social interactions in particular) and increased social connection and belonging.

Conclusion

This study contributes to our understanding of the sources of social support for adult, online students and how much social support predicts their academic self-regulation. This study also provides evidence of online doctoral programs offering greater opportunity to first generation students and that their parents' education level still affects academic self-regulation even in adulthood. Limitations of this study are several. First, generalizing is problematic from the study sample from one private, non-profit, faith-based institution. Second, the measure of academic self-regulation, while widely used, was not designed for adults studying online. Future research is needed to explore how adult students describe the networks and patterns of social support, including sources of support, social support regulating behaviors, and types of social support. Another research opportunity would be to use the recently developed and validated self-regulated online learning questionnaire (Jansen et al., 2017) to explore the experiences of adult students in online programs. The present study, in spite of reasonable limitations, contributes key insights into the drivers of academic self-regulation in adult learners in online graduate programs.

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Online Education for Public Health Capacity Building in Low- to Middle-Income Countries: The Peoples-uni Experience

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Abstract

People's Open Access Education Initiative (Peoples-uni, http://peoples-uni.org) aims to contribute to improvements in the health of populations in low- to middle-income countries by building public health capacity via e-learning at affordable cost. We describe experience over nine years of the initiative, including the development and delivery of a Master of Public Health (MPH) programme in public health and collaboration with a UK University. Courses rely on Open Educational Resources and volunteer tutors from over 50 countries to date. During 18 semesters since 2008, 1619 students from 92 countries (71% from Africa) enrolled. Of 128 students accepted on an MPH programme accredited by a UK University, 94 earned an MPH (73%) and a further 18 (14%) achieved a postgraduate diploma or certificate. Other developments include continuing involvement with Alumni, and a sister site for Open Online Courses to include topics not often found in MPH courses. We offer insights for further development of this and similar online capacity building programmes within low-resource environments. Our experience shows the feasibility of affordable, high quality online education and that there is scope for accelerating capacity building programmes through partnerships with higher education institutions and health(care) organisations.

Keywords: online education, open educational resources, public health, capacity building, low-income countries, middle-income countries

Introduction

The People's Open Access Education Initiative, known as Peoples-uni (http://peoples-uni.org), aims to contribute to improvements in the health of populations in low- to middle-income countries (LMICs) by building public health capacity via e-learning at affordable cost. This paper describes our experience over nine years of the initiative in the development and delivery of a master's programme in public health, including our collaboration with a UK University for an accredited Master of Public Health (MPH) degree. Given growing concerns about public health workforce shortages globally (World Health Organisation, 2016) there are important lessons from this review of an innovative experiment in capacity building.

We start with a brief description of the development of Peoples-uni over time. We describe the model of delivery, followed by an analysis of student experience and outcomes and an account of lessons based on our data and experience, and then outline future development opportunities for partner organisations that share our mission and may wish to collaborate.

Background: Development and Current Status of Peoples-uni

We have previously described the development of the concept and the situation analyses that led us to setting up Peoples-uni (Heller et al., 2007; Heller, 2009). In essence we developed a programme that could be delivered entirely online to health professionals working in LMICs. By focusing on competence-based educational outcomes through a social model including the use of volunteer tutors and support staff, and use of Open Educational Resources (OER), we are able to offer high quality education at very affordable cost.

Table 1 provides an overview of the development of Peoples-uni in three phases, since its establishment in 2006.

Table 1

Timeline of Key Steps in Development of Peoples-uni

Date	**Event**	**Comment**
Phase One		
2006	Small team of colleagues in Manchester, UK explores idea for low cost public health capacity building in LMICs.	Builds on opportunities presented by the advent of OER and availability of an open online platform (Moodle).
2007	Situation analysis performed in six developing countries.	Few opportunities for master's-level education in LMICs and large need identified. Focus on master's level to develop future trainers to accelerate local workforce development.
2007	People's Open Access Education Initiative registered as UK charity.	Educational purpose stated, but no registration as formal educational provider.
2007	Small team worked with Royal Society for Public Health to develop curriculum and course structure.	Course based on previous experience of online learning and sound educational principles.
2008	Pilot Maternal Mortality module	Positive experience and feedback.

	established on Moodle and run with 30 students in Africa and two tutors.	
2008	Volunteer tutors to develop course modules and IT support identified through networks.	
	First six modules offered.	All modules ran to timetable, fully supported by tutors and IT support, student feedback was positive.
2009-11	Additional modules offered.	Certificates and diplomas awarded.
Phase Two		
2011	Partnership with Manchester Metropolitan University (MMU) commenced after modification of modules and addition of Dissertation - Master of Public Health (MPH) degree approved.	Large amount of administrative work to ensure compliance with requirements of a formal UK master's level award. Tutors and students continue to increase in numbers.
2013	Partnership with MMU ceases after four semesters of student entry. Attempts to identify alternative university partner commence.	High quality of education acknowledged. Difficulty in finding alternative partner.
Phase Three		
2014	Open Online Courses (OOC) site developed for free access to self-paced courses covering additional topics.	Offers topics not usually included in MPH programmes, and introductory public health courses. Hosting and development of courses for external partners.
2015-2018	Modules continue to be offered at master's level. MPH awarded through Euclid University. OOCs continue to be developed and offered.	Quality assurance maintained and course development continues.

Phase one: Setting up. Curriculum development was initially undertaken by a small group, with advice from colleagues at the UK Royal Society for Public Health (RSPH), and leaned heavily on the experience of online master's courses at the University of Manchester, United Kingdom, and the University of Newcastle, Australia, which had been developed and directed by one of us. The educational offerings were developed at the master's level, including competences of analysis, synthesis, and evaluation according to Bloom's terminology (Bloom et al., 1956). Course modules follow a common framework, hosted on the Moodle open platform, populated by OER, with metadata to guide students through the resources. Students are also supported by online discussion forums facilitated by expert tutors. Written assignments are used as summative assessment.

Each course module was developed by a team of expert tutors, including at least one person from or with experience of an LMIC, and reflected competences of relevance to public health in LMICs (Reynolds & Heller, 2008). To maximise accessibility by LMIC students, we used low bandwidth resources and asynchronous discussion forums. As time went on, the materials were revised and new modules added. Students could take individual modules and also work towards securing a certificate or a diploma based on passing a number of course modules.

Phase two: Formal university collaboration. While valuing the courses, students identified in their feedback a need to gain academic recognition through an accredited award. Manchester Metropolitan University (MMU) agreed to support us as a university partner on a time limited basis, and a thorough validation process was undertaken with them. A number of changes were made to the structure of the modules and methods of assessment to ensure that the programme was benchmarked at the requisite standard for a UK Level 7 (master's) degree. This included ensuring that the learning outcomes used appropriate terminology and that the assignments were extended in scope and depth. As part of the validation exercise, external experts joined MMU staff and gave their input to and then approval of the MPH Programme. Following this, students who passed at least two Peoples-uni modules became eligible to enrol as external students on the MMU MPH Programme. All education, assessment, and infrastructure was provided by Peoples-uni whereas MMU provided quality assurance through an examinations board and external examiner.

Since the end of the partnership with MMU, we have continued to offer the same (and additional) courses to the same academic standards as before, under matching internal quality control mechanisms. A new partnership with Euclid University (http://www.euclid.int/) allows us to continue to offer an MPH award to the students who study with Peoples-uni.

Phase three: Development of open online courses. In a quest to remain responsive to emerging needs of students, to widen the course offerings, and to make them accessible to all health care workers, we created another course delivery site in 2014. This Open Online Courses (OOC) site (http://ooc.peoples-uni.org) also uses the Moodle platform and OER to provide smaller, self-paced, free online courses without academic credit for topics not usually covered in an MPH programme, as well as introductory public health topics. The site allows course development for, and hosting of, courses produced by other organisations.

Infrastructure and setup. The programme courses run on the Moodle open source educational platform. IT support and the development of enrolment processes and recording systems are provided by both volunteers and a paid infrastructure team, who also provide a Helpdesk to students and tutors. An academic coordinator oversees the recruitment and supervision of volunteer tutors, and student enrolment. Module leaders lead the development and delivery of each module in teams of at least five tutors. Modules run to a semester timetable, with the majority of modules being available in each semester.

Tutors and student support. Tutors are required to have a master's degree and are volunteers from academic or service backgrounds; new tutors are paired with experienced tutors for the first semester. Each tutor is asked for only a small time commitment, as the majority are in active employment.

An additional team of Student Support Officers (SSO) – graduate volunteers – provide additional academic skills support as many students have little experience of postgraduate studies. This support included a free *Preparing to Study Course* prior to module enrolment, a Student Corner section on our website with online study skills resources, and a student-to-student discussion forum.

Financial model. During our situational analysis, we were advised to levy a small charge (not make it free) so we instituted a small fee per module to cover basic costs. Additional low fees were levied on those pursuing the full MPH programme. For those who could not afford the fees, we granted full or partial bursaries.

Quality assurance. We use several mechanisms for quality assurance, including student feedback surveys of every module each semester, module revisions at least every three years, and the appointment of an External Examiner and an Educational Committee, which functioned as an examinations board and quality assurance body.

Analysis of Student Experience and Outcomes

Methods

Much of the administrative data collection was automated. Automated spreadsheets registered enrolments with demographic information collected on the registration and application forms, and assignment results were recorded, in addition to a number of other details of progress throughout the programme. Automated reports were developed to record pass rates according to demographic data of the students. Tutors were registered on a spreadsheet, with their demographic data. In compliance with data protection rules, student registration forms stated that anonymised information would be collected for analysis and possible publication.

For the purposes of this study, we explored information from these sources up to August 2017, compiling descriptive statistics. No statistical analyses were performed as we were not testing hypotheses in this report. In addition, regular student feedback surveys are performed in compliance with usual quality assurance practice. In every semester, all students received anonymous online feedback surveys for each module after marking was complete; three reminders were also sent. Response rates varied across modules and semesters. In early 2017, we undertook a special survey of internet connectivity using the same anonymous online survey method. The survey was sent to all 118 students who had enrolled in the most recent semester.

Student numbers and completion rates. During 18 semesters since 2008, a total of 1,619 students enrolled in 6,049 modules, of which 2,164 (36%) were passed with a mark of at least 50% (master's level pass mark). Students accepted in to the master's programme had enrolled in 1,814 modules, with 1,451 (80%) passes at the master's level. Of 128 students accepted on the MMU MPH Programme, 94 were awarded the MPH (73%). A further 18 (14%) achieved a postgraduate diploma or certificate award. Four students failed the programme on academic grounds (the other non-completers dropped out).

Student characteristics. Table 2 shows the distribution of student characteristics on initial enrolment for the group as a whole and for those who passed at least one module at the master's level. Distributions of characteristics did not differ substantially between these groups. One third of all students were medical graduates, 26% already had a higher degree (master's or PhD) and 40% gave their employment as Public Health. Students were from 92 different countries, with 71% from Africa (Table 3).

Table 2

Characteristics on Initial Enrolment of 1,474 Total Students and 497 Students Who Passed at Least One Module at the Master's Level: Percentages are of Denominators (N) in Each Column Category

	All: N (%)	**Passed at least one module at master's level: N (%)**
Gender	*1431**	*477**
Female	529 (37)	199 (42)
Male	902 (63)	278 (58)
Date of birth	*1429**	*476**
<1969	239 (17)	84 (17)
1970-79	582 (40)	176 (37)
1980+	608 (43)	192 (40)
Qualifications	*1474*	*497*
Degree (not health related)	348 (24)	111 (22)
Health qualification (degree, not doctor)	464 (31)	155 (31)
Health qualification (non-degree)	149 (10)	47 (9)
Medical degree	482 (33)	174 (35)
None	31 (2)	10 (2)
Higher qualification	*1474*	*497*
Certificate	157 (11)	49 (10)
Diploma	245 (17)	78 (16)
Masters	340 (23)	115 (23)
None	583 (40)	211 (42)
Other	110 (7)	33 (7)
PhD	39 (3)	11 (2)
Employment	*1474*	*497*
Academic	112 (8)	45 (9)
Clinical (not specifically public health)	357 (24)	123 (25)
Non-health	56 (4)	14 (3)
None	72 (5)	22 (4)
Other health related	246 (17)	79 (16)
Public health	586 (40)	197 (40)
Student	45 (3)	17 (3)
How heard about	*843*	*276*

*Peoples-uni***		
Search engine	77 (9)	22 (8)
Informed by other Peoples-uni student	325 (39)	105 (38)
Informed by someone else	248 (29)	84 (30)
Internet advert	25 (3)	4 (2)
Link from another site or forum	125 (15)	47 (17)
Referred from partnership institution	40 (5)	14 (5)
Facebook	3 (0.3)	0

Note. Data were not collected on some students at the start of the programme. *some data missing ** question added later

Table 3

Country of Students

Region	**N**
Eastern Africa	436
Western Africa	447
Central Africa	91
Northern Africa	20
Southern Africa	53
Southern Asia	202
Europe (incl UK)	79
US/Canada/Australia/NZ	32
South Eastern Asia	64
Western Asia	20
Latin America	14
Other	16
Total	1,474

Note. Data were not collected on some students at the start of the programme.

Choice of modules. The award of a diploma required students to complete six modules in the MMU programme, increased to eight subsequently, and the master's programme requires the addition of a dissertation module. Students could select any modules they wanted, provided at least two came from each of the Foundation Sciences and Public Health Problems groups. Students could also gain a certificate based on passes in any three (now four) modules. Table 4 shows the distribution of the modules which the students selected. Based partly on the experience and selection of modules, we have now changed to require that all students take *Introduction to Epidemiology* and *Biostatistics* as core modules.

Table 4

Selection of Modules by Students

Module	**N semesters offered**	**N Applications***	**Ranking**
Foundation sciences group			
Biostatistics	18	712	2
Evaluation of interventions	13	306	11
Evidence based practice	17	393	5
Health economics	15	302	12
Health promotion	11	282	13
Inequalities and the social determinants of health	10	175	15
Introduction to epidemiology	18	899	1
Public health concepts for policy makers	14	331	9
Public health ethics	4	81	16
Total		3481	
Public health problems group			
Communicable disease	17	444	3
Disaster management and emergency planning	17	390	6
HIV/AIDS	14	412	4
Maternal mortality	18	355	7
Non-communicable disease	14	224	14
Patient safety	7	101	17
Preventing child mortality	16	328	8
Public health nutrition	15	321	9
Total		2575	
Dissertation	11	213	

Note. Details of the module content can be seen at http://www.peoples-uni.org/content/unit-module-descriptions-and-codes. *7 of these students did not go on to enrol

Student feedback. Students were generally positive about their experience with Peoples-uni (Awofeso, Philip, & Heller, 2012). Student feedback on each module is obtained at the end of each semester to guide further developments and improvements. In the most recent two semesters, 93% of all responding students considered their course "relevant" or "very relevant" to someone working in an LMIC, and 96% would recommend the course to others.

In early 2017, a survey among the 118 students who enrolled in modules in the second semester of 2016 had 53 respondents with full data (45%), of whom 22 (42%) reported that they regularly had to travel to remote locations without internet connectivity for at least two weeks in a semester. While the cost varied considerably, 45 (85%) of the students had to pay for internet access from their own funds.

Volunteer tutors. A total of 535 people registered on the website as potential tutors, resulting in the selection of 372 active tutors from 51 countries. Table 5 shows the geographic distribution of the active tutors.

Table 5

Country of Active Volunteer Tutors

Region	**N**
Africa	46
Southern Asia	26
Europe	24
UK	147
US/Canada/Australia/NZ	109
Other	20
Total	372

In 2014, we surveyed 367 Peoples-uni volunteers (including tutors, SSOs, and other administrative support staff), resulting in 192 (52%) responses. The majority (75%) were keen to continue in their role for the foreseeable future and 71% felt very well looked after by their module leaders and colleagues. Responses highlighted that volunteers embraced the mission and characteristics of Peoples-uni (high-quality formal education for LMICs at low cost, the collegiate, personalised approach and enthusiasm of tutors, the flexibility, and the ease of exchange and communication between tutors and students from across the world).

Alumni. Graduates of the master's programme are enrolled on an alumni network where they are supported in undertaking the next steps of their career and research (Heller et al., 2015). So far, 30 master's-level graduates have joined as volunteer tutors or SSOs. A separate evaluation is underway that will report the progress of alumni in terms of career progression and impact.

Open online courses (OOC) site. There are 30 courses so far; some are created by Peoples-uni, some are developed for or with other organisations, and some are produced by other organisations and hosted on the OOC site.

To date, there have been more than 3,000 users of the OOC site. In an early description of the first two years of operation, 1,174 students from 100 countries had registered on 14 courses, and among the 1,597 enrolments, 15% gained a certificate of completion (Heller et al., 2017). The students who had registered in more than one course were most likely to gain a certificate of completion.

Discussion and Lessons Learned

We have described the creation of a model for supporting public health capacity using developments in OER and open access IT, and by leveraging the tremendous goodwill that exists amongst people who are prepared to volunteer their expertise and time. Our results demonstrate the success as well as the limitations.

Student population and recruitment. The majority of students work in health, 40% in public health. One third of the students have a medical degree. Generally, students find out about Peoples-uni through word-of-mouth recommendations. As such, this may influence some of the described demographics; however, it is also a reminder of the largely untapped population of potential students in the field who might benefit from such a programme. A more targeted approach to student recruitment (and even programme development) is conceivable, for example, if partner organisations identified potential students in-country.

Student admission criteria and completion rates. We require no documentation of previous education at the undergraduate level or language skills; acceptance onto the master's programme is restricted to those who have passed at least two modules at the master's level. This provides evidence of academic and language ability adequate for this level of education. Although many master's level courses allow entry to a proportion of students who do not have a prior undergraduate degree (in our case 12 % of all our students and 11% of those who passed at least one module – Table 2) there is little information in the literature about the completion rates of these students compared with others. There is some information on the predictive validity of English language testing, where correlation with examination performance is only about 0.3-0.4 (Davis, 2007). The requirement to demonstrate ability by passing two modules prior to enrolment to a master's level course has served us very well, as demonstrated by the MPH completion rate, and the fact that only a very small number actually fail the programme on academic grounds. We suggest that others may consider this approach, as documentation of prior qualifications and English language skills are cumbersome and carry a high administrative cost.

Programme contents and student choice. The original selection of modules to include in the programme was determined partly by reference to competences deemed relevant to public health practice in LMICs (Reynolds & Heller, 2008) and partly by the interests of course developers. The programme allows maximum flexibility for students to choose modules. This might be considered to be at the expense of key areas usually provided as part of an MPH programme, including those of relevance to LMICs (Zwanikken et al., 2014a). Our approach has been to ensure that people could not graduate without knowledge and skills in key areas, such as epidemiology, by including relevant elements, for example in Public Health Problems modules, as well as in the dissertation.

Students' choices indicate that Epidemiology and Biostatistics are ranked highest in terms of popularity, hence we have now made these core requirements for the master's programme. Some modules from the Public Health Problems group (e.g., Communicable Disease, HIV, Disaster Management, and Maternal Mortality) were also ranked highly, most likely indicating the perception that students need these courses to support their work and career. Alternatively, the lack of enrolment in the new Global Mental Health module may indicate that this topic may not be seen as priority for local healthcare systems yet.

Online education in LMIC environments. Although they did not report on public health, Frehywot et al. (2013) provided a review of e-learning in medical education in LMICs. They found a number of examples, mainly using blended learning, with positive student feedback and increased educational opportunity, but did highlight the need for institutional readiness. At the time that Peoples-uni was being established, Ijsselmuiden et al. (2007) identified that "Over half (55%) of countries do not have any postgraduate public health programme." and concluded that "Africa urgently needs a plan for developing its public health education capacity" (p. 914). More recently, Zwanikken et al., (2014b) commented on the need for public health education: "The human resources for health crisis, i.e., the severe shortage of human resources in 57 low- and middle-income countries (LMICs), has highlighted the need for high-level public health education to add specific capacities to the workforce" (p. 2). They report on six MPH programmes in LMICs and document positive outcomes among their graduates including on their careers, leadership, and application of competences, impact on the workplace, and, less substantially, on society. Distance learning MPH courses at the University of the Western Cape and Makerere University, (Alexander, Igumbor & Sandars, 2009; Sanders, Guwatudde & Alexander, 2008) each have more than 20 modules available and completion rates of 57% of 120 students for Western Cape and 17% of 49 students for Makerere (although the final data were not yet available). An online MPH programme for Francophone Africa has a completion rate of 78% of the 37 students, although concerns are raised about its sustainability (Chastonay et al., 2015). We have not found other published reports of distance or online MPH courses in LMICs.

Student feedback confirms our courses as relevant to LMIC settings, and students are prepared to recommend the courses to others. Previous analysis of our students has shown that poor engagement is associated with poor pass rates (Philip & Lee, 2011). Frequently reported factors in student feedback surveys that prohibit course participation and completion include poor internet access and lack of time. We currently place great emphasis on students preserving time for study given multiple demands of work and life. We also continue to explore ways of supporting student engagement given their constraints.

Internet access remains an issue as well as cost for some students. Given costs and limited internet access, we continue to respect the low bandwidth requirements by not using videos or real-time exchanges, and offer all resources in zipped files for easy downloading and offline study.

Many LMIC professionals are used to face-to-face and more didactic teaching hence we have provided extensive support to enable them to use and benefit from e-learning.

Quality assurance is crucial and one major benefit of our programme is that its online nature makes the entire operation eminently amenable to continuous quality surveillance and audit. For example, the academic coordinator and module leaders have the opportunity to observe and revisit any tutor-student exchanges, and do this to provide feedback and support to tutors, very soon after the exchanges happen.

Open and distributed learning. The online nature of the educational process is key to this model, which allows both students and tutors to remain in their workplace and geographical setting. The use of OER, in the context of a standardised course format, allows modules to be developed and delivered with greater ease, as well as with increased confidence in their quality, than if content had to be created anew. These factors, together with the use of the open source Moodle platform, contribute to the ability to offer the programme at a cost appropriate to the target audience in low resource settings.

Volunteers as providers of online higher education. The reliance on volunteer tutors also differentiates this programme from universities. An online programme allows engagement of an international cadre of expert tutors, and the limited time commitment required enables us to draw on an extensive group. Use of a clear and consistent framework and OER for each module also support and underpin the volunteer role. Alumni volunteering to join the tutor team are a testament to the mutual regard between graduates and the organisation, and further exemplifies our train-the-trainer approach. It also provides the next generation of students the benefits of a broad range of input into the discussions from those working in LMICs themselves.

University partnerships. The initial partnership with MMU was instrumental in our being able to benchmark to the UK master's level. The partnership ended due to the University's review of their strategy – there were no concerns about the quality of the education offered by Peoples-uni. Following the end of this partnership, we have had discussions with many other universities in a number of countries as potential replacements. Most have not been ready to agree due to a variety of business reasons including low levels of fees (and hence limited income), competition with existing courses (as a large number of universities offer their own MPH programmes). Most of our conversations were very supportive at individual levels and they were uniformly impressed with the quality and commitment at Peoples-uni; however, they also felt unable to negotiate the complex university system of decision making, especially for an organisation such as Peoples-uni, which is volunteer led and driven, with no physical space and a very small financial base. While the RSPH agreed to be our original partner and were helpful in the programme development, in addition to accrediting the programme as a whole, they were not authorised to provide accreditation at the master's level.

The new partnership with Euclid University, accredited as a provider of higher education under a UN charter, will allow our students to continue to gain an MPH degree.

Current and future developments. The described experience in developing and delivering a fully online accredited master's programme in public health encourages us to continue and scale up efforts at capacity building through online education. Our model provides an approach to life-long learning by providing options for not just studying a one-off course but also further progression via alumni development and additional study through OOCs. We have developed the concept of online global learning as "innovative, integrated, global opportunities for capacity building through online learning and shared experiences *between* and *within* Low- to Middle-Income Countries and High-Income Countries, in a continuous process that helps health care workers learn as they progress through their careers" (Madhok et al., 2018, p. 91). There is potential for partnerships with education and healthcare providers and non-governmental organisations for further developments such as blended learning, building the capacity of educational partner institutions to deliver education online, targeted programmes tailored to the educational needs of organisations and groups of students for continuing professional development, and joint awards.

Conclusion and Limitations

We have shown that a course can be developed outside the traditional higher education sector and gain validation from a recognized university even when it is reliant on volunteer teachers, OER, and offered at low cost. Students based in LMICs and learning entirely online were able to complete a rigorous master's programme. Our experience over nine years encourages us to continue this innovative approach to online capacity building targeted at low-resource environments.

There are a number of limitations to our model, including the reliance on volunteers (although this can also be seen as a strength), the difficulty we faced in gaining new academic partners to offer an accredited award to the students, and the problems of supporting the course infrastructure while keeping fees appropriately low for the target audience. Each of these are threats to the long-term sustainability of the programme.

For the future, there is scope to build on this experience through further educational development and partnerships with other organisations. The online nature of programmes such as ours provides opportunity to scale up to meet the massive public health capacity needs faced by LMIC populations.

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Examining the Complexities of Parental Engagement at an Online Charter High School: A Narrative Analysis Approach

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Abstract

With the rapid growth of K-12 online learning opportunities, calls have come for more and better parental engagement to improve student engagement and reduce student attrition. In this article, we drew from a larger study to share rich narratives from three parents of students who required high levels of parental support for their online learning while enrolled at a charter cyber school. In the first narrative, a mother describes her experiences attempting to work with her son Ivan, who rejected her efforts and disobeyed rules while enrolled in the cyber school. The move from a brick-and-mortar school to the cyber school further strained their relationship and the mother was unprepared to manage Ivan's learning. The second narrative focuses on how a mother attempted to support Matthew, who lacked self-regulation abilities. The mother who previously homeschooled Matthew, turned to the cyber school because she wanted "less on [her] shoulders" but underestimated the amount of support Matthew required and became frustrated at her lack of control over the pace and content of courses. The final narrative focuses on a mother who had two students enrolled in the cyber school. Each student exhibited different needs that required her to adapt the support strategies she used with Hannah, who procrastinated, and Karl, who lacked confidence. These narratives highlight some of the complexities parents navigate when engaging with their children's online learning.

Keyword: parent engagement, narrative analysis, charter cyber school, homeschooling

Introduction

K-12 online enrollments have grown rapidly and perceptions of online learning are also becoming more positive (Johnson, Adams Becker, Estrada, & Freeman, 2015) despite higher attrition rates in online courses than in face-to-face courses (Freidhoff, 2017). Research and frameworks used to examine online learning in higher education can offer some insights (see Bawa, 2016) but these findings should not be generalized to K-12 settings due to differences between the student populations and the types of support they require. Parental engagement is one example of a critical type of support universally recognized by the K-12 community but largely ignored when examining adult student populations.

Research conducted in brick-and-mortar schools indicates that when students' parents are involved, they are more likely to succeed (Wilder, 2014). Parents can have an even greater impact on their children's online learning than in traditional courses, especially when students take most or all of their courses online (Liu, Black, Algina, Cavanaugh, & Dawson, 2010). However, little research has examined parents' responsibilities. Identifying and defining types of parental engagement in non-traditional environments may help us increase and leverage the types of parental engagement that are most likely to impact student engagement and learning.

Because parental engagement in their children's online learning has been under-researched, qualitative research examining the experiences of parents and the obstacles they encounter is necessary to understanding their experiences and perceptions (Hasler-Waters, Borup, & Menchaca, 2018). What little qualitative research has been done in this area examines themes drawn from surveys, interviews, and observations with many parents. These articles have offered important insights but have failed to provide rich descriptions of individual parents' experiences. Wolcott (1994), who claimed to have never studied more than one of anything, identified "a tendency to increase the scale, rather than the depth, whenever the question of sample size is raised among qualitative researchers" (p. 181). Following Wolcott's guidance, we examined three parents' experiences and perceptions in an attempt to highlight the complexities they navigated when engaging with their children's online learning.

Literature Review

Trends in Online Learning

While most students use online learning to supplement their face-to-face coursework, cyber schools (full-time online programs) are one of the fastest growing forms of online learning (Gemin, Pape, Vashaw, & Watson, 2015). Survey research has helped to identify reasons that parents enroll their children in cyber schools. Based on a national survey of online course providers, Gemin et al. (2015) found 20% of cyber school students came from homeschooled populations who sought a high school diploma, desired more social interactions, and/or required support their parents were unable to provide. Using student (n=269) and parent (n=232) surveys, Beck, Maranto, and Shakeel (2016) found parents of rural students enrolled in cyber schools accessed more educational opportunities for their students. Beck, Egalite, and Maranto (2014) found that parents enrolled their children with special needs in cyber schools so they could be more involved in their children's learning. Harvey, Greer, Basham, and Hu's (2014) analysis of 140 student surveys found students were drawn to online courses for the flexibility to pursue extracurricular opportunities (Harvey et al., 2014). Cyber schools also provide alternative educational opportunities for students with prolonged health issues or who feel unsafe or uncomfortable at school (Fernandez, Ferdig, Thompson, Schottke, & Black, 2016).

One important downside of online courses is higher attrition rates than in face-to-face courses. For instance, Freidhoff (2017) examined 453,570 online course enrollments from 90,878 students and found online course pass rates (58%) were lower than the pass rates for those same students in face-to-face courses (78%). Early reports comparing online and face-to-face performance found no significant difference (Cavanaugh, 2001; Cavanaugh, Gillan, Kromrey, Hess, & Blomeyer, 2004; Ferdig, DiPietro, & Papanastasiou, 2005). However, these reports relied on small sample sizes and unequal comparison groups (Barbour, 2013). More recent reports have addressed these limitations and provided a clearer understanding of student performance in cyber schools. Woodworth et al. (2015) conducted the largest study on student performance at cyber schools, comparing student data from 158 charter cyber schools face-to-face students who were similar demographically. The comparison found that "online charter students have much weaker growth overall" (p. 23).

Parental Engagement

Because parents' engagement in their children's online courses is not well studied, researchers have sought insights from parental engagement frameworks established in face-to-face settings such as those from Epstein (1987) and Hoover-Dempsey and Sandler (2005). However, researchers have found the Epstein's (1987) and Hoover-Dempsey and Sandler's (2005) frameworks helpful but ultimately incomplete—especially when attempting to identify the specific types of parental engagement.

Epstein's (1987) framework was developed following the analysis of surveys from 1,200 parents and 3,700 elementary school teachers and principals in face-to-face elementary schools. The analysis identified four primary types of parental involvement: providing for students' basic physiological and academic needs, participating in school-to-home communication, volunteering in school and extracurricular events, and assisting students at home to develop academic and social skills. Guided by Epstein's framework, Curtis (2013) interviewed eight cyber school parents and identified three types of parental engagement that appeared to be especially impactful on students' performance: motivating, monitoring, and mentoring efforts. Burdette and Greer (2014) lightly based their research on Epstein's framework when they administered a survey to a stratified sample of parents across the United States with children with disabilities enrolled in an online course. Over half of their 119 parent participants indicated that they helped their child to understand course assignments and content, encouraged them to complete assignments, organized their time, and helped them to develop positive social and behavioral skills.

Rather than focus on the specific activities like Epstein's framework, Hoover-Dempsey and Sandler's (2005) framework identified four broad *mechanisms of influence* that could occur at home or school: encouraging, modeling, reinforcing, and instructing. In a case study involving 14 teachers, parents, and administrators at a full-time elementary cyber school, Hasler Waters and Leong (2014) built on Hoover-Dempsey and Sandler's (2005) framework and found that parents impacted their children's learning by organizing their time and space, setting expectations, motivating, monitoring, and guiding their learning. Using a survey developed by Hoover-Dempsey and Sandler (2005), Liu et al. (2010) created and validated an instrument that measured parents' encouraging, modeling, reinforcing, and instructional efforts in online courses.

To encourage a more coordinated and focused research agenda, Borup, West, Graham, and Davies (2014) drew on face-to-face and online parental engagement research to create the Adolescent Community of Engagement (ACE) framework, which identified and defined specific types of parental engagement in their children's online learning. Borup and colleagues then conducted two case studies at a cyber school to refine and expand the types of parental engagement originally identified in the ACE framework (Borup, 2016; Borup, Stevens, & Hasler Waters, 2015). The following forms of engagement were consistently identified by charter cyber school teachers, students, and parents:

- Instructing: Parents provided instructional support by answering content-related questions when possible, reviewing assignment directions and projects, and helping students develop study skills.
- Organizing: Parents provided students with an organized learning space and schedule.
- Nurturing relationships and interactions: Parents worked to maintain caring relationships with students and facilitated interactions between students and their online teachers.
- Monitoring and motivating: Parents closely monitored student performance and motivated students as needed.

Parents' Reasons for and Obstacles to Involvement

Hoover-Dempsey and Sandler (2005) identified seven contributors to a parent's decision to engage in their children's face-to-face learning: perceived roles constructed throughout their lives, self-efficacy, self-perceived knowledge and skills, self-perceived available time and energy, general school invitations, teacher actionable invitations, and student invitations. Based on their framework, we predict that parents' inexperience with being or supporting an online student will impact how they perceive their roles and the self-efficacy, knowledge, and skills that are required to successfully engage in their children's online learning. A national survey also found online schools can differ in their perceptions of parental engagement (Woodworth et al., 2015). Qualitative researchers have found that parents increase their engagement activities when they recognize online students' underperformance (Curtis, 2013; Hasler Waters, 2012). Parents' tendencies to increase their engagement following underperformance may help to explain why correlational research has not identified stronger relationships between the amount of parental engagement and students' overall performance (Black, 2009; Borup, Graham, & Davies, 2013).

Methods

Context and Data Collection

We conducted our research at Mountain Cyber Charter (MCC), a charter cyber high school. MCC employed 21 teachers. Of their 338 students, 90% were white, 18% had previously been homeschooled, and 14% were economically disadvantaged. All parents were automatically made members of MCC's parent organization. Parents and students also attended a mandatory face-to-face orientation in which MCC provided students with a computer and established expectations for students and parents.

Based on teacher recommendations, we identified 10 students with varying levels of engagement and support needs. We invited the parent most involved in each student's learning to participate in two one-hour interviews, using a semi-structured interview protocol created from the ACE framework. Because two of the identified students were siblings, we conducted three interviews with their parent. In total, we conducted 19 hour-long interviews with nine parents.

Analysis

Guided by elements of constant comparison coding methods (Glaser, 1965), we analyzed all 19 parent interviews, the results of which we reported in an earlier article (see Borup, Stevens, & Hasler Waters, 2015). In this article, our aim is to provide richer descriptions of the experiences of the three parents who described the most complex obstacles to supporting their students. As the parent of the set of siblings, one of the parents participated in three interviews. The other two parents participated in two hour-long interviews each for a total of seven interviews.

We used a narrative inquiry approach to offer a nuanced description of the three parents' experiences as well as to provide an uninterrupted opportunity for these parents to "speak" for themselves. We recognize that narrative inquiry is a broad field and the methods used in narrative inquiry are diverse:

> The term *narrative* carries many meanings and is used in a variety of ways by different disciplines, often synonymously with *story*...the narrative scholar [pays] analytic attention to how the facts got assembled that way. For whom was this story constructed, how was it made and for what purpose? What cultural discourses does it draw on—take for granted? What does it accomplish? (Riessman & Speedy, 2007, p. 428-429)

Our goal was to, as much as possible, elicit and present the experiences of these parents in a way they themselves might present them to another parent or friend. Prompted by Riessman and Speedy's (2007) comments, we recognize that these parents' experiences were constructed for research purposes; participants knew they were being recorded and also knew their words would likely be published for others' consumption and, perhaps, scrutiny. Therefore, we understand some personal, embarrassing, or otherwise negative details might not have been shared. However, we feel it is still important to share these narratives because they give the research community, practitioners, and other parents access to the nuances and subtleties of the learning these parents have gleaned from their experiences. We therefore seek to present these parents' "knowledge *from* the past and not necessarily knowledge *about* the past" (Bochner, 2007, p. 203).

To present the nuances and subtleties of this "knowledge from the past," we turned to Polkinghorne (1995), who presented two types of narrative inquiry: *analysis of narrative* and *narrative analysis*; the former is deconstructive and the latter is constructive. Here we have chosen to conduct a variation of Polkinghorne's (1995) constructive narrative analysis approach so that we could present the uninterrupted, rich, and reconstructed narratives of three parents' experiences with online schooling in their own words—an approach that we previously followed (Borup, West, & Graham, 2013). Our ultimate goal was to preserve and honor the voices of those who are closest to and strongest experts of their own lived experiences, while creating opportunities for others to learn from those experiences. Therefore, we reconstructed these parents' experiences with online schooling, using their own words as much as possible and inserting bracketing filler words only to connect ideas and ensure the flow of the storied experience. We also engaged in multiple rounds of peer debriefing to ensure our reconstruction reflected as closely as possible the intent of the informant. After reconstruction, we examined each story holistically and identified key lessons about how parents can best support their children in online schooling environments.

Findings

In this section, we share the results from the narrative analyses. To protect participants' identities, we refer to them using pseudonyms. In the first narrative, a parent describes her experiences attempting to work with her son Ivan, who rejected her efforts and disobeyed rules. The second narrative focuses on how a parent attempted to support Matthew, who lacked self-regulation abilities. The final narrative focuses on a parent who used different strategies to support each of her two children: Hannah, who procrastinated, and Karl, who lacked confidence.

Supporting Ivan

I graduated with a teaching certificate in elementary education. I never used [my degree] except with my own kids because I did homeschool with my children—we adopted the last two, including Ivan. [At the time,] I put Ivan on the first-grade [online] program with [a large online course provider] where he learned

English really well. Our family moved and I put him in the [brick-and-mortar school] and they took him at grade five, so he skipped the fourth grade. He did okay in grade five—a lot of B and C work. Then he wanted to go back to [the large online course provider] for sixth grade.

He started getting madder and madder [at home in the online program] and throwing books and ripping papers up. I put him in public school [for eighth grade]. He did okay, he got a 3.0 [G.P.A.] for the year. At the high school there were so many Fs. [Ivan was] very influenced by outside influences. The art teacher said [Ivan and] his friends would make fun of the teacher or make fun of kids. He wouldn't come home after [school]. He would hang out with "friends," skip classes, that kind of stuff. I thought, "Okay, this is not going to continue." I happened to read a magazine that mentioned [MCC]. I thought, "I will try that."

Everything started off great last fall [at MCC], grade-wise and everything. I can access the parent login [and] see how many hours and minutes were spent in each subject each day. I checked grades today and there are two classes that are being passed right now out of six. Two of them that he is failing he might make it past 60%. I would be really surprised [if he passed] the other two.

My suggestions are rejected. "We could do flashcards. Why don't you contact [your teacher] and get some help?" He doesn't want it, "No, I can do it myself, I don't need you." I see how much time [he] spent here and how much time [he] spent there, "I looked and noticed you hadn't spent the 30 minutes on math that you said you did." I get a, "How dare you?! How dare you check on me?!" I can look ahead and say, "Okay, I see you have something due this day." And he'll say, "None of your business, I'll get it in, why are you bugging me?!" Initially when we started I would check on grades and say "Why aren't you doing well?" [He'd reply], "You don't know what you are talking about, this is my school, not yours." My husband is really good at math and has tried to help, but [Ivan] says, "You don't know how to teach." He will sometimes try to bully me into doing [his assignments] but we say no.

We set up a desk [in the living room] and he's never taken [the school-provided computer] into his bedroom. [MCC administrators] have supposedly blocked as much as they can [on his computer]. That was great until he discovered YouTube. So now there are hours and hours spent on that—continually. Time to time, I will check from behind, "Are you doing homework?" [He'll reply], "Oh, I'm taking a break right now." That's just a justification.

He also loves sleep. He can sleep until 1:30 [p.m.] if I don't drag him out. Other times I have to threaten, "You won't get a shower because the water will be cold because I'll be doing the wash when you wake up." He eats breakfast with the family and he is invited to go get dressed, sit at the computer, but normally he goes right back to bed.

It's also [Ivan's] attitude. You hear all the time with him, "Why should I learn this, this is boring?" We can say, "Grades are the most important thing. Do well in school and then we could afford your insurance." or "This has to be done before this fun thing can happen. Now you get this done. You're free when your little brother comes home." He does it anyway. "I'm taking off, goodbye." I just physically can't restrain [him].

I don't know how to change that attitude. It's not your normal situation. Most of the time, I don't want to go in there and actually find out what is going on because then it's like, "Well, you didn't tell me to do it. It's your fault. You didn't push me to do it, it's your fault." He pushes me around. That's why I'm just staying away from it. I don't know what else to do so I have to leave it up to him. I have run out of options.

[MCC] needs a school for the mother. Other than an orientation, I have only interacted with a few [teachers]. [Teachers] send progress reports once a week. We have received phone calls from time to time, not very often. It's a two-way street. The exciting thing about [MCC] was that they had access to the teachers pretty much anytime they wanted. I can call an individual teacher, but I don't. I would like individual parent-teacher time every other week. I'm guessing that there are others like [Ivan]. There needs to be something more done. I wish I didn't have a [child] who was needing that much. [We are] just doing our best.

Supporting Matthew

I have four kids [and Matthew] is the last—he just turned 15. We have homeschooled the past eighteen years. My husband and I wanted to have our values instilled in them [and] we love doing life-learning things together. I loved everything about [homeschooling but] I [was] getting a little tired after all those years and I wanted less on my shoulders. I was happy for [MCC] to come along for Matthew.

[MCC] was a huge learning curve. I realized at the beginning, "Wow! He needs much more help here than I ever thought." It was grueling. I had to sit side by side with him for the first 4-6 weeks to help. We would start at 9:00 in the morning and do everything [together]. We wanted to pull our hair out. The whole goal [of enrolling in MCC] was to make it so I didn't have to be side by side with him. I also didn't have the time to keep up with that. At some point, I needed to let him sail with it. Then at a slow rate, I was backing up and encouraging him and telling him that he needs to take over [and] contact his teachers. He wasn't keeping up with the content per each week's deadline.

He can definitely improve on time management. At the beginning, I didn't know how to help organize his week. He likes to work late and sleep in. [We] could use help with some type of scheduling. That's the hardest part. [I've] written out [a learning schedule] and he's like, "I know. I know. But then I always get interrupted or sidetracked." He loves to invent. [Next to his school] desk he has a whole workbench where he will be creating or soldering. So just the other day, he goes, "We need to rearrange my room. The workshop stuff is making it over to the school desk." That took him almost a year to figure out that, "Gee, this isn't a good setup." I don't know if I would have noticed that so I'm trying to let him figure it out.

He likes a little more flexibility and one day he might be on [the computer] for three hours and take the rest of the day off. The beauty of homeschool is you can be flexible. There is no time [with MCC] to do any life things that we were used to doing, "Hey do you want to go to the library?" or "Let's go to the zoo." [He says,] "Nope, we can't. I have to do some work." It's just like, "Aw, come on." Less time is spent with each other [doing] good, valuable life-teaching events. And then again, it could be the time management part. We feel rushed. It's like, "Oh that's nice that you want to talk about that but we don't have time because your deadline is at 9:00 p.m. Let's get this done." It's hard.

I'm trying to not hover over him and let him try to figure how to be successful with his time management. [I] don't want to be controlling. I want him to own it. There's that fine line. Basically, I have said, "I'm here. Let me know if you need any help." I used to look at his grades and assignments every day or every other day. [Now I check grades] maybe once a week. Now that he's failing a couple classes, I will look at some things and see where he needs help. Mostly I just make sure that he is on time on the current week and keeping things turned in. I tell him every day, "Let me know if you need any help. Is there anything I can help you with?" And he will say, "No, no, no I'm fine." And then later I will see something that maybe didn't get turned in. He just needs to finish and finish strong.

Supporting Hannah and Karl

I have five children and work full-time outside of the home. I didn't go to college because college just wasn't my thing. Before [MCC] we did homeschooling. Karl and Hannah were both in [Mountain Cyber Charter] together, and now my younger two are both going to go.

Hannah was getting bullied a lot [at the brick-and-mortar school]. Her self-esteem was horrible so we pulled [her] out. It was pulling teeth to get her to do her schoolwork [with the homeschool curriculum]. Now, the last few years that she's been in [MCC], she's had no problem. She would get the laptop out every morning, do her schoolwork, and then she would have the weekend to do her fun stuff. She's a very good student. I think her grade point average is 3.6 something.

Hannah is just a procrastinator. It takes me nudging, pushing her a lot. But when I do, she does it. Once she figured out how much free time she had to herself if she just sat down and did it, she was all over it. When it comes to the deadline, she gets nervous. "Oh my gosh! I only have two weeks left." I'm like, "Yeah, you had two months. I don't know what to tell you. I guess you better hurry." And she'll [get it done] every time.

She needs help with [organizing her time]. Sometimes if she was falling behind then I would try to help her, "So maybe do the quicker stuff first and the harder stuff last, or vice versa." Last semester we sat down together and she read her 6-8 page paper to me. I just have to kind of help her, "Okay, well it would probably fit better here, and not here." We did stuff like that together. I watch her grades, and every day, we go through what she's done and what she has left. I think listening is a lot and checking up and making sure she's doing okay.

[Karl] went to a brick-and-mortar school until fourth grade and then we pulled him out [and homeschooled him]. He is a fun kid. He helps around the house a lot. He totally hates school [but] loves to work. He's just really a motivated kid. He just wants to be done so badly that he does school on the weekends even. I don't know why he's always had such a problem with school. He doesn't like anybody telling him what to do and so he's going to fight you tooth and nail.

He's a very needy child. For some reason, he doesn't have the confidence in himself to just go and do it. He hates instruction, but if he doesn't get instruction every step of the way, he gets lost and confused and he won't even try. Math is his worst subject ever. Karl comes to us every day. "Do it for me." Me and my husband have to be very careful how much we help. He'll act like he has no clue, until you finally get so frustrated and irritated with him that you give him the answer. It's gotten to the point where we just will give him the basics and if he still doesn't get it, "Okay, then contact your teacher."

Public school, they're like, "Okay, mom, I didn't get this. Can you help me with this?" [MCC] is nothing like that because they go directly to their teachers. If they have any struggle whatsoever, teachers are always there. I feel more my role with him is making him go to the teacher. "Dude, you've got to go to the teachers because I don't know." I don't know why he doesn't like going to the teachers for help, I guess because they won't do it for him.

He likes to know that he's done a good job. Like yesterday, "Hey, I've got four assignments in math today. I'm going to break—that's all I have left Mom. I'm going [to turn in] two of them on Thursday and two of them on Friday." Then he'll just randomly call me in the middle of the week, "Hey mom, guess what? I have a 98% in history, I have a 79% in math."

Hannah's a procrastinator, but Hannah also knew she had to do it, and she knew what to do. She never had low self-esteem when it came to school. [Karl's] needy so I try and help him without giving him the answers. Hannah wants someone to discuss it with. Karl wants you to tell him step for step for step what exactly he needs to do. I'll help as much as I can. They know we're here if they need us. If [online students] don't have somebody to come and talk to, what are they going to do, where are they going to go?

Discussion

In this section, we synthesize these parents' "knowledge from the past" (Bochner, 2007, p. 203) and connect them to research findings, offering implications for practice and research. We do this for each of the three narratives separately in an effort to preserve the uniqueness of each parent's experiences and insights.

Ivan

Supporting Ivan proved especially difficult for his mother even though she had previously earned her teaching certificate. Over the years, she struggled to find an educational fit for Ivan. Ivan was homeschooled for two different stretches and enrolled in a brick-and-mortar school before enrolling at MCC. At times these decisions followed defiant outbursts from Ivan. For instance, he was enrolled in a brick-and-mortar school because when he was learning from home "he started getting madder and madder and throwing books and ripping papers up." However, Ivan's misbehavior only continued in the brick-and-mortar setting. His mother attributed it to his "friends," which prompted her to enroll him in MCC to remove negative "outside influences." Similarly, Beck et al. (2016) found that parents commonly enrolled students in a cyber school following behavior problems. However, while enrolled in a cyber school, Ivan continued to demonstrate misbehavior and anger towards his mother. Ivan's mother believed that she had "run out of options" and made the decision to "leave it up to [Ivan]" to improve his performance. Hoover-Dempsey and Sandler (2005) found that parents were more likely to engage in their students' learning when they received invitations from their student. The reverse was true in Ivan's situation: Ivan's mother stopped engaging in his learning when he rejected her efforts.

In face-to-face settings, Levin at al. (1997) found that when homework raised student-parent tension it proved counter-productive to students' performance and well-being. Similarly, McNeal (2012) explained that in some cases parent involvement can harm their relationships with their children. If parent-student relationships are already strained when the student is learning in a brick-and-mortar school setting, then a shift to cyber schooling will likely worsen that relationship. However, when students are being homeschooled, a shift to a cyber school may help to reduce tensions because many of the instructional responsibilities shift away from the parent to the online teacher.

Online teachers commonly highlight that they enjoy no longer having to deal with misbehavior in the classroom (Larkin, Brantley-Dias, & Lokey-Vega, 2015). However, cyber school programs should recognize that student misbehavior is still occurring at home and being addressed by a parent who may not be prepared to do so. As a result, some parents require support from the online program. As Ivan's mother stated, there "needs to be a school for the mother." A cyber school psychologist may have helped to avoid academic and behavioral problems (Tysinger, Tysinger, & Diamanduros, 2016). However, this type of support is both under-researched and underused in cyber school settings (Tysinger et al., 2016). Additional research should seek to identify strategies for supporting defiant students directly through the use of school psychologists and other professionals as well as strategies for supporting parents.

Matthew

Matthew's mother, who homeschooled Matthew since first grade, enrolled him at MCC because she wanted "less on [her] shoulders." She was surprised at how much support Matthew still required: "He needs much more help here than I ever thought." She "didn't have the resources" to fully support him and began "telling him that he needs to take over." When that occurred, Matthew's performance suffered due to poor self-regulation, which is commonly cited as a contributing factor to online learning's high attrition rates. Roblyer, Freeman, Stabler, and Schneidmiller (2007) explain: "Student ability to handle distance education courses appears to depend more on motivation, self-direction, or the ability to take responsibility for individual learning" (p. 11) than on their ability to learn the course content. Because of their physical proximity, the responsibility for helping students develop self-regulation skills often falls on parents. Matthew's mother struggled to support him in the development of those skills. She admitted, "as a parent I did not know how to help organize his week" and her efforts to create a learning schedule were commonly rejected by Matthew.

Matthew's mother believed the learning schedule was too demanding and missed having "all the time in the world" for spontaneous "live-learning things" when she homeschooled. Like Matthew's mother, other homeschooling parents may also be drawn to online learning to lessen their responsibilities while not fully understanding how the change will remove some control and flexibility. In contrast, parents with students in brick-and-mortar schools will likely find that cyber schooling provides them with more flexibility. Borup's (2016) case study examining cyber school teacher perceptions explained that, "teachers found that those [parents] who previously homeschooled their students needed to be 'willing to step back' and those whose students previously attended brick-and-mortar schools needed to be willing to take a step forward" (p. 79). As a result, online programs should recognize these differences and customize their orientation and support materials accordingly. Additional research is needed to better understand how parents' previous background impacts how they engage in their students' online learning.

Hannah and Karl

Unlike Ivan and Matthew, Hannah and Karl accepted and sought their mother's support. Their needs varied and their mother had to adjust her efforts accordingly. Hannah habitually procrastinated but was able to complete the work, and Karl liked to work ahead but would stop working when he encountered challenges. This affirms previous assertions that the types and levels of parental engagement depend on the attributes and abilities of each student (Hasler Waters et al., 2018). Hannah and Karl's mother's ability to impact their learning appeared to be the result of their trusting relationships. As Borup, Stevens, and Hasler Waters (2015) discussed, "[Parents'] trusting relationships with their students formed the foundation for all other types of parental engagement" (para. 23). As a result, parent-student relationships should be considered when deciding whether online learning is best for students. As Rose, Smith, Johnson, and Glick (2015) stated, "Rather than 'Is online learning right for me?' students should be asked, 'What support systems do you need to be successful in online learning?'" (p. 75). Students should also be asked, "Would you be willing to accept support if offered?"

Conclusion

Drawing on research in face-to-face settings, researchers and policymakers have called for an increase in parental engagement in online schooling. In this study, we sought to understand the nuances and complexities of individual parents' attempts to support their children's learning in a cyber school setting. Examining the reconstructive narratives of three parents' experiences has allowed us to illustrate that complexity and simultaneously to show the breadth of parent experiences. These narratives lead us to the conclusion that many factors should be considered when parents make decisions about their students' education and the ways that they choose to support them once those decisions have been made. Our analysis suggests that parents need to take into account their children's learning preferences and their relationship with them when deciding to enroll them in an online program, because it is the parent who will be primarily responsible for encouraging and supporting engagement in online schoolwork if their child lacks internal motivation. Parents should also consider just how much time high-level support of online learning will take and how much control they will have over their children's learning.

While the primary purpose of this research was not to identify themes across narratives, we did recognize some commonalities. First, taken together, the narratives demonstrate that the support that parents provide needs to be tailored to their children based on their attributes, skills, and behavior. While parents were often reactive to students' behavior, their close relationships with their children and understanding their children's attributes and skills allowed them to be more proactive in their engagement. Second, students' lack of self-regulation made it difficult to maintain the level of consistent engagement that is required to be successful in a cyber school. Third, parents were unprepared to provide the levels and types of supports that their children required, even when they recognized their needs. Lastly, our analysis highlights how important it is for students to be willing to accept support from their parents and how difficult it can be for parents to fulfill their responsibilities when their child is resistant to their efforts.

While the nature of qualitative research prevents generalizations to other settings, these narratives may provide insights to school administrators, teachers, parents, and researchers. Additional case studies may help practitioners to not only develop a better understanding of the obstacles that parents face when engaging with their children's online learning, but also develop empathy for those parents. While research has examined teachers' empathy for parents in face-to-face settings (Broomhead, 2013) and teachers' ability to recognize their online students' social presence (Hawkins, Barbour, & Graham, 2011), we are not aware of any research that has examined online teachers' empathy for parents or online teachers' ability to recognize parents' social presence in mediated communication. Additional case studies should also be conducted examining parental engagement in a variety of cyber school settings. Previous case studies have focused on understanding parents' behaviors and perceptions, but more research should consider students' perspectives, especially given the crucial role that acceptance of parental support played for students in our study. These efforts may provide insights into the invitations that students extend to parents, which can have an important impact on parents' engagement (Hoover-Dempsey & Sandler, 2005). These qualitative efforts can provide important insights to those interested in designing large-scale quantitative research. For instance, researchers should look to develop and validate instruments that measure different types of parent engagement that could help to identify the impact on or correlations with learning outcomes.

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Structural Relationships of Factors Which Impact on Learner Achievement in Online Learning Environment


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Abstract

The purpose of this study is to identify relationships of learners' achievement goal orientation, self-regulation, test-anxiety, self-efficacy, participation, satisfaction, and achievement in online learning environments in Korea. A total of 1,832 student responses from a Korean cyber university were used to find structural relationships of factors. Causal relationships among various variables are provided as results of this study. Achievement goal orientation –approach, self-regulated learning, test-anxiety, and self-efficacy, were positively related to participation; however, achievement goal orientation-avoidance was negatively related to participation. Test-anxiety was directly related to learning achievement and it was found that participation affected learning satisfaction and learning achievement. It was also revealed that learning satisfaction was related to learning achievement. Results of this study suggest that a comprehensive management of learners' psychological variables, such as achievement goal orientation, self-regulation, test-anxiety, self-efficacy for designing, and managing online learning environments is important to online learning organizations, instructors, and administrators for better learner support.

Keywords: online learning, achievement goal orientation, self-regulation, test-anxiety, self-efficacy, participation, satisfaction, achievement, structural relationships

Introduction

With the rapid growth of MOOCs and smartphone technology, many people have developed an increased interest in online learning and choose it for their professional development or degree acquisition. MOOCs have changed the framework of formal education in many ways; learners are able to search and select courses that they want to attend, and they have flexibility of time and type of course delivery (Kaplan & Haenlein, 2016). However, this autonomy comes with a heavy responsibility to learners. Learners in online courses, not only in MOOCs, are expected to have self-regulation skill since they are expected to engage in a learning process comparable to one in a traditional education setting (Puzziferro, 2008).

Mobile technology is another important factor that recently expanded online learning venues. Nowadays, a learners' daily life is prominently attached to mobile technology, creating a culture that manages almost everything through mobile devices. Mobile technology enables learning on-the-go as well as active learning through the exchange of learning materials based on various contexts (Jones, Scanlon, & Clough, 2013; Shin &Kang, 2016**).**

Given the different dynamics of learning in an online environment, many researchers explored diverse factors which impact on learning outcomes in this specific environment and investigate the relationships between various factors. Relationships between human-related variables and design variables (Piccoli, Ahmad, & Ives, 2001); environment, individuals, and learning outcomes (Lim, Kang, & Park, 2016); and interaction-related factors and learning outcomes Kang & Im, 2013) have been examined in the online learning environment.

More specifically, learners' achievement goal orientation has been suggested as one of the important factors that predict learning achievement (Lee, 2003), and has shown a positive relationship with learning flow (Park & Han, 2013). Self-regulated learning has been suggested as one of the predictive factors to learning satisfaction and learning achievement (Joo, Chung, Seol, & Yi, 2012). Test-anxiety was studied as one of the critical factors that impact learning achievement, but the results were not consistent (Bak & Im, 2010; Sung, Chao, & Tseng, 2016). Also, studies that explore relationships among test-anxiety and other factors in the online learning environment are very limited. Self-efficacy has an important role in deciding how much effort learners will put into learning, so it is suggested to have a positive relationship with learning achievement (Zimmerman, Bandura, & Martinez-Pons, 1992; Womble, 2007; Cho, 2010; Lim, Kang, and Park, 2016). In sum, the relationships between these factors and learning outcomes, such as participation, learning satisfaction, and learning achievement, were individually analyzed in previous studies. Thus, there is a lack of studies that explore comprehensive relationships of these factors with learning outcomes in online learning settings.

The purpose of this study is to identify determinants of learners' outcomes in online learning environments. Among various factors surrounding online learning, individual factors such as achievement goal orientation, self-regulated learning, test-anxiety, and self-efficacy were specifically selected for this study. Learning outcomes in this study represented learning satisfaction and learning achievement.

Background

Online Learning in Korea

With the increased demands for flexible learning environments in Korea, coupled with the quality advancements in technology, online learning has increased. Usage of online learning in Korea has been experiencing exponential growth annually, from 53.3% in 2012 to 58.2% in 2015 (National IT Industry Promotion Agency, 2016). Mobile learning has more rapidly expanded due to the one-person one-smartphone culture in Korea; between the years 2011 and 2013, the number of people who had experienced mobile learning nearly doubled from 18.4% to 32.9%. (National IT Industry Promotion Agency, 2015)

A recent study tested a theoretical model of successful mobile learning (Shin & Kang, 2016). This study found online university learners have started accepting mobile technology and this acceptance was directly and indirectly related to learning achievement.

With the growth of online learners, there are lots of efforts to figure out key factors for the success of online learning. Lim, Kang, and Park (2016) explored relationships of online learning environments, learner characteristics, and learning outcomes. These researchers found that qualities of online learning content and system are significant determinants of learners' motivation and self-efficacy. Also, learners' intrinsic and extrinsic motivation showed direct influence to their satisfaction but not to achievement in this study.

Individual Variables Which Impact on Learning Outcomes

Achievement goal orientation. Achievement goal orientation can be defined as a personal intent that affects the individual learner's decision of why and how to approach and participate in specific learning activities (Pintrich, 2000). Individual learners approach, participate, and respond to learning activities differently, and based on their achievement goal orientation (Ames, 1992). Achievement goal orientation focuses on how individual learners think about their motivation and intent to learn tasks apart from presence and absence of external learning motivation. Therefore, achievement goal orientation has been previously used as a framework that explains a learner's achievement motivation (McGregor & Elliot, 2002).

Many of achievement goal orientation studies focused on examining the relationship with self-regulation strategies and achievement. Lee (2003) found learning achievement goal orientation was the most important factor that predicts the use of self-regulation strategy and learning outcome for undergraduate students. An experimental study showed goal orientation and motivation had significant correlations with learning flow in an online learning environment (Park & Han, 2013) and Sen (2016) discovered performance approach goals and self-regulated learning skills were positively related to chemistry achievement.

Self-regulated learning. Prior research has found that self-regulated learning and learners' outcomes showed positive relationships (Cellar et al., 2011; Yukselturk & Bulut, 2007; Sen, 2016). Positive relationship between self-regulated learning and achievement was found with college students in Korea

(Lee & Shin, 2013). Joo, Lee, and Hong (2011) revealed the positive effect of self-regulated learning to achievement within 317 cyber university students. It was also found that self-regulated learning positively predicted both satisfaction and achievement in an online learning environment (Joo, Chung, Seol, & Yi, 2012), while Kang and Lim (2013) found that self-regulated learning directly affected achievement at Cyber University.

Test-anxiety. Test-anxiety refers to a response of anxiety when a person faces test situations (Mandler & Sarason, 1952; Zeidner, 1998). Morris, Davis, and Hutchings (1981) conceptualized test anxiety consisting of two dimensions: cognitive dimension and affective dimension cognitive dimension of test-anxiety is called as worry, and affective dimension of test-anxiety is called as emotionality. Cognitive dimension of test anxiety refers to negative expectancy on doing well in certain test and affective dimension of test anxiety is about being nervous or terrified toward test. Previous studies show inconsistent results on the correlation between test-anxiety and learning outcomes (Chapell et al., 2005; Bak & Im, 2010; Eum & Rice, 2011; Sung et al., 20016).

A meta-analysis study found negative relationship between test-anxiety and achievement (Bak & Im, 2010), whereas Sung et al. (2016) examined the relationship between test-anxiety and achievement and found positive correlation between them.

Self-efficacy. Self-efficacy refers to a personal judgment of one's own capability to perform activities that are necessary to succeed in certain tasks (Bandura, 1997). Self-efficacy possesses the critical role to determine that a person will put how much effort, and how long the efforts will last for the task (Zimmerman, 2000). Self-efficacy has been found to have positive relationships with learning outcomes in many studies (Zimmerman et al., 1992; Womble, 2007; Cho, 2010; Lim, Kang, & Park, 2016). A meta-analysis study using publications in Korea between 2001 and 2014 revealed the mean effect size of self-efficacy to achievement as .66 (Ku, Yang, & Choi 2014).

Learning Outcomes

Most important and commonly measured variables as learning outcomes are learners' satisfaction and achievement. Prior research suggested that both cognitive (achievement) and affective (satisfaction) dimensions of learning outcomes should be considered (Paechter, Maier, & Macher, 2010; Lim, Kang, & Park, 2016). In addition, satisfaction is known as one of the important factors for online course completion and achievement (Levy, 2007; Puzziferro, 2008; Wang, Shannon, & Ross, 2013). It is possible to conclude that online learning success can be determined by how satisfied learners are with their online learning experience and level of achievement as a result.

Based on the review of related research, this study focuses on identifying determinants of learner satisfaction and achievement in an online learning environment. Among various factors surrounding online learning, individual factors including achievement goal orientation, self-regulated learning, test-anxiety, and self-efficacy were specifically selected in this study. The research hypotheses with these given variables are like below:

1. Learner's achievement goal orientation is related to satisfaction and achievement.
2. Learner's self-regulated learning skill is related to satisfaction and achievement.
3. Learner's test-anxiety is related to satisfaction and achievement.
4. Learner's self-efficacy is related to satisfaction and achievement.

Methods

Participants

Participants of this study were undergraduate students in a cyber university in Korea. Originally, a survey was sent to 2,224 students, however, 392 invalid responses (empty or identical responses) were excluded from the analysis. Thus, 1,832 questionnaires were used in addressing the study's research questions. Demographic information of survey participants is shown in Table 1.

Table 1

Participant Demographics

Gender		Age		Grade	
Category	Number	Category	Number	Category	Number
Male	855	Under 19	8	1	690
Female	977	20~29	457	2	99
		30~39	504	3	769
		40~49	597	4	274
		Over 50	266		
Total	1,832	Total	1,832	Total	1,832

Materials

A questionnaire was developed for this study based on previous studies regarding achievement goal orientation, self-regulated learning, test-anxiety, self-efficacy, participation, learning satisfaction, and learning achievement. In this study, achievement goal orientation was measured by two dimensions including approach and avoidance. Three experts in educational measurement and educational technology reviewed this questionnaire for ensuring face validity.

To measure learner's achievement goal orientation, 16 items regarding achievement goal orientation approach, and 10 items regarding achievement goal orientation approach were adopted from a survey by Bak and Lee (2005) with a Cronbach's α of .88 and .86 respectively. Fifteen items were adopted from a research of Pintrich and De Groot (1990) to measure learner's self-regulated learning and the Cronbach's α for these items was .90. Regarding test-anxiety 10 items were adopted from a questionnaire designed by Spielberger et al. (1980) with a Cronbach's α of .95. For checking self-efficacy of learners, nine items were adopted from Lee (2006) and Flowers (2011), with a Cronbach's α of .95. Each item consisted of a 5-point Likert scale from 1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, to 5 = strongly agree. Number of survey items and Cronbach's α for each variable are shown in Table 2.

Table 2

Number of Survey Items

Category	Number of items	Cronbach's α
Achievement goal orientation_ approach	16	.88
Achievement goal orientation_ avoidance	10	.86
Self-regulated learning	15	.90
Test-anxiety	20	.95
Self-efficacy	9	.95
Participation	16	.91
Learning satisfaction	3	.90
Learning achievement	6	.94

Data Collection

A total of 1,832 survey responses were collected for 10 days using the university's online learning platform. Structural equation modeling was used to investigate the research model hypotheses, and the data was analyzed using AMOS 18.0.

Results

Measurement Model

Convergent validity. Before analyzing convergent validity, an exploratory factor analysis was done and valid factors were extracted. A convergent validity test (Fornell & Larcker, 1981) was conducted in three elements: item reliability, construct's composite reliability, and the average variance extracted (AVE). Item reliability test was conducted to confirm convergent validity of items with factor loading of each item. The factor loadings for the items were ranged between .697~.934, which were significant and met the convergent reliability. Composite reliability met the required value of ≥ .7(.764 ~ .963), AVE met the required value of ≥ .5(.503 ~ .868). The fit indices were obtained as follows: x^2 / df = 5.923; TLI = .964; CFI = .976; RMSEA = .052.

Discriminant validity. A construct's discriminant validity test was performed. The square root of the AVE should exceeds the correlation coefficient between constructs to obtain the validity (Segars & Grover, 1998). Table 3 shows the results of the validity test and confirms the research instrument's validity.

Table 3

Correlation Matrices and Discriminant Validity Among Variables

Variable**	AVE	AGO-AP	AGO-AV	SRL	TA	SE	PA	LS	LA
AGO-AP	.61	.84*							
AGO-AV	.50	-.03	.78*						
SRL	.76	.55	-.31	.71*					
TA	.71	.07	.43	-.11	.87*				
SE	.50	.44	-.06	.55	-.11	.71*			
PA	.69	.51	-.34	.75	-.16	.55	.83*		
LS	.75	.39	-.27	.57	-.05	.36	.58	.87*	
LA	.87	.43	-.25	.37	-.03	.37	.60	.93	

*Square root of the AVE (Average Variance Extracted) ** AGO_AP : Achievement Goal Orientation related to APproach, AGO_AV : Achievement Goal Orientation related to AVoidance, SRL : Self-Regulated Learning, TA : Test Anxiety, SE : Self Efficacy, PA : Participation, LS : Learning Satisfaction, LA : Learning Achievement.

Structural model. Indices for the structural model indicated that the model was adequate. The following results were obtained: (x^2) = 758.443 (p < .001); x^2 / df = 6.116; TLI = .963; CFI = .973; RMSEA = .053.

Figure 1 shows causal relationships among variables. Detailed results are as follows: AGO_AP was not related to PA, but AGO_AV related to PA. SRL, TA, and SE were related to PA. TA was related to LA. PA was related to LS and LA. LS was related to LA.

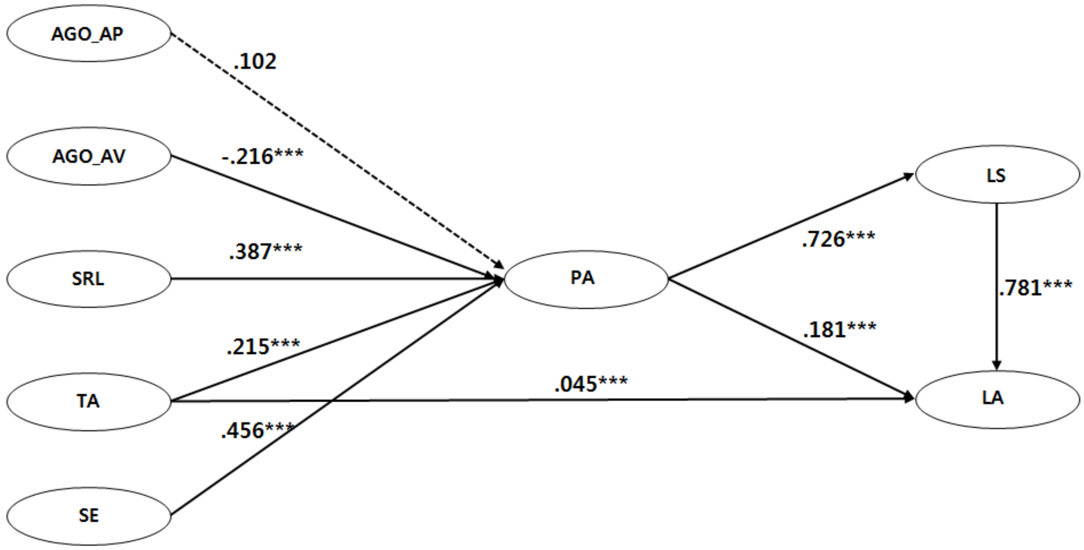

Figure 1. Structural relationships between variables. AGO_AP : Achievement Goal Orientation related to APproach, AGO_AV : Achievement Goal Orientation related to AVoidance, SRL : Self-Regulated Learning, TA : Test Anxiety, SE : Self Efficacy, PA : Participation, LS : Learning Satisfaction, LA : Learning Achievement.

Indirect and total effects for the research model are provided in Table 4. First, self-efficacy was the most powerful determinant for participation, with a total effect of .46. This was followed by self-regulated learning, test-anxiety, with a total effect of .39 and .25 respectively. Second, participation was the most important determinant for learning satisfaction, with a total effect of .73. This was followed by self-efficacy, self-regulated learning, test-anxiety, with a total effect of .33, .28, .and .18 respectively. Third, learning satisfaction was shown as the most influential determinant for learning achievement, with a total effect of .78. This was followed by participation, self-efficacy, self-regulated learning, and test-anxiety, with a total effect of .75, .34, .29, and .23 respectively.

Table 4

Direct, Indirect, and Total Effects for the Research Model (A-> B)

B	PA			LS			LA		
A	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total
AGO_AP	.10		.10		.07	.07		.08	.08
AGO_AV	-.21*		-.21*		-.16*	-.16*		-.16*	-.16*
SRL	.39*		.39*		.28*	.28*		.29*	.29*
TA	.25*		.25*		.18*	.18*	.05*	.18*	.23*
SE	.46*		.46*		.33*	.33*		.34*	.34*
PA				.73*		.73*	.18*	.57*	.75*
LS							.78*		.78*

*$p < .05$ AGO_AP : Achievement Goal Orientation related to APproach, AGO_AV : Achievement Goal Orientation related to AVoidance, SRL : Self-Regulated Learning, TA : Test Anxiety, SE : Self Efficacy, PA : Participation, LS : Learning Satisfaction, LA : Learning Achievement.

Discussion and Conclusion

In this study, structural relationships among learners' characteristics, participation, satisfaction, and achievement in the context of online learning environment were explored. As a result of this study, a model that achievement goal orientation, self-regulation, test-anxiety, self-efficacy have impact on learners' participation, and participation turned out valid. Specifically, this model showed that participation has a mediated effect among exogenous variables and achievement.

Summary of results of this study is like below. First, achievement goal avoidance was negatively related to participation, satisfaction, and achievement. Second, test-anxiety was positively related to participation, satisfaction, and achievement. Third, participation had a mediated effect between three of exogenous variables (self-regulated learning, test-anxiety, self-efficacy) and satisfaction and learning achievement. Fourth, participation had the biggest impact on satisfaction, as well as biggest impact on learning achievement mediated by satisfaction. One of interesting findings from this study is that test-anxiety showed positive relationships with participation, satisfaction, and achievement, which is different with main stream of previous studies. Most of text-anxiety research found negative relationship between test-anxiety and achievement. However, few studies found positive relationship between test-anxiety and achievement (Sung et al., 2016; Hardy & Hutchinson, 2007). These researchers suggested that test-anxiety increased performance motivation and improved achievement as a result based on the motivational enhancement model.

Here are two plausible reasons for this interesting result. First, the participants of this study were adult learners mostly had a full time job pursuing a bachelor's degree from the Cyber University. It means they had a clear goal to achieve and high responsibilities for their learning. Thus, for these learners, test-anxiety made them more motivated to study hard and led to better achievement. Second, the unique test environment in the Cyber University may decrease the cognitive interference effect. The test environment in online learning could be more relaxing and less stressful.

Results of this study showed that learners' psychological variables as exogenous variables had strong impact on participation and learning achievement. This study examined the structural model that explained learners' achievement goal orientation, self-regulation, test-anxiety, self-efficacy had positive effects on learning outcomes (satisfaction, achievement) mediated by participation and it would be valuable for further research. Based on the results of study, it could be suggested that a comprehensive management of learners' psychological variables such as achievement goal orientation, self-regulation, test-anxiety, self-efficacy for designing and managing online learning environment is important to online learning organizations, instructors, and administrators for better support to learners.

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The Impact of Social Media Participation on Academic Performance in Undergraduate and Postgraduate Students

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Abstract

The main objective of this study was to analyse the influence of social media participation on academic performance. The sample consisted of 1960 students taking one of two courses at undergraduate or postgraduate level, respectively (Faculty of Education, National Distance Education University, Spain), of whom 411 students carried out an activity based on social media participation. We used a mixed quantitative (descriptive analysis and ANOVA) and qualitative (content analysis) design. Our results showed that the students who participated in a social media-based activity presented better academic performance than those who did not carry out any activity or who took part in a more traditional learning activity. We conclude that regardless of educational level, social media participation exerts a positive influence on performance. Consequently, it is important to consider the variable of social networking site use because this can partially explain academic performance. We also found that the networks generated during the course did not constitute stable communities of practice. Our main recommendation is that three stages of instruction should be considered when designing a course based on social media participation: beginners, intermediate, and professional.

Keywords: social participation, Twitter, academic performance, educational level

Introduction

Research into Higher Education affirms that online students demand more direct, more synchronous communications with teachers and classmates (Bonk, Wisher, & Nigrelli, 2006), and that use of synchronous tools in university-level distance education has been observed to be a motivating element for students, as it facilitates interaction within the working group and therefore cohesion and a sense of community belonging (Santoveña, 2012). Social networks such as Twitter provide an original framework in which to attempt to respond to students' new demands.

Research has pinpointed several variables that affect the performance of university students in general and of first year students in particular. One such variable currently considered of particular importance is social relations (Bond, Chykina, & Jones, 2017). It has been demonstrated that the social connections undergraduate students establish in their first few months of university life can exert an influence on their academic performance (Krasilnikov & Smirnova, 2017) due to the signal importance for these students of building a network of contacts, which can in turn help improve academic performance (Pascarella & Terenzini, 2005).

The use of social networking sites as part of the learning process is no longer a novelty, and increasing numbers of students (Dahlstrom & Bichsel, 2014; Karal & Kokoc, 2013) and teachers employ them in their daily academic work (Fox & Bird, 2017; Lupton, 2014). Consequently, it is essential to study their influence on academic performance. Various authors have highlighted the added value of social networking sites in education, their pedagogical potential (Durak, 2017), and their especially effective role in social learning (Johnson, Becker, Estrada, & Freeman, 2014). However, studies of the relationship between social media participation and academic performance have obtained conflicting results.

The goal of this study was to analyse the influence of social media participation, in this case using Twitter, on the academic performance of undergraduate and postgraduate students aiming to become education professionals (social educators, educationalists, and teachers in secondary education and/or vocational training), attending the National Distance Education University (UNED) Faculty of Education.

Literature Review

This study rests on the concept of learning as social participation, understood as a process "of being active participants in the practices of social communities and constructing identities in relation to these communities" (Wenger, 2001, p. 22). It is considered that to facilitate a space for direct, immediate interaction with teachers and students through Twitter reinforces a feeling of group affiliation that may help maintain the community of practice over time. We, like Wenger (2001), feel that an overlap exists between a community of practice and a community of learning, and that communities are made up of people who are participating in a collective learning process.

Mixed results have been found in regard to social networking site use in educational settings. Some studies have reported significant evidence concerning the negative relationship between social media and academic performance (Karpinski, Kirschner, Ozer, Mellott, & Ochwo, 2013; Paul, Baker, & Cochran, 2012; Rosen, Carrier, & Cheever, 2013). Paul, Baker, and Cochran (2012) found that devoting time to social networking sites has a negative impact on academic performance. According to other studies, this negative impact mainly occurs when social networking sites are used in the classroom because multitasking diminishes performance (Bellur, Nowaka, & Hullb, 2015; Wood et al., 2012), and when the students involved are in their first year of university (Junco, 2015; Krasilnikov & Smirnova, 2017; Liu, Chen, & Tai, 2017). It seems that students who use social media spend less time studying, with an adverse effect on outcomes (Kirschner & Karpinski, 2010). However, other studies have found no relationship between the use of social networking sites and performance (Al-Bahrani, Patel, & Sheridan, 2017; Pasek, More, & Hargittai, 2009), and have even reported that responding to or posting tweets of an academic nature does not impair learning (Kuznekoff, Munz, & Titsworth, 2015).

Furthermore, some have suggested that social networking sites offer added value in educational settings, facilitating assimilation of this new knowledge on teaching practice and new educational methodologies and theories (Balakrishnan & Lay, 2016; Eid & Al-Jabri, 2017; Macià & García, 2016), and thus creating the conditions necessary for developing new methodologies (Putnik et al., 2016). The main benefits that social media offer in educational settings stem from their value as a tool for information exchange (Asterhan & Bouton, 2017) and as a means of socialisation and communication (Balakrishnan & Lay, 2016; Eid & Al-Jabri, 2017; Macià & García, 2016).

Social networks offer a unique opportunity to spur socialisation at university. The social interaction processes and patterns of information sharing that can develop on Twitter have a positive influence on the sense of community generated among students (Blight, Ruppel, & Schoenbauer, 2017). As Mamonov, Koufaris, and Benbunan-Fich (2016) assert, social interaction has a positive relationship with the sense of community on social networks. Social networks foster student interaction, thus generating higher levels of satisfaction and participation (Yu, Tian, Vogel, & Kwok, 2010), and students who have social networks, in addition to a virtual course, tend to finish their academic tasks and show greater commitment (Callaghan & Bower, 2012). In effect, the use of social networking sites seems to reinforce student commitment to and participation in academic activities (Alhazmi & Rahman, 2014; Tur & Marin, 2015). These studies found that satisfaction and participation were associated with improved performance. Some authors have highlighted the value of social networking sites as spaces that facilitate the development of cognitive abilities (Alloway, Horton, Alloway, & Dawson, 2013) and as a means to improve academic performance (Al-Rahmi, Othman, & Yusuf, 2015; González-Ramírez, Gascó, & Llopis-Taverner, 2015).

Various initiatives have spotlighted the benefits of microblogging. Such benefits include its ability to serve as a personal learning network (Mitchell & Powell, 2011) or as a space that facilitates debate and fosters student participation (Clarke & Nelson, 2012; Gao, Luo, & Zhang, 2012; Jones & Baltzersen, 2017). Others have highlighted the positive influence of Twitter use on academic performance (Clarke & Nelson, 2012; Khan, Wohn, & Ellison, 2014; Quansah, Fiadzawoo, & Kuunaangmen, 2016) and even on collaborative and reflective learning (Gao, Luo, & Zhang, 2012).

It is important to note that despite having found that social media use facilitates student participation, some reports indicate that the networks generated in this context do not constitute stable communities of practice, since students stop using the social networking site once the academic activity is over, at which point the teacher becomes no longer involved in the interaction (Lima & Zorrilla, 2017). These authors have suggested that in Spanish-speaking countries, student behaviour is regulated by teacher leadership and consideration as a source of reinforcement (Lima & Zorrilla, 2017). By themselves, networks alone do not reinforce student commitment; instead, this may be influenced by a multitude of factors (Alhazmi & Rahman, 2014). As Henrie, Bodily, Manwaring, and Graham (2015) have indicated, in an analysis of continued student participation over time in virtual learning settings, it is important to bear in mind that the clarity of the instruction and the relevance of the activities exert more influence on student satisfaction than the medium used for instruction. Forbes (2017) has highlighted the importance in social media-based teaching of offering different types of support according to the students' experience and confidence with social media platforms. Forbes indicates that regarding Twitter, students may be classified as beginners (just starting Twitter activity), intermediate (attracting followers, among other aspects), and professional (learning through social networking sites).

Results indicating a correlation between social media use and performance should be viewed with caution. Despite having found a low correlation between both variables in the studies analysed, it is important to consider the variable of social networking site use because it can partially explain academic performance (Huang, 2018).

Research Question and Hypotheses

The main research question was as follows:

- Does student participation in social networking sites, in this case Twitter, influence the academic performance of undergraduate and postgraduate students?

The following hypotheses were derived from this research question:

H1. Educational level (undergraduate or postgraduate) influences social media participation and academic performance.

H2. Students who use Twitter show better academic performance than those who do not.

H3. Instruction in social networking sites ensures continued student participation over time, after conclusion of the academic activity itself.

H4. Instruction in social networking sites should include different stages adapted to educational level.

Methodology

Participants

This document examines the Twitter participation experience of the students of two different courses given at the Faculty of Education at the National Distance Education University (UNED) in Spain. The study population consisted of 2866 students, of whom 68.4% (n=1960) opted to take the course and comprised the study sample. Most participants were women (73.9%) and undergraduates (73.9%). Of the total sample, 14.3% (n=411) took part in a continuous assessment activity (CAA) based on participation in social networking sites. Sampling error was estimated on the basis of simple random sampling in the worst-case sampling scenario (p=q=0.5), obtaining an error of 1.2% for the sample of students taking the course and an error of 4.5% for the sample of students who took part in the social media-based CAA (Table 1).

Table 1

Study Population and Sample

Participants	Enrolled		Sat test		Completed CAA on TW	
	No.	%	No.	%	No.	%
Undergraduate	2090	72.9	1448	73.9	345	83.9
Postgraduate	776	27.1	512	26.1	66	16.1
Both	2866	100	1960	68.4	411	14.3
Sampling error			1.2%		4.5%	

Each course lasted one half-year term; the undergraduate course ran from October to January, and the master's degree course, from February to July. The objective of both courses is to train future education professionals. Both are core courses students must take, and both are based on a distance methodology in a process of autonomous, self-regulated distance education. Accordingly, students carry out the learning process on the basis of UNED's teaching model, where the established learning situations are virtual courses (for all) and guidance sessions (virtual and face-to-face sessions for undergraduates and virtual sessions only for postgraduates). The means of communication traditionally used at UNED in general, and specifically in the courses at issue here, are discussion boards linked to and forming a part of each virtual course.

The objective of course activities was to reinforce learning. The undergraduate students were assessed based on the outcome of a classroom test (an objective test featuring 20 questions with three multiple-choice answers) and the outcome of the voluntary continuous assessment activity, which was worth 20% of the grade. In the postgraduate course, the activities were mandatory and subject to grading. Two options were made available, a *Traditional* activity or *Twitter* activity, and students chose which kind of activity they wished to complete. This activity accounted for 30% of students' final grade, while a classroom test consisting of five questions, requiring short essays for answers, accounted for 70% of their final grade.

The CAA based on social media participation comprised two parts. The first part (analysed in the present study) was common to both courses and was aimed at teaching students how to post on Twitter and overcome any difficulties involved in maintaining an account. In addition, students were required to select resources of social, cultural and/or educational interest, and to include the course hashtag in their tweets. For the undergraduate course, the second part of the CAA consisted of using *Scoop.it* as a means to curate content, while for the postgraduate course, students were required to design a teaching plan for using social networking sites in the classroom. To sum up, the primary objective of the activities was to get the students started on acquiring competences for swift, effective social network management, learning to share information, and creating a community with shared interests.

Research Design and Instruments

A mixed quantitative and qualitative design was used, based on three types of analysis: statistical (descriptive and relational) analysis and content analysis. Data analysis was performed using the SPSS Statistics package, version 22. Data on academic performance were obtained from student marks (examination, CAA, and global evaluation), while data on Twitter participation were obtained from the application programming interface (API).

Data gathering began with the transcription of the lists of test grades and continuous assessment activity (CAA) grades at the end of the academic year (September). Data on Twitter participation were extracted in December 2017. Students' Twitter accounts were accessed and their activity (number of tweets, followers, followed, and likes) was recorded. In addition, we analysed continuity of Twitter activity once the course had ended (whether the Twitter account was still active in December 2017 and if students posted a tweet from their account in 2017).

Due to the temporary nature of Twitter data, data collection systems present limitations. The Twitter API limits the retrieval of tweets, depending on the number of messages sent; however, as Bruns and Stieglitz (2013) have noted, the data remain relevant for research despite their temporary nature. Furthermore, in order to retrieve all tweets or hashtags, it is necessary to rely on the API, as this is the only means to obtain large quantities of data. Researchers have no other means to confirm the quality and accuracy of the data, and this is therefore considered an inevitable limitation that does not invalidate the results.

Data Analysis

The quantitative study was conducted using descriptive analysis and a relational analysis. The latter was based on the contrast of means (independent samples t-test) and factorial analysis of variance (multivariate ANOVA). These analyses shed light on the influence on performance of the following variables: *educational level* and *type of continuous assessment activity*. We conducted a Spearman's correlation analysis of *Twitter participation*, *academic performance*, and *continuity of activity over time*.

The qualitative study consisted of a content analysis of the messages posted on the discussion board with questions about the Twitter-based CAA: this entailed objective reading of messages, encoding, subsequent grouping by thematic categories and quantifying the responses. In addition, we analysed the timing and organisation of the discussion throughout the semester.

Results

The study results are presented according to the hypothesis tested.

H1. Educational Level (Undergraduate or Postgraduate) Influences Participation and Academic Performance

Undergraduate students obtained significantly better marks for the CAA [F (.018) t= -7.224, sig. (bilateral)= .000], confirmed by the Mann-Whitney U-test (sig. 0.000). As regards social media participation, postgraduate students obtained a higher mean for tweets and likes, whereas undergraduate students had a higher number of followers and followed more Twitter users (Figure 1).

Significant differences were only detected in relation to the number of followers [*F*(3.478) *t*= -2.254, sig. (bilateral)= .025], confirmed by the Mann-Whitney U-test (asymptotic sig. (bilateral)= .003).

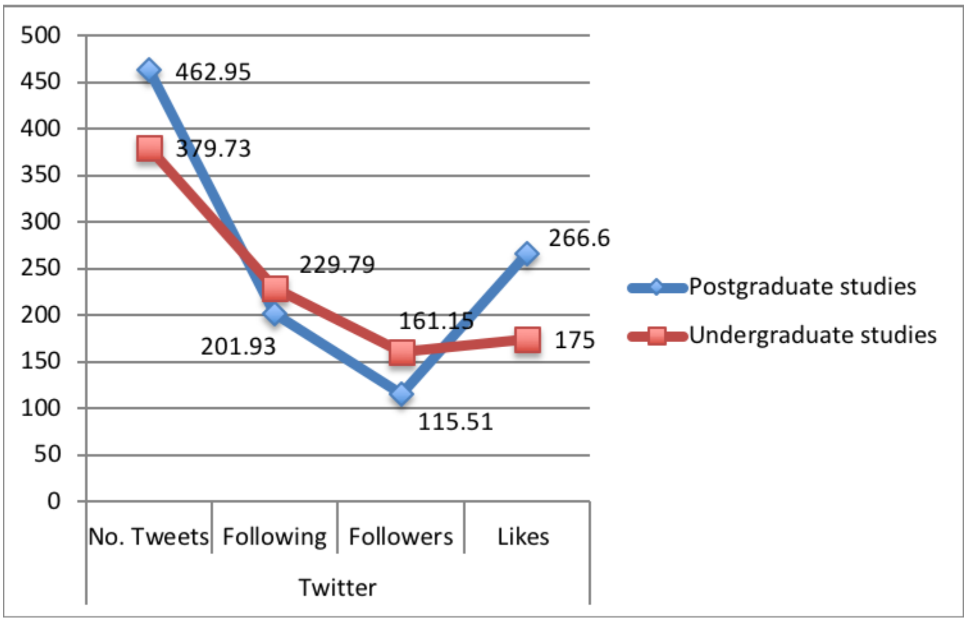

Figure 1. Descriptive analysis of Twitter participation (means).

H2. Students Who Use Twitter Show Better Academic Performance Than Those Who Do Not

A descriptive analysis showed that 56.3% of the students did not carry out any activity, 22.8% participated in the more traditional activity (analysis and evaluation of teaching materials), and 21% took part in the Twitter-based CAA.

The students who completed the social network-based activity were found to earn higher grades than the students who completed the more traditional activity or those who did not complete any activity. The differences were significant in relation to CAA and test grades ([*F* (7.030), Sig. (bilateral)= .001]), confirming our findings as resembling those of Welch and Brown-Forsythe (sig. .000 y .0001). The post-hoc or a-posteriori tests (Bomberroni, Tukey and T2 Tamhane) found that the differences lay in the *test* grades of those who completed the *CAA on Twitter* and those who completed the *Traditional* activity (sig. .023), likewise those who *Did not complete CAA* (sig. .001). However, despite having significant differences, the estimate of the size of the effect of the analysis of variance shows a weak effect for the dependent variable “test grades;” only 0.7% of variance in test performance can be explained by the type of CAA completed (Table 2).

Table 2

Tests of Between-Subjects Effects: Estimates of Effect Size

Origin	Dependent variable	Type III sum of squares	df	Root mean square	F	Sig.	Partial-eta squared	Observed power[d]
Corrected model	TestGrade	40.8[a]	2	20.4	7	0.001	0.007	0.92
	CAAGrade	31924.8[b]	2	15962.4	14842.5	0	0.94	1
	FinalGrade	606.7[c]	2	303.3	104.8	0	0.097	1
Intersection	TestGrade	63380.8	1	63380.8	21816	0	0.92	1
	CAAGrade	47391.4	1	47391.4	44066.6	0	0.96	1
	FinalGrade	73901.8	1	73901.8	25539.3	0	0.93	1
CAAType	TestGrade	40.8	2	20.4	7	0.001	0.007	0.92
	CAAGrade	31924.8	2	15962.4	14842.5	0	0.94	1
	FinalGrade	606.7	2	303.3	104.8	0	0.097	1

Note. a. R squared = .007 (adjusted R squared = .006); b. R squared = .938 (adjusted R squared = .938); c. R squared = .097 (adjusted R squared = .096); d. Calculated using alpha = .05

In addition, we found that although only 21% of students took part in the Twitter-based CAA, mean participation on this site was very high: 393.09 tweets sent, 225.31 followers, 153.82 Twitter users followed and 189.77 likes. A correlation analysis (Spearman's rho) between social media participation and academic performance revealed a significant correlation between all variables at a different level of bilateral significance (0.01 or 0.05).

H3. Instruction in Social Networking Sites Ensures Continued Student Participation Over Time, After Conclusion of the Academic Activity Itself

A total of 84.2% of students maintained their Twitter accounts throughout the academic year 2016-17; however, only 29% of the students posted a tweet in 2017 (Figure 2).

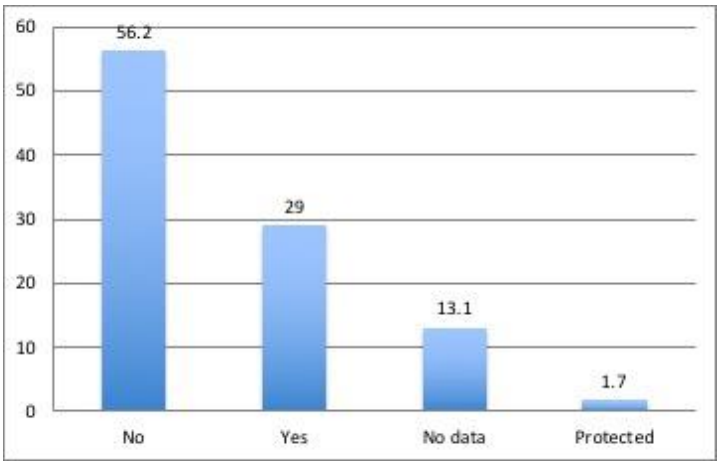

Figure 2. Messages sent from Twitter accounts in 2017 (percentages).

H4. Instruction in Social networking Sites Should Include Different Stages Adapted to Educational Level

A time analysis of student participation on the discussion boards showed falling use as the course progressed, reaching minimum figures in the last month. Participation in the boards was highest in the first month, when 50.7% of messages were posted (Figure 3). However, differences were detected between undergraduate and postgraduate students, whereby the former posted more questions at the beginning of Twitter participation, in the first month (60% of messages), whereas the latter were most active in the third month (41.23% of messages), one month before handing in the activity, mainly with the objective of renegotiating evaluation criteria with the teaching staff (Figure 4).

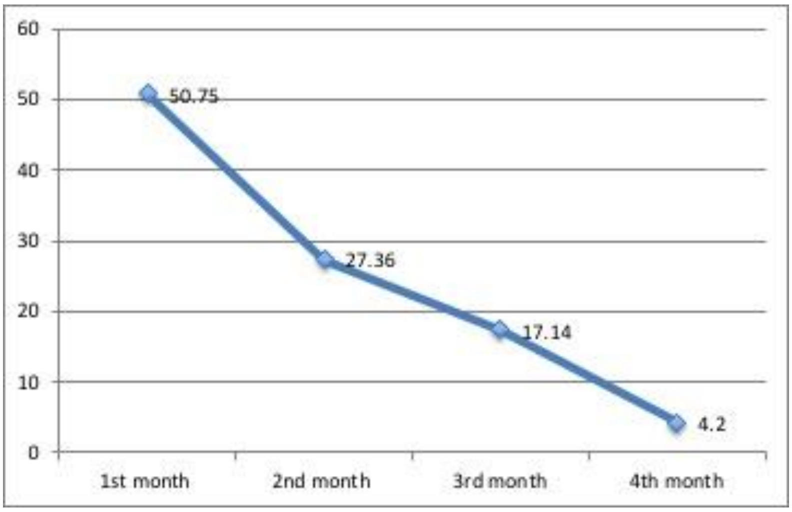

Figure 3. Time analysis of discussion board participation (percentage of messages posted on the boards).

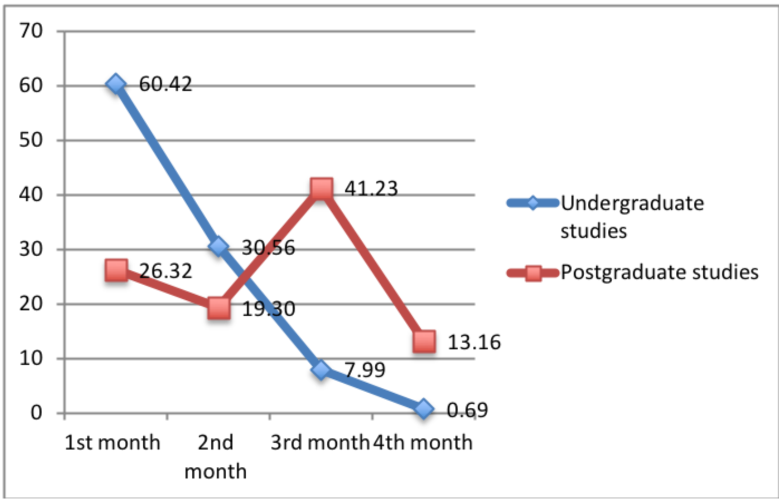

Figure 4. Time analysis of discussion board participation (percentages).

A content analysis of messages posted on the discussion board showed that for both courses, students tackled the activity in three stages: initiation, intermediate, and finalisation (Figure 5). However, each group gave more weight to a different kind of problem.

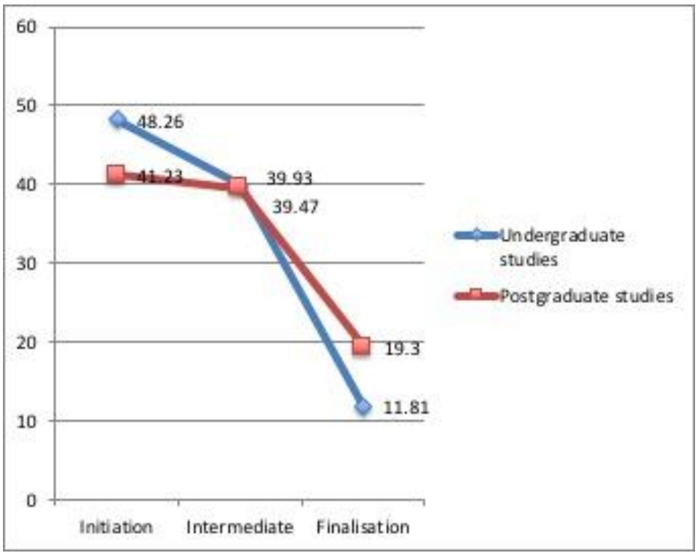

Figure 5. Stages of tackling the task: comparison of undergraduate and postgraduate students' discussion board activity (percentages).

Student Approach to Tackling Activities

Initiation stage: Starting the Twitter-based activity. Most of the students' discussion board activity occurred during this stage. This was when 46.27% of the messages were posted, and 68.9% of messages were posted during the first month of the semester. This thematic thread included various kinds of questions; however, all were related to starting work on the Twitter-based task. Most of the questions (32.9% of messages) were related to activity duration or clarifying when to start Twitter participation (e.g., Does the activity consist of consecutive or separate weeks? Have I spent the right amount of time on the task? What is the deadline for handing in work?) These were followed by questions on how to share Twitter addresses on a Google Drive file (27.27%), and thirdly, on how to tailor the account topic (16%). Other themes included students' expectations and insecurities (7.4%) and questions about creating a specific Twitter account to carry out the activity (8.5%).

Undergraduate students' questions focused on problems related to sharing an address on Google Drive (17.36%). In 3.8% of messages, students expressed their expectations and insecurities about starting the activity with statements such as "I hope I'll pick all of this up soon," and "Actually, I feel a bit lost." In responding to these messages, teaching staff attempted to reassure students with statements such as "She doesn't seem lost to me. Quite the opposite. She's doing fine."

Postgraduate students' questions focused on the activity start date (20%) and duration (10%). We also observed that in April (a few weeks before the deadline for handing in work), postgraduate students returned to the subject of activity duration and timing with the aim of renegotiating evaluation of the CAA. For example, one student posted:

> So here is how I see it: according to the task instructions, we had to use Twitter for at least three weeks. I opened an account yesterday for this activity, but there isn't enough time left now so I can't comply with the instructions. On the other hand, if I used my personal account, which has been active for longer, I could comply with them…

It was then explained by a teacher that in order to achieve the CAA objectives, students had to fulfil the requirements published in the course outline:

> The activity must be carried out for at least three weeks, which is why it was set at the beginning of the semester. In fact, the most important aspect of the activity is to demonstrate an interest in interacting with peers throughout the semester.

Intermediate stage: Continuing to work on Twitter. The second highest amount of activity, accounting for 39.8% of messages posted by students throughout the semester, occurred during this stage. Activity was highest in the second (40%) and third (37.5%) months of the semester. Questions mainly concerned technical problems, how to carry out the activity (28.7%), how to use the course hashtag (20%), how to retrieve tweets (18%), and among postgraduate students, how to carry out the second stage of the task (18%). Other questions focused on how to attract followers on Twitter (10%) and how to compile a report on the bibliographical references (4%).

Undergraduate students were more uncertain about how social networking sites functioned, experienced more technical problems, and presented a greater tendency to seek approval from the teaching staff and confirmation that they were doing the activity correctly. Some 16% of their messages were related to this subject ("When I changed my account from Yahoo to Gmail, Twitter blocked it as suspected spam … I haven't been able to fix it.") Teaching staff responded to these questions by providing guidance, reminding students about the supporting documents available to them with statements like "don't forget to look at the course outline, the discussion board and the video tutorials." Students also had questions about how to use the course hashtag in their tweets (11.11%), such as where to place it, what kind of tweets to include it in, in tweets like: "Thanks for following me," and "Go guys! We can do it!" They also needed advice on how to attract followers and find other users.

The postgraduate students did not ask many questions about technical issues, attracting followers or using the hashtag. 25.4% of students asked about the design of a social media-based teaching plan, for example, one student asked "In the section 'General objective of the plan' do we need to describe the goals pursued?” 6.14% of messages concerned the bibliographic references required to document the work, with questions such as “in the part on Twitter references, do we put the links we’ve visited that gave us ideas?”

Finalisation stage. There was less activity on the discussion boards during this stage, which accounted for only 13.93% of the messages posted and took place in the third (25%) and fourth (14%) months of the semester. Questions were raised about the report to hand in (42%) and evaluation of the activity (25%). Some 32% of discussion board activity focused on a thematic thread created by the teaching staff, concerning application of knowledge.

Both groups of students asked about how to compile the final report necessary to pass the CAA (the sections to complete, how to send it through the virtual platform, etc.). Undergraduate students asked more questions about the evaluation process than the postgraduate students. In order to encourage student participation on social networking sites, teaching staff provided information about other tools that complement Twitter, for example, *ifttt* (to synchronise different social networking sites), *Klout* (to see the impact of each account), *Topsy*, *Twittercounter.com* (to collect Twitter data), and *Scoop.it* (to publish on different networking sites).

Discussion and Conclusion

The undergraduate and postgraduate students had similar outcomes in terms of performance and Twitter participation. Therefore, *hypothesis 1* is not confirmed, and it is concluded that educational level does not influence social media participation or academic performance. Comparison to detect differences between undergraduate and postgraduate students enables teaching staff to adapt social media participation activities where necessary to suit students’ educational level and to ascertain if, in the course of their university experience, students develop a greater disposition to embrace new forms of networked social interaction. The data indicate that the Spanish university system does not seem to have favoured student predisposition to collaborate in social learning processes. In fact, it was found that postgraduate students chose to do a more traditional activity of analysing and evaluating teaching materials, which consisted in a solo project instead of networked interaction. Obviously, the attempt failed to reach the majority of the students and failed to instil an interest in social media participation. The outcome disconfirms previous studies suggesting that students are increasingly choosing to use social networks (Dahlstrom & Bichsel, 2014; Karal & Kokoc, 2013) as in the courses at issue here the majority of students chose to complete no activity at all, and only 21% chose *CAA on Twitter*.

The students who completed the CAA on Twitter displayed significantly higher test grades and final grades; however, the effect of activity type on performance was weak. Therefore, our conclusion is that, even though there are significant differences, the type of activity completed does not have a strong influence on student performance. On the other hand, it was found that, the more students participated in Twitter, the greater their performance, and vice versa. Social media participation over Twitter could provide added value for the Spanish education system by offering students the possibility of enriching their online social capital, as highlighted by authors such as Jones and Baltzersen (2017). In short, the data do not allow us to confirm *hypothesis 2*, because Twitter participation had only a weak influence on academic performance, but sufficient signs do exist to consider social network participation a means that can facilitate learning, as affirmed by Al-Rahmi, Othman, and Yusuf (2015), among others.

Academic instruction concerning social networks, more specifically Twitter, was found not to guarantee social network participation over time beyond the end of the academic activity in question. Although most students maintained their Twitter accounts, we observed that over half ceased active participation once the academic activity had ended. Only 29% of the students posted messages on Twitter in 2017. These results are consistent with those found by authors such as Lima and Zorrilla (2017), and in line with their argument, we conclude that cultural variables may have influenced these results: in Spanish-speaking countries, student behaviour is regulated so by teacher leadership and consideration as a source of reinforcement than by socialization with peers. As noted by Alhazmi and Rahman (2014), it is important to bear in mind that social networking sites by themselves cannot explain student commitment. Furthermore, as indicated by Henrie, Bodily, Manwaring, and Graham (2015), in order to analyse continuing student participation, it is necessary to consider variables such as the clarity of instruction and the relevance of the proposed activities. It is possible that the proposed Twitter activity on the courses analysed lacked relevance, which could explain this lack of commitment to and participation on social media. The Twitter activity had a primarily practical, functional focus. Its objective was for students to learn to interact on Twitter and form a community. The activity may need to be redesigned to give a more analytical focus, requiring students to engage in a more reflective, more critical kind of participation based on academic discussion processes on Twitter. Discussions could be scheduled throughout the academic year, and teaching staff intervention on Twitter could be changed from an *observer* role to a *participant* role, where teachers could interact more with students. Thus, it would be possible to analyse whether this type of activity influences performance and what influence the teacher's role has on social network participation by distance university students. We therefore conclude that the networks generated did not constitute stable communities of practice. Hence, *hypothesis 3* was not confirmed.

Lastly, when designing a learning activity involving social networking sites, it is essential to incorporate the three stages proposed by Forbes (2017) (beginners, intermediate, and professional), since we observed that students tackled the task in these three stages. Although our quantitative results suggest that educational level affects neither performance nor participation, our qualitative study indicates the need to offer different scaffolds according to educational level. In the initiation stage, undergraduate students experienced more basic problems; therefore, instruction at this stage for these students should focus on and address these problems. This is especially important in the first month of carrying out a social media-based activity in order to prevent disengagement and ensure continuity, since this month was when most activity occurred and exerted a decisive influence on effective implementation of the task. Among other things, the timing of the activity should be made very clear to the students at this point. In the intermediate stage, our undergraduate students were unsure how to use a hashtag or attract followers, indicating that attention at this stage of a social media-based activity should focus on technical problems and how social networking sites work. Technical support and answering questions about how to carry out the activities are the main functions in the intermediate stage. Our undergraduate students were more uncertain about how social networking sites functioned, experienced more technical problems and presented a greater tendency to seek approval from the teaching staff and confirmation that they were doing the activity correctly. This aspect should be borne in mind when designing an activity. In the finalisation stage of carrying out social media-based activities, we observed less activity on the discussion boards, and the main questions raised by students concerned evaluation of the activity and the final report to hand in, rather than seeking further knowledge about social networking sites. We conclude that the students did not show a very high level of interest in the acquisition of knowledge. *Hypothesis 4*, that instruction in social networking sites should include different stages for students at different educational levels, was confirmed, since although both groups tackled the task in the same stages, their questions reflected different themes.

In short, as Huang (2018) affirms, outcomes indicating a relationship between social network use (in our case Twitter) and performance must be viewed with concern.

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Nonverbal Communication in Text-Based, Asynchronous Online Education

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Abstract

Does nonverbal communication exist in asynchronous, text-based online education? It is commonly believed that it does not due to the absence of body language and paralanguage. An examination of the definitions and forms of nonverbal cues suggests the possibility for some of them to be transmitted through asynchronous, text-based online human interactions. To explore the presence, type, and potential impact of *electronic* nonverbal cues (*e*NVC), I conducted this research using the Exploratory Sequential Mixed-Method Design. Phase 1 constituted the preliminary, qualitative stage of this research, during which participants completed an online questionnaire to identify what *actions*, if any, could *speak louder than words* in discussion-based courses. Thematic analysis of the questionnaire answers revealed the potential existence and influence of several *e*NVC categories. Phase 2 constituted the quantitative stage, and served to validate Phase 1 findings through the data collection and analysis of two versions of an online survey: one for professors and another for learners. The collated research findings confirmed that *e*NVC exist and communicate messages beyond those sent and received through printed words in the asynchronous, online learning environment. According to study participants, these types of *electronic* cues contributed to the social and teaching presences, and therefore carried the potential to influence students' levels of engagement and motivation.

Keywords: text-based, asynchronous, communication, electronic nonverbal cues (*e*NVC), social presence, teaching presence, engagement, motivation

Introduction

"Online courses are convenient, but they lack interactions with students and instructors." This is a statement I often hear when I share the benefits of online education. Regardless of my efforts to explain the different forms of interactions within the online learning community, I usually receive the typical response of, "Yes, but I prefer *real* interactions," a statement which suggests that my collocutor is unknowingly referring to the nonverbal cues that accompany face-to-face encounters such as facial expressions, body language, and paralanguage.

In face-to-face situations, nonverbal cues fill out language gaps by providing optical illustrations and aural representations that affirm, emphasize, or contradict the meaning of the spoken words (Knapp & Hall, 2009). So, is it possible for learners participating in asynchronous, text-based online courses to experience *real human* interactions without facial expressions and paralanguage? Can they establish and perceive social presence without body language, and if so, how? Are there different types of nonverbal cues which fill out the *electronic* language gaps and influence the online learning experience?

To explore the existence and impact of *electronic* nonverbal cues (*e*NVC), I conducted this research using the Exploratory Sequential Mixed-Method Design. Phase 1 established the basis of this project when eight participants answered the open-ended questions of an online questionnaire. Phase 2 consisted of two versions of an online survey, one for faculty and another for learners. The survey questions stemmed from Phase 1 data analysis, and aimed to verify Phase 1 findings.

The combination of the qualitative and quantitative findings suggested the existence of four categories of *e*NVC which have the potential to influence participants' perceptions of social and teaching presences, as well as the students' engagement and motivation in text-based, asynchronous online learning environments.

Background

Education is a social activity based on communication. During the last decade, ways of communicating within the educational context have changed due to the emergence and growth of online education. Students and instructors participating in web-based courses experience the need for learning how to use this channel not only to exchange unambiguous messages, but also to build supportive learning communities (Dunlap & Lowenthal, 2018). Since communities are formed through interpersonal relationships comprised of both verbal and nonverbal communication, it is necessary to examine how an online learning community can establish interpersonal relationships despite the lack of traditional nonverbal cues usually present in face-to-face interactions.

In critical reflection regarding my experience in asynchronous, text-based online learning environments, I notice that it is possible for participants in such courses to send and receive messages beyond their printed words. Such messages usually pertain to emotions, attitudes, and personality traits, thus they can be labeled as nonverbal cues. However, due to their distinctive electronic feature, I will refer to them as *e*NVC throughout this study.

Online Learning

Although there is a wealth of terms describing educational programs which do not require the participants' physical presence in the learning environment, the term "online learning" is used throughout this study to refer to asynchronous, text-based courses delivered solely via the World Wide Web. This study excludes web-based courses with any type of integrated and evaluated video/audio conferencing, blended learning, and real-time virtual representations of participants.

Nonverbal, Body Language, and Paralanguage

Despite the prevailing belief that nonverbal communication is absent from online courses, a quick investigation of the terms "body language," "paralanguage," and "nonverbal" reveals the underlying reason behind this misconception. Body language refers to facial expressions, physical appearance, gestures, posture, and kinesics, whereas paralanguage refers to vocal elements present in speech (Littlejohn & Foss, 2009). While body language and paralanguage are important forms of nonverbal communication, they do not encompass all forms of nonverbal communication which consists of any type of messages sent and received beyond the use of words (Burgoon, Guerrero, & Floyd, 2010). Within the scope of this project, such messages could be embodied in the writing style, timing, frequency, and length of asynchronous, text-based communication. They could also include two-dimensional (2D) visual cues such as photographs, pictographs, illustrations, symbols, and colors.

Research Questions

This research sought to answer the following questions:

1. In the absence of body language and paralanguage, are *e*NVC which relate to instructors' and learners' emotions, attitudes, and characteristics present in the asynchronous, text-based online learning environment? If so, what types of *e*NVC are present?

2. Is there any correlation between *e*NVC and the social/teaching presence in the asynchronous, online learning environment?

3. What impact, if any, do *e*NVC have on the students' motivation, level of engagement, and overall perception of the online learning experience?

Research Context

Research participants included faculty and students of an online graduate program at a Canadian university. In this program, text-based courses are spread over six-week terms, during which asynchronous interactions take place in the form of postings in discussion boards (DBs). Usually, each course starts by inviting students to write a brief autobiography and to post a profile picture. Following the introductory stage, students independently complete assigned readings, then initiate weekly discussion threads, and respond to some of their peers' postings. Instructors' direct engagement in the online discussions varies, according to their beliefs of what constitutes best online instructional practices. Limiting the study to a single setting helped eliminate variables which could derive from differences in institutional policies, platforms, programs structures, and courses requirements.

Theoretical Framework

Due to the lack of academic studies on the topic of *e*NVC, this research was guided by the principles of the theory of communication, and the elements of the social and teaching presences as described in the community of inquiry (CoI) model.

The Communication Process

Communication is at the core of all educational acts, including online learning. To explain the human communication process, many scholars (Berlo, 1960; Fisher & Adams, 1994; Schramm, 1955) present conceptual models which expand on Shannon's theory of communication (1948). This basic theory describes human communication as encoded messages a sender transmits to a receiver through a channel. The receiver decodes the messages to derive meaning (Shannon, 1948). In his Sender-Message-Channel-Receiver (SMCR) model of communication, Berlo (1960) separates Shannon's (1948) model into four distinct parts, and presents factors that influence the communication process, such as communication skills, social systems, knowledge, culture, and attitudes. Schramm (1955), on the other hand, focuses on the importance of feedback, and describes communication as a circular process in which participants are both senders and receivers who code and decode messages based on their experiences.

Research shows that the coding of messages can be either verbal or nonverbal (Keating, 2016), and that, in interpersonal relationships, people communicate all the time even if their intention is not to communicate (Watzlawick, Beavin Bavelas, & Jackson, 1967). To be more specific, lack of communication is also considered as a form of communication, because by not communicating, the sender can convey a variety of messages which receivers perceive and interpret differently depending on the situation (Watzlawick et al., 1967). So, how can this communication principle aid in exploring the presence, types, and potential impact of *e*NVC?

Nonverbal Communication

According to communication theorists, verbal messages are expressed through the meaning of words (written or spoken), whereas nonverbal messages are expressed beyond the actual meaning of words, and they mainly reveal emotions, characteristics, and attitudes (Manusov, 2016; Mehrabian, 1981). Nonverbal communication is not the opposite of verbal communication, as it usually complements it (Creative Commons, 2012). In face-to-face encounters, verbal and nonverbal cues work together in concert to present clearer, more comprehensive messages; moreover, communication theorists indicate that nonverbal messages need to be interpreted "as clusters within contexts" (Creative Commons, 2012, p.35).

A study of the literature reveals that some scholars use the expressions "nonverbal communication" and "body language" interchangeably. Therefore, they assume that text-based online courses lack any type of nonverbal communication because body language is nonexistent. For instance, Reilly, Gallagher-Lepak, and Killion (2012) discussed the lack of nonverbal communication in online learning as an emerging theme that had both positive and negative connotations.

A deeper examination of nonverbal cues reveals that some are related to the perception of 2D visuals and time (Blatner, 2002; Manusov, 2016). Although body language and paralanguage are absent from the text-based online learning environment, this does not overrule the presence of other types of *e*NVC which can convey attitudes of understanding, reassurance, appreciation, empathy, and encouragement. Conversely, those same *e*NVC can transmit negative messages that lead to apprehension and demotivation.

Social Presence

Academic research on the topic of *e*NVC is scarce. However, some studies on the efficiency of online learning unknowingly focus on the consequences of neglecting these cues. For instance, research shows that, despite its popularity and rapid growth, online education still has higher attrition rates (Bart, 2012; Liu, Gomez, Khan, &Yen, 2007; Newman, Couturier, & Scurr, 2010). Students enrolled in online courses often report feeling socially disconnected, and missing teacher immediacy and interpersonal relationships with peers (Menchaca & Bekele, 2008).

To overcome feelings of isolation, learners need to become socially connected with their peers and instructors. The community of inquiry (CoI) model as introduced by Garrison, Anderson, and Archer (2000) refers to successful relational interactions in the online learning environment as “social presence.” They define social presence as “the ability of participants in the community of inquiry to project their personal characteristics into the community, thereby presenting themselves to the other participants as “real people” (Garrison, Anderson, & Archer, 2000, p. 89).

Methodology

The novelty of the research topic necessitated the adoption of a design suitable for exploring a new phenomenon. Creswell (2013) describes the Sequential Exploratory Mixed-Method Design as a method in which findings of the preliminary qualitative data analysis inform the quantitative data collection, whereas the quantitative results serve to validate the qualitative findings. It is particularly useful when instruments for quantitative data collection are absent, and when quantifiable data is needed to verify personal views (Creswell, 2013). Following this design, this research had two consecutive phases, as shown in Figure 1. Both Phase 1 questionnaires and Phase 2 surveys were administered using a cloud-based survey development software, and data from questionnaires and surveys was electronically collected, stored, and analyzed. The project complied with the Tri-Council Policy Statement: Ethical Conduct for Research Ethics Involving Humans (2014).

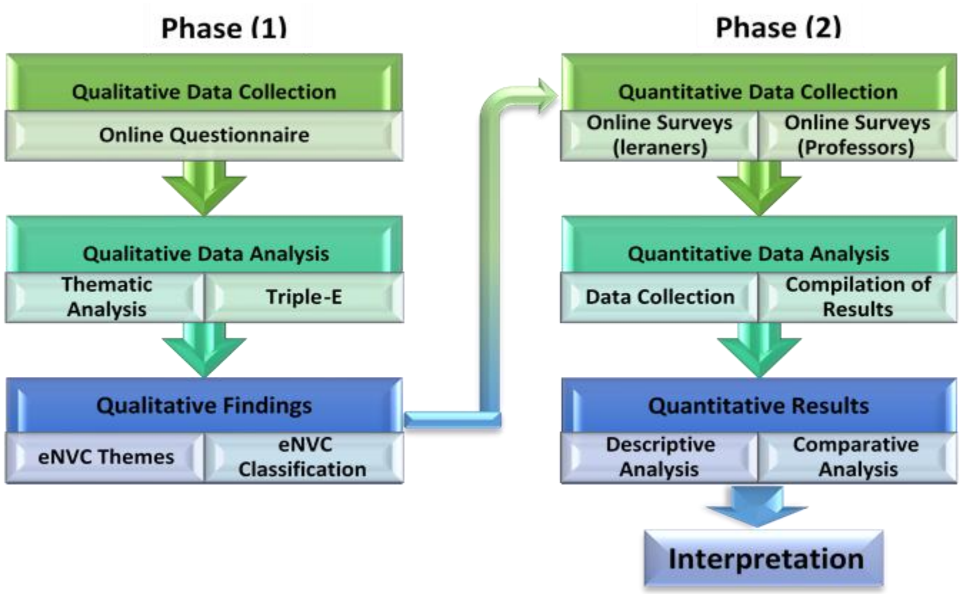

Figure 1. Sequential exploratory mixed-method design.

Phase 1

A purposive sampling of eight participants (three faculty and five students) was selected to answer 10 open-ended interview questions about their online teaching/learning experiences. Recruitment criteria included extensive knowledge of the online teaching and learning environments.

Data Analysis

After gathering the questionnaire responses, two rounds of thematic analysis were conducted (Braun & Clarke, 2006). The first round aimed to identify and categorize themes in the participants' responses, whereas the second aimed to:

- *Exclude* irrelevant themes.
- *Eliminate* general concepts.
- *Encode* themes related to *e*NVC.

This *Triple-E* process led to the exclusion of themes related to audio, video, text-based synchronous chats, and text content. Additionally, it resulted in the elimination of some general concepts that were too broad to define in Phase 1, and verify in Phase 2, such as "willingness" and "openness."

Findings

The last step in the *Triple-E* thematic analysis involved encoding relevant themes by determining how they could be connected based on their explicit and implicit contextual meanings. Figure 2 displays a mind map representing the findings of Phase 1 thematic analysis, which helped identify five *e*NVC categories, four of which described their types, whereas the fifth pinpointed their potential influence.

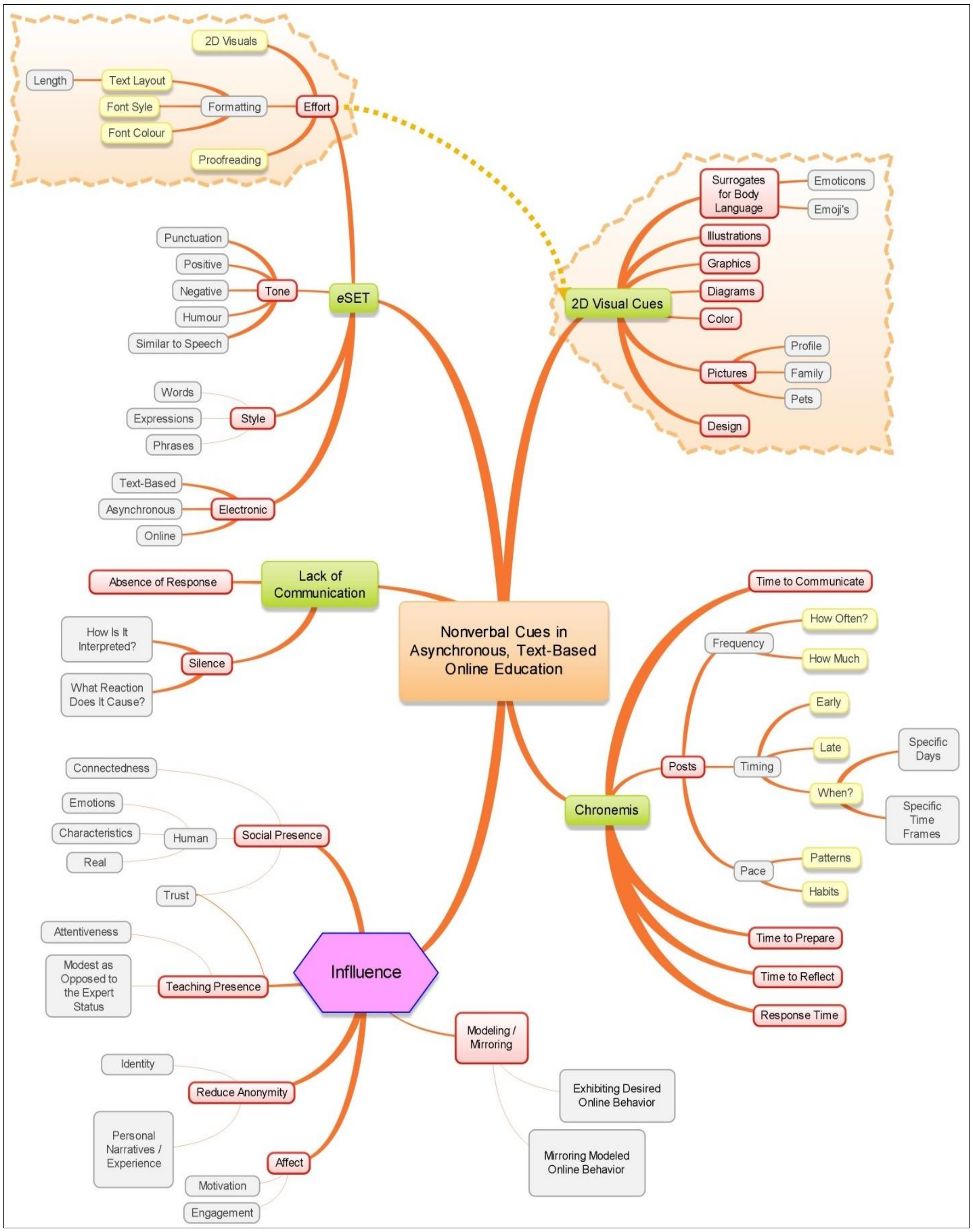

Figure 2. Mind map illustrating phase 1 findings and *e*NVC categorization.

Below is a description of the five *e*NVC categories identified:

Chronemics. In communication, chronemics is "the study of the concepts and processes of human temporality, or connections with time, as they are bound to human communication interactions" (Littlejohn & Foss, 2009, p. 96). Therefore, this *e*NVC category is associated with the perception and use of time. According to Phase 1 data analysis, those cues could be embedded in the:

- Weekly posts' timing, frequency, and pace reflected in posting and login routines.
- Taking time to reflect, prepare, and communicate inside or outside the course DBs.
- Response time or the time lag between an event and the reaction to that event, like a question posted in the course forum and the instructor's reply to that question. Expressions such as "immediate response," "answer quickly," and "prompt replies" were indicative of this subcategory, whereas the total absence of response was classified under lack of communication.

Lack of communication. As presented earlier, "no communication" is a form of communication. The questionnaire answers implied that this category is closely associated with negative learning experiences, as evidenced by a students' comment:

> If the teacher does not respond, or if no one responds to what I write, then I am left in a cloud of ambivalence. ... If I am ignored, I take it as a negative response. If, and when, this occurs, I tend to only contribute sufficiently to get my marks.

Phase 1 data analysis also suggested that "ignoring" or "not replying to" unpleasant peers' posts was a common cue to show discontent.

ESET. This was the most challenging category to label as it represented an amalgamation of many properties associated with the written text, beyond the actual meaning of words. It largely resembles paralanguage, or the vocalic attributes of spoken words, and includes: the writing style, tone, choice of words/expressions, structure, layout, and format in addition to the effort a person makes to express thoughts and/or feelings. While exploring the effectiveness of a variety of expressions that describe this category with two peers, one peer suggested the term "*e*SET" as an acronym for the "*electronic* Style, Effort, and Tone" which also appear as one *set* (D. Dell, personal communication, April 3, 2016).

References to *e*SET were found in many of the respondents' answers to questions related to the perception of *e*NVC. For instance, one student wrote, "Emoticons, punctuation, caps, etc. can implicate what non-verbal, in person cues may," whereas another's list of *e*NVC included:

- Short or quick answers;
- Positive or negative words, phrases, or comments;
- Supportive words, phrases, or comments; and

- Emoticons (use of, overuse of, no use of).

Moreover, many responses implied that the two *e*NVC categories, *e*SET and 2D Visuals, overlap at the point of effort participants make to send clearer messages.

2D visual cues. All participants mentioned 2D visuals as a form of *e*NVC, including:

- Surrogates for body language in the form of pictographs, emoji's, and emoticons
- Profile pictures and photographs of family and pets
- Illustrations in the form of graphics and diagrams
- Font style, color, size, and format
- Text layout and length

Respondents also considered 2D visuals as indicators of social presence because they could convey messages related to feelings more than plain text. This type of human interaction could increase the level of motivation and engagement, as one student wrote:

> Emoticons indicate passion, excitement, frustration, and other various emotions. Emphasizing key ideas through font choice and format can tell others how one feels about the topic at hand. When there is a meaningful discussion at play where emotions and personal perspectives are welcomed, the level of engagement and motivation definitely increase.

Influence. The final category identified in Phase 1 data analysis was the influence of *e*NVC on the online learning experience in general, and on the students' engagement and motivation in particular. The questionnaire answers suggested that *e*NVC helped respondents see their peers and instructors as "real" people, therefore, they contributed to the creation of social presence. However, *too much* presence could become a deterrent to social connectedness, as one of the students stated:

> Someone who participates regularly, and does so in a timely and professional manner taking the time to proofread their posts, include extra references or design interesting, colorful graphics are the people I tend to respond to in the asynchronous online classes I am involved with. Those people have a social presence online. However, people that have too much social presence (posting first all the time, tone of posts sound like they know it all), are the people I avoid interacting with.

To sum up, most respondents indicated that it was possible for *e*NVC to communicate messages related to emotions and attitudes, which could also impact the learners' levels of engagement and motivation. Consequently, if learners in online courses detected signs of attentiveness and engagement, especially from their professors, they would become more motivated and engaged, and vice versa. This line of thought suggested the existence of the modeling/mirroring principle, as it was more explicitly stated by one of the instructors' remark, "I try to model behavior in my classes, online ones included, so I use cues I am comfortable with and post early and often, the more I show students, the more they give back."

Phase 2

Phase 2 built on the findings of the research preliminary stages which informed the content of two versions of an online survey: Learners' Version (LV) and Professors' Version (PV). The difference between the two versions was limited to the exclusion of two demographic questions from the PV, and the inclusion of specific questions for each group to investigate the theme of silence.

Data analysis and results. Although the aim of Phase 2 was to validate and quantify Phase 1 findings, having two versions of the same survey provided a better insight into the similarities and differences in perspectives between the two groups of respondents.

Learning environment. A comparative analysis of the survey data revealed differences in the preference of the learning setting. While 75% of the professors were comfortable teaching in any environment (face-to-face, online, or blended), 58% of the learners chose either face-to-face (41.30%) or blended (17.39%). Although 73.33% of the learners strongly agreed that they chose to study online because it was convenient, and 80% because it was flexible, only 41.30% indicated a preference for online learning.

Teaching presence and response time. Despite some differences in views, data analysis from the question about the factors that contribute to the teaching presence showed that 95.65% of the learners and 87.50% of the professors agreed that *speed of feedback* contributed to the teaching presence.

Social presence. As concerns the meaning of social presence, 76.90% of the learners and 87.50% of the professors chose the option which describes it as *the feeling of being "there" with other members of the learning community*. Both groups agreed that *e*NVC related to chronemics (timing, frequency, and pace of postings), 2D visuals (profile pictures and emoticons), and *e*SET in the form of stylistic cues contributed to social presence. They also confirmed that *e*NVC in the form of posts timing, length, frequency, as well as 2D visuals indicate human characteristics.

Lack of communication. Lack of communication was a major *e*NVC category identified in Phase 1, which was challenging to investigate in insolation of other themes. That is why the PV question related to this category asked about the professors' impressions, assumptions, and actions if a student in their online classes, who regularly participated in the class DBs, had been absent from the class discussions for a week. All respondents stated they would notice the absence, and contact the student either by email (87. 50%) or phone (12.50%). Only one professor stated they would deduct marks for lack of class participation.

Additionally, lack of communication in the form of "ignoring" or "not replying" was also identified as a cue for showing discontent in asynchronous, online discussions. Results of a question investigating the learners' behavior if a peer wrote something they found offensive revealed that 47.73% would ignore that post.

Also, from the learners' perspective, lack of communication was investigated in a question about their feelings if no one replied to their posts. Of the 46 learners who completed the survey, 20.45% stated it did not have any effect on them while 43.18% associated it with feeling demotivated, ignored, or devalued. In the space for comments, some added feeling their posts were of "no interest." Two of the 12 learners who added comments to this question mentioned the possibility of others not having time or already meeting their requirements for weekly posting.

Influence of ESET. Although none of the survey respondents associated lack of replies with the post format, results from the question about *e*SET revealed that formatting may have more influence than anticipated. As a practical application of this category identified in Phase 1, two layouts of the same post were presented to participants: Layout A, without special text formatting, greeting, or concluding remark and; Layout B, with special text formatting, numbering, paragraph breaks, smiley, greeting, and concluding remark (Appendix). Respondents were asked to take a cursory look at both layouts then answer related questions.

Results indicated that 72.09 % of the learners and 75% of the professors chose Layout A as the one which reflected a monotonous tone. Moreover, 79.55% of the learners and 87.50% of the professors stated that Layout B gave the impression of social presence. Most learners (79.55%) and professors (75%) indicated they were more likely to respond to Layout B, while 0% of all respondents chose Layout A as the post they would respond to (Figure 3).

Remarkably, 22 learners added comments to explain their choices. They included clarifications about Layout B being more reader friendly, organized, easier to navigate, and visually pleasing. They described the writer of layout B as: "Friendly, warm, inviting, open, inclusive, engaging, pleasant, fun, thoughtful of the time of others," and "not taking themselves too seriously." On the other hand, some of them described the writer of Layout A as: "Someone who did not have time" or who "did not put enough effort into making their thought/opinion meaningful to their peers," therefore implying that *e*SET was a powerful *e*NVC which could send messages related to the writer's personality and attitude toward learning.

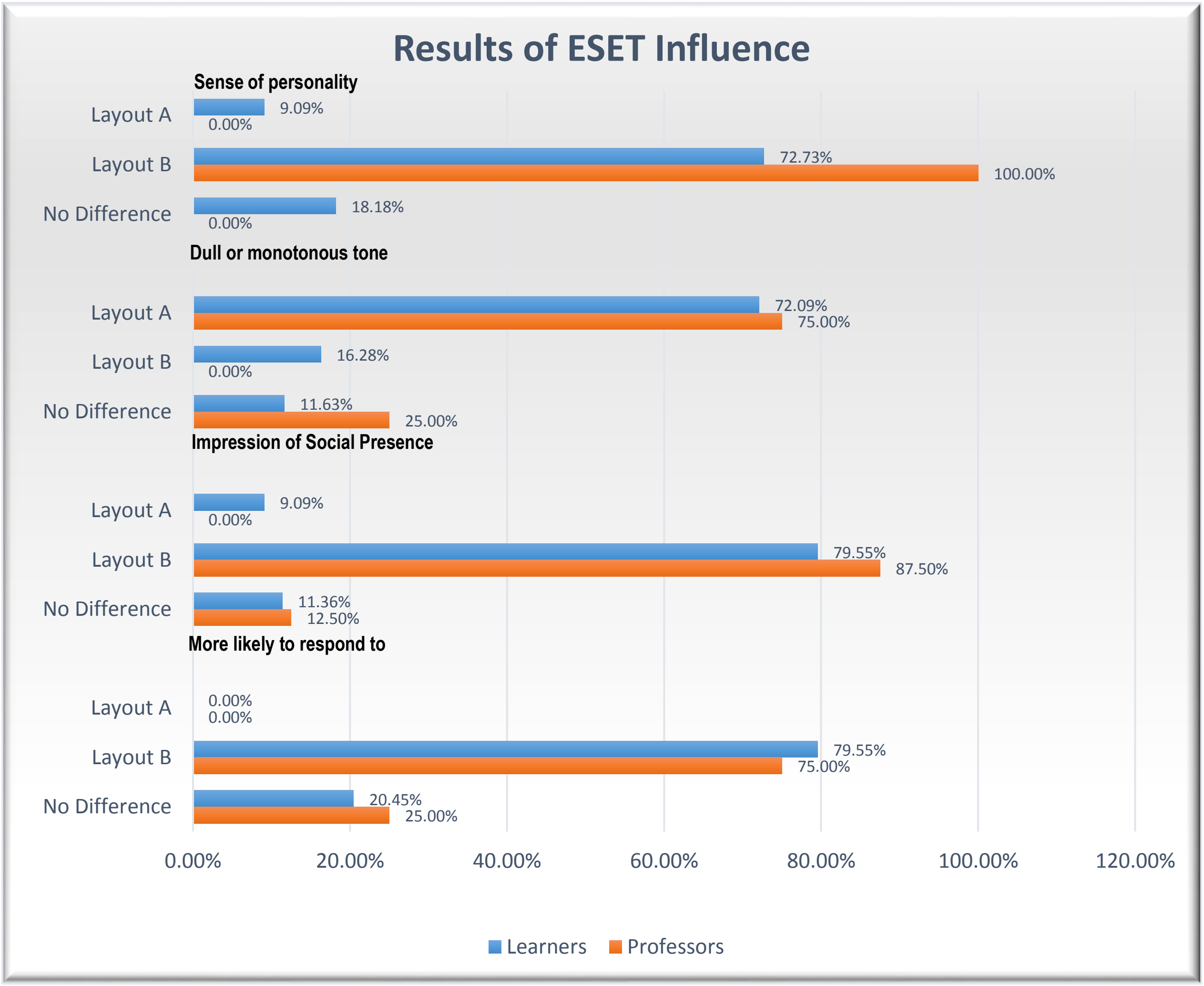

Figure 3. Impressions about posts with same content but different layouts.

Engagement and motivation. Could *e*NVC influence learners' levels of engagement and motivation? Survey results suggested that instructors' actions could impact students' levels of engagement and motivation. For instance, 85.71% of the learners and 100% of the professors stated that students engaged more if instructors *quickly* provided help when detecting signs of struggle, therefore making a direct correlation between the *e*NVC category of chronemics and learner engagement.

As for the negative impact, 71.43% of the learners and 87.50% of the professors indicated that students engaged less if instructors ignored their questions, drawing relationships between the *e*NVC category of lack of communication and student motivation. Additionally, 100% of the professors confirmed that students became more engaged and motivated when instructors provided quick feedback, and less engaged and motivated if instructors did not log in to the course website for several days. On this matter, one student added the following comment:

> It makes me very upset when an instructor does not log in to the course website for several days during the week (four to five days in a row). It happened with my previous course and I am still disturbed by that.

This comment pinpointed the importance of the teacher's presence which, in the learners' opinions, exceeded the importance of their peers' presence. Results from the LV showed that 71.43% of the learners engaged less, and 66.67% became less motivated if instructors ignored their questions, while 51.22% stated they engaged less, and 36.84% became less motivated if their peers ignored their questions. However, the PV results showed that 75% of the professors thought students engaged less and became less motivated if their peers ignored their questions.

Another difference in views between the two groups appeared in the results related to posts timing. For instance, 71.43% of the professors thought peers engaged more with students who post the first day of the week (Monday). However, 40.48% of the learners indicated it had no effect on their engagement, whereas 19.08% stated it made them engage less.

However, those views met again at the post length, when 75% of the professors and 78.05% of the learners stated that long posts (700 words or more) caused students to engage less. In this regard, one student added the following comment: "Too long don't read. Seriously, I don't have time to read novels."

Discussion

The findings of this research confirmed that, despite its increasing popularity, online education continues to be associated with attrition and feelings of isolation (Liu et al., 2007; Menchaca & Bekele, 2008). That is why most online learners prefer the face-to-face or blended educational settings, in which they experience a more elaborate sense of belonging to the learning community. However, this sense of belonging is not totally absent from the virtual learning community (Kop, Fournier, & Mak, 2011). According to the CoI model, it could be created through the combination of the teaching presence, the cognitive presence, and the social presence which is the responsibility of the teaching presence, and it mediates the cognitive presence (Garrison & Arbaugh, 2007). Since all three presences contribute to the perception of the learning experience, a negative experience could result from failures in establishing a cognitive presence, and even more so from the other presences that facilitate it. Therefore, it is necessary to acknowledge the factors which contribute to creating and maintaining the social and teaching presences within the online learning environment.

Some of these factors are directly related to the process of communication, which is fundamental to all social interactions within any educational setting, online learning included. However, it is commonly believed that the nonverbal element of communication is totally absent from the asynchronous, text-based online learning environment because body language and paralinguistic cues are neither conveyed nor perceived through written language. This could be true with archaic forms of written communication, but with the advent of Web 2.0 which created new forms of computer-mediated human interactions situated somewhere between writing and speech (Baron, 2003a, 2003b), it became possible for various elements of nonverbal communication to be transmitted, received, and interpreted through electronic texts. This was supported by the research at hand, which identified four categories of *e*NVC types, along with their potential influence on teaching and social presences, and in turn, the learners' engagement and motivation.

For any category/subcategory to be recognized as *e*NVC, it must be nonverbal, expressed beyond the use and/or meaning of the written words, and transmitted electronically through asynchronous, text-based online human interactions. In the view of these criteria, this study classified four main types of *e*NVC: chronemics, 2D visuals, *e*SET, and lack of communication. Except for *e*SET, all these *e*NVC types constitute forms of traditional nonverbal communication. However, many of them go unnoticed in face-to-face encounters due to the presence of more visible nonverbal cues, such as facial expressions, body posture or gestures, and voice. But, similarly to people who compensate for their loss of a certain sense through the heightening of other senses, the results of this research seem to indicate that once learners lose the ability to see and hear other participants in the learning community, they compensate for this loss by developing abilities to decipher codes transmitted through time, silence, and other types of *e*NVC including *e*SET, which is comparable to paralanguage in the spoken language. Although *e*SET accompanies printed words, it carries the power of conveying messages beyond the meaning of those words, which can reflect the writer's personality, feelings, and/or attitudes as demonstrated by the results of questions related to the same post presented in two different layouts (Figure 3).

It is worth noting that *e*NVC, as an innovative concept in online education, should be deliberated with caution until further studies prove its influence on the learning experience. Although this research suggests that some forms of *e*NVC contribute to the social and teaching presences, online educators and learners need to remember that nonverbal cues should be interpreted as clusters within a context (Creative Commons, 2012; Matsumoto & Hwang, 2016). Therefore, prior to deciding whether a certain behavior could increase or decrease students' engagement and motivation, it is necessary to take into consideration the contextual framework, as well as other forms of communication, surrounding that behavior. Electronic nonverbal communication is not the opposite of verbal communication, nor is it its substitute; it is rather a complementary component of electronic communication which helps fill out the visual and vocal void in the asynchronous, text-based online learning environment.

Potential Future Research

At the end of this project, it was rewarding to see that what had started as a personal inquiry led to academic research findings, which could improve our understanding of the online learning experience. However, throughout every step of this study, I came across information that generated many more questions, most of which I was unable to investigate within the scope of this project.

For instance, little did this research reveal on the topic of modeling/mirroring desired behavior in online courses. However, participants alluded to the fact that learners engaged less when they perceived signs of their instructors' lack of engagement. Although most of these signs were mainly related to the frequency of posts/replies and the response time, as a member of the online learning community, I noticed other types of mirroring related to text formatting, the use of emoji's, and posts timing. Examples of such actions include learners imitating their instructor's special text formatting (such as the use of a specific color or font type) while quoting another participant, and posting on the same days their instructors post. Therefore, it would be interesting to investigate this type of modeling/mirroring online behavior, and the impact it might have on the learners' engagement.

Another potential topic for future research is associated with the differences in opinions about the time online learners have to reflect on the course material. Although some participants indicated their preference for online learning because it gave students more time to think, others stated that the six-week terms were too short for students to reflect fully on each course content. In the view of the importance of time as a category of *e*NVC, it would be beneficial to explore how learners perceive the amount of time allocated for the coursework, and whether this has any effect on their academic success.

Perhaps future research will explore those topics, along with other areas I pondered on while completing this research, such as: the generational and gender differences in transmitting, perceiving, and/or interpreting *e*NVC; the effect social media has on the use and understanding of *e*NVC in online education; the difference between perception and reality when it comes to decoding the meaning of *e*NVC; intentional and unintentional eNVC; and the association of emoji's with innate, international, and culturally acquired nonverbal behaviors in the form of body language and/or facial expressions.

Summary and Conclusion

My aim throughout this study was to explore the existence, forms, and influence of *e*NVC in the online learning environment to improve the students' learning experience. Due to the lack of academic studies on this topic, theories of communication as well as the CoI model provided a foundation for the theoretical model. The Exploratory Sequential Mixed-Method constituted the research design, dividing it into two consecutive phases: Phase 1 was qualitative, and aimed to provide preliminary knowledge on the *e*NVC themes; Phase 2 was mainly quantitative, and built on Phase 1 findings to validate and quantify them.

In conclusion, the research findings and results provided the following answers to the research questions:

1. In the absence of body language and paralinguistic signals, are *e*NVC which relate to instructors' and learners' emotions, attitudes, and characteristics present in the asynchronous, text-based online learning environment? If so, what types of *e*NVC are present?

Electronic nonverbal communication exists, and the most noticeable *e*NVC were chronemics, 2D visuals, *e*SET, and lack of communication. Each one of them contained subcategories which were identified in Phase 1, and validated in Phase 2 as having the potential to convey human qualities related to emotions, attitudes, and personality traits.

2. Is there any correlation between eNVC and the teaching/social presence in the asynchronous, online learning environment?

The outcome of this research suggested that *e*NVC, especially the ones related to chronemics (such as response time), had a great impact on establishing and maintaining a teaching presence, whereas lack of communication could lead to the absence of any social and/or teaching presence. Additionally, *e*SET and 2D visuals could contribute to the social presence.

3. What impact, if any, do *e*NVC have on the students' motivation, level of engagement, and overall perception of the online learning experience?

The research findings suggested that chronemics and lack of communication had more influence on students' levels of engagement and motivation than 2D visuals. However, although *e*SET was not recognized as a significant factor in the students' engagement, survey results regarding the length, format, and layout of posts suggested it may have more impact than anticipated.

Despite its growing popularity, online learning is still regarded as less satisfactory than face-to-face learning environments. Interestingly, the reason for this dissatisfaction is not the decreased levels of education, but rather the decreased level of human interaction, which is indispensable for connecting individuals within any community, including the online learning community. Those interactions which convey the feeling of being with other "human beings," despite being alone facing a computer screen can be recognized as "presence," and cannot be transmitted through written words alone, but rather through *e*NVC. As suggested by the research at hand, *e*NVC can show members of the learning community that their instructors and peers are "real" and "there," and they do care about community members' intellectual, social, and emotional well-being.

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Appendix

Layout A

U-learning (ubiquitous learning) is soon replacing the term e-learning with the advancement of computing technologies and wireless communication that allow us to carry our learning material wherever we go, and access it anytime from anywhere, depending on our availability and needs. But, how does u-learning impact formal education? In the view of this week's readings, I see the impact as taking place on three levels. On the learner's level, u-learning has faded the lines between life and education; therefore, it had become the learner's responsibility to develop skills in self and time-management to ensure allocation of adequate time for each educational activity. Based on my experience as a U-learner, I confirm that this can be challenging at times, especially that my educational requirements are so invisible that they may go unnoticed. It is because of this invisibility that my children constantly interrupt me while studying. On the instructor's level, u-learning is also demanding as it is not limited to specific teaching and office hours. Online learners expect personal attention, which requires a shift in the instructional strategies and awareness to what keeps learners engaged. On the institutional level, u-learning requires choosing user-friendly platforms with mobile applications, and adjusting the courses offerings and design to fit the current learner's needs, with the option of constantly updating them as those needs evolve. Special attention should be given the technological side of the learning, with electronic space for secure storage of information, and processes for retrieval.

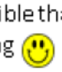
Layout B

Hello Everyone,

U-learning (ubiquitous learning) is soon replacing the term e-learning with the advancement of computing technologies and wireless communication that allow us to carry our learning material wherever we go, and access it anytime from anywhere, depending on our availability and needs.

But, how does u-learning impact formal education?

In the view of this week's readings, I see the impact as taking place on three levels:

1. On the learner's level, u-learning has faded the lines between life and education; therefore, it had become the learner's responsibility to develop skills in self and time-management to ensure allocation of adequate time for each educational activity. Based on my experience as a U-learner, I confirm that this can be challenging at times, especially that my educational requirements are so invisible that they may go unnoticed. It is because of this invisibility my children constantly interrupt me while studying  .

2. On the instructor's level, u-learning is also demanding as it is not limited to specific teaching and office hours. Online learners expect personal attention, which requires a shift in the instructional strategies and awareness to what keeps learners engaged.

3. On the institutional level, u-learning requires choosing user-friendly platforms with mobile applications, and adjusting the courses offerings and design to fit the current learner's needs, with the option of constantly updating them as those needs evolve. Special attention should be given the technological side of the learning, with electronic space for secure storage of information, and processes for retrieval.

Thank you for reading. Comments welcome.

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University Teachers and Open Educational Resources: Case Studies from Latin America

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Abstract

The Open Education movement has made efforts to systematise experiences and to evaluate the adoption of Open Educational Resources (OER). However, OER adoption is not part of the prevailing paradigm in higher education, both at the global level and in Latin America. This paper describes results of a study that analysed the social representations regarding the development, use, and reuse of OER by university teachers in their pedagogical practices. We conducted a study of 12 cases from Latin American universities based on Grounded Theory. The results show that the use and reuse of OER lacks of public and institutional policies. The main agents are teachers organised in teams that support OER adoption. The reasons that encourage the creation of OER are mainly intrinsic, such as the pleasure derived from contributing and sharing, as well as external and related to professional development needs from the reflection on one's own educational practice. Educators consider it essential to evaluate the resources created so that they can be reused in continuous improvement processes. Commercial use and misappropriation of the works are two of the main tensions identified. The community factor of teaching guides most behaviours in OER adoption in educational institutions and is presented as an inherent part of the development and transformation of the curriculum.

Keywords: Open educational resources, university teachers, higher education, adoption, Latin America

Introduction

Spanning over 20 years, the practice of creation, use, and open sharing of digital educational resources is far from being widespread in educational environments. Besides, Open Educational Resources (OER) adoption in the Global South is not yet fully understood (Hodgkinson-Williams & Arinto, 2017). This paper presents the results of a study on OER adoption in Latin American (LATAM) Higher Education (HE) context. The study focuses on the social representations (Moscovici, 2006) regarding the development, use, and reuse of OER by university teachers in their pedagogical practices.

From an interpretative paradigm, we implemented a qualitative methodology on 12 cases from three public universities in three countries. Findings lead to identify three core categories: Institutional factors of the OER adoption; Attitudes and perceptions towards OER; and Practices of use, creation, and sharing of OER .

This paper is organised as follows: First, we introduce state of the arts on qualitative and mixed studies about the adoption of OER, then we explain the research methodology, and, finally, we address the results, discussion, and the most significant conclusions.

State of the Arts

Many efforts have been made to evaluate OER adoption, creating frameworks, and good practices. Despite the difficulties, OER dissemination has reached a maturity level, especially since the appearance of national and regional policies in the English-speaking north (Mulder, 2013; Stacey, 2013; de Langen, 2013; Falconer, Littlejohn, McGill, & Beetham, 2016).

Thus, there is still a great imbalance in the Global South (Umar, Kodhandarama, & Kanwar, 2013; Kanwar, Kodhandaraman, & Umar, 2010; Cobo, 2013; Mtebe & Raisamo, 2014), which includes linguistic barriers, digital gaps, closed educational systems, and lack of regional cooperation. However, Hodgkinson-Williams and Arinto, (2017) show that 51% of academics from nine developing countries have used OER, with slightly different rates by region.

OER adoption in LATAM HE has been sparsely studied, showing early stages of adoption, mainly caused by the lack of visibility, mobilisation, and articulation of existing experiences (Inamorato, Cobo & Costa, 2012; Abeywardena & Westermann, 2017).

Numerous mixed and qualitative studies on the adoption of OER focus on teachers' perceptions and attitudes, enablers, and barriers (Allen & Seaman, 2014; Annand, 2015; Annand & Jensen, 2017; Arinto,; Belikov, 2016; Bossu & Fountain, 2015; Cox, 2017; Cox & Trotter, 2016; Hanley & Bonilla, 2016; Harley, Lawrence, Acord, Dixson, & University of California, 2009; Hassall & Lewis, 2017; Hernández, 2014; Hodgkinson-Williams & Arinto, 2017; Jung, Bauer, & Heaps, 2017; Kaatrakoski, Littlejohn, & Hood, 2016; McGreal, Anderson, & Conrad, 2015; McGreal, Kinuthia, Marshall, Commonwealth of Learning, & Athabasca University, 2013; McKerlich, Ives, & McGreal, 2013; Mishra, 2017; Mitros & Sun, 2014; Mtebe & Raisamo, 2014; Shigeta et al., 2017; Stacey, 2013; Stagg, 2014; Toledo, 2017; Woodward, 2017).

Findings show that most university teachers are still not familiar with OER, and that these are not considered in the decision-making process regarding which educational materials will be used.

Several studies identify teachers as the main agents of the OER adoption decision-making process (Allen & Seaman, 2014; Cox, 2017; D'Antoni, 2008; Rolfe, 2012) and the prevailing institutional culture as a relevant factor (Cox, 2017). Tensions related to educators' practice and OER are aligned with educators' practice, professional development, and wider societal factors in the educational field (Kaatrakoski et al., 2016).

Such findings allow us to identify institutional factors and teachers' agency as fundamental dimensions in the adoption of OER in HE. Within institutional factors, the most relevant are social culture (Cox, 2017), organisational structures and constraints (Falconer et al., 2016; Kaatrakoski et al., 2016; Pirkkalainen, Jokinen, & Pawlowski, 2014), and institutional policies (Butcher, Kanwar, & Uvalić-Trumbić, 2011; Conole, 2013; Cox, 2017; Cronin, 2018, 2018; D'Antoni, 2008; Glennie, Harley, Butcher, & van Wyk, 2012; Inamorato Dos Santos et al., 2017; Kaatrakoski et al., 2016; Nkuyubwatsi, 2017).

Regarding policies, incentives, and academic promotion are enabling conditions for the adoption by academics (Annand & Jensen, 2017; Conole, 2013; Hylén, 2006; McAndrew, Farrow, Elliott-Cirigottis, & Law, 2012; Nkuyubwatsi, 2017). Nevertheless, recent studies show that policies can act as a motivating factor depending on the type of institutional culture it is embedded (Cox, 2017), and simultaneously lead to changes to both organisational and individual practice (Kaatrakoski et al., 2016).

Academics' practices of creating, sharing, and reusing OER are determined by motivation and desire or will to adopt OER (Cox, 2017; Reed, 2012; Rolfe, 2012), supportive environments (D'Antoni, 2008; Rolfe, 2012; Thakrar, Wolfenden, & Zinn, 2009), and teachers' professional development (Hassall & Lewis, 2017; Zhang & Li, 2017), including digital literacies (Atenas, Havemann, & Priego, 2015; Cronin, 2018; D'Antoni, 2008; Nkuyubwatsi, 2017), and copyright literacies (Anderson, 2011; Atenas et al., 2015; Rolfe, 2012; Secker & Madjarevic, 2012). Petrides, Nguyen, Kargliani, and Jimes (2008) find visual and technical changes as the most prevalent reuse behaviours, and Falconer et al. (2016) identify major tensions between commercial use and open publication.

Teachers have identified barriers to OER adoption such as lack of enabling policies (Nkuyubwatsi, 2017), time (Allen & Seaman, 2014; Rolfe, 2012), skills (Atenas et al., 2015; Rolfezhang, 2012), reward system (Rolfe, 2012), interest for pedagogical innovation among colleagues (Rolfe, 2012), confusion over copyright (Atenas, Havemann, & Priego, 2014; Rolfe, 2012), technology access and support (Nkuyubwatsi, 2017; Rolfe, 2012), recognition (Atenas et al., 2014; Jhangiani, Pitt, Hendricks, Key, & Lalonde, 2016; Nkuyubwatsi, 2017), self-confidence about the quality of their materials (Cox, 2017), OER awareness (Reed, 2012; Rolfe, 2012), availability of relevant and high-quality OER (Clements & Pawlowski, 2012; Willems & Bossu, 2012), and personal interest (Falconer et al., 2016; Reed, 2012; Rolfe, 2012).

National and institutional policies and strategies are enablers (Cox & Trotter, 2016; Cronin, 2018; Lesko, 2013; Nkuyubwatsi, 2017), as well as incentives and promotion (Hylén, 2006; Nkuyubwatsi, 2017), extra time (Nkuyubwatsi, 2017), desire and volition (Cox & Trotter, 2016), adequate resources (Thakrar et al., 2009), support for teachers (Thakrar et al., 2009), local culture (Cox & Trotter, 2016; Thakrar et al., 2009), institutional practices (Cox & Trotter, 2016; Thakrar et al., 2009), sustainable funding (Annand & Jensen, 2017; Thakrar et al., 2009), infrastructure access (Cox & Trotter, 2016; Kaatrakoski et al., 2016; Lesko, 2013; Nkuyubwatsi, 2017), legal permission (Cox & Trotter, 2016), conceptual awareness (Cox & Trotter, 2016; Rolfe, 2012), technical capacity (Cox & Trotter, 2016), availability of educational resources (Cox & Trotter, 2016; Hylén, 2006; Nkuyubwatsi, 2017), beliefs and values (Cox & Trotter, 2016; Rolfe, 2012), and enhancement of individual and institutional reputations (Rolfe, 2012).

Purpose of the Study

This study aims at identifying the adoption dimensions of OER by university teachers in LATAM HE. The study deepens up in understanding social representations (Moscovici, 1979; Moscovici, 2006) of lecturers regarding OER in the context of their institutions and teaching practices.

The research questions that guided the study were:

- RQ1. What factors influence the adoption of OER among lecturers in LATAM universities?
- RQ2. How can these factors be addressed for enhancing the use and reuse of OER in LATAM universities?

Methodology

The study falls within the interpretive paradigm, where situated interpretations are used to understand social life. The methodological approach is qualitative, based on Grounded Theory (Glaser & Strauss, 1967; Strauss & Corbin, 1990; Miles & Huberman, 1999; Charmaz, 2006).

Grounded theory both guides the research and the researcher, towards theoretical development (Charmaz & Mitchell, 2001). What is constructed through this process is substantive theory, that is, theory that can be applied only to the area that is being analysed. Validation of the theoretical scheme with other actors, and the inclusion of new cases, people, or groups, can be developed.

Participants

We selected a population of university teachers who participated by sending their own educational resources to the Latin American Conference on Learning Technologies (LACLO) Learning Objects Contest, for the years 2012, 2013, and 2014.

The selection of this community is based on the understanding that participants are close enough to the creation and publication of digital educational resources to have the relevant experience within the subject of study. Although they may not necessarily be experts, they can be identified as representatives of the population of university teachers who create, use, and share digital educational resources.

On the database, a longitudinal quantitative study was conducted to characterise the population by pointing out some of its main demographic characteristics (Rodés, Pelerino, Gewerc, & Llamas, 2016). The variables number, country, gender, discipline, and institution were analysed.

The population studied included 283 individuals. Of the total, 120 were men (42%) and 163 women (58%; see Table 1).

Table 1

Population Distributed by Gender

Gender	Number of participants	% of participants
Women	163	58 %
Men	120	42 %
Total	283	100 %

The research participants were from 10 countries, with the majority (84%) located in Brazil (59.4%), Colombia (13.8%), and Venezuela (12.0%), making them the highest participation group (HPG). In turn, Mexico, Chile, and Costa Rica in total account for almost 10% of the participants, with shares of 3.9%, 3.2%, and 2.8%, respectively, placing these participants into the medium participation group (MPG). Finally, Cuba, Ecuador, Uruguay, and the USA together account for 5% of participants, with shares of 1.8%, 1.4%, 1.4%, and 0.4% respectively. These are the low-participation group (LPG). Participants belong to 49 HE Institutions (HEIs): 22 from Brazil; 8 from Colombia; 4 from Cuba;. Venezuela, Mexico, and Chile have participants from three HEI each; and Costa Rica, Ecuador, Uruguay, and the USA have participants from one HEI each (see Table 2).

Table 2

Participants and Higher Education Institutions (HEIs) Per Country

Countries	% of participants	Group	Number of HEIs
Brazil	59.4	HPG	22
Colombia	13.8	HPG	8
Venezuela	12.0	HPG	3
México	3.9	MPG	3
Chile	3.2	MPG	3
Costa Rica	2.8	MPG	1
Cuba	1.8	LPG	4
Ecuador	1.4	LPG	1
Uruguay	1.4	LPG	1
United States	0.4	LPG	1
Total	100.0		49

Participants come from 25 scientific disciplines that were grouped in three areas. The majority of participants were from Science and Technology (S&T), while the two other discipline areas, Social Sciences and Arts (SS&A) and Health Sciences (HS) had a lower, though significant, presence (see Table 3).

Table 3

Population Distributed by Discipline Areas

Area	Number of participants	% of participants
Science & technology	210	75%
Social sciences & arts	59	20%
Health sciences	14	5%
Total	283	100%

The S&T area includes disciplines such as computer sciences (37.81%), educational computing (13.07%), chemistry (7.77%), physics (5.65%), and maths (4.59%), among others. The SS&A area includes education (12.37%), graphic design (2.83%), language (2.12%), and other. The last area, HS, includes nursing (2.12%), medicine (1.7%), and psychology (0.35%), among others (see Table 4).

Table 4

Population Distributed by Disciplines

Discipline	Area	Number of participants	% of participants
Computer sciences	S&T	107	37.81 %
Education informatics	S&T	37	13.07 %
Chemistry	S&T	22	7.77 %
Physics	S&T	16	5.65 %
Maths	S&T	13	4.59 %
Natural sciences	S&T	6	2.12 %
Seismology	S&T	3	1.06 %
Law	S&A	2	0.71 %
Agronomy	S&T	2	0.71 %
Statistics	S&T	2	0.71 %
Electrical engineering	S&T	1	0.35 %
Industrial engineering	S&T	1	0.35 %
Education	SS&A	35	12.37 %
Graphic design	SS&A	8	2.83 %
Language	SS&A	6	2.12 %
Economy	SS&A	3	1.06 %
Communication	SS&A	2	0.71 %
Administration	SS&A	1	0.35 %
Marketing	SS&A	1	0.35 %
Tourism	SS&A	1	0.35 %
Nursing	HS	6	2.12 %
Medicine	HS	5	1.77 %
Psychology	HS	1	0.35 %
Dentistry	HS	1	0.35 %
Speech Therapy	HS	1	0.35 %
Total		283	100.00 %

As can be seen, the wide territorial, cultural, and institutional coverage is offered by the LACLO community, allowing us to access a wide and diverse range of individuals. This provides the variability and comparability elements required for the theoretical sampling process that is fundamental for the methodology chosen.

Theoretical Sampling

The aim of theoretical sampling is to compare events, incidents, or situations, to determine how a category can differ in terms of its properties and dimensions.

The participants were puposefully selected to maximise the differences between comparison groups, established by country, institution, disciplines, gender, and communities or work teams. Therefore, the dataset was designed as follows: a country from each group according to the degree of participation classification (high, medium, low) presented above. We selected Venezuela, Costa Rica, and Uruguay to have good territorial coverage of the Caribbean and the northern and southern regions of LATAM. Universidad Central de Venezuela (UCV),Universidad Estatal a Distancia de Costa Rica (UNED), and Universidad de la República (UDELAR), respectively. They are three public universities, with different characteristics regarding teaching modalities (distance education at UNED, mixed education at UCV, and face-to-face education at UDELAR). Twelve individuals were selected, four per university, considering variability regarding gender and areas of knowledge. From UCV, Venezuela, two men (V3 and V4) and two women (V1 and V2) were selected, who are teachers in the area of science and technology (computer science, physics, and chemistry); from UNED, Costa Rica, all were female teachers (CR1, CR2, CR3, and CR4), one from the area of science and technology (computer science) and three from the social and arts fields (education, tourism, and design); from UDELAR, Uruguay, we selected three women (U2, U3, and U4) and one man (U1), a lecturer from the science and technology area (biology), two from the social and arts field (economics, communication), and one from healthcare (nursing).

Data Collection

We chose an open thematic interview to identify attitudes and practices regarding open educational resources.

The interviews were conducted between November 2015 and September 2016 using Google Hangouts live, which allowed us to make video calls and to record them automatically on YouTube. Between two and three interviews were conducted with each subject, lasting between 40 min and 1h 20 min each. Over 24 hours of recordings were obtained.

Data Analysis

To perform the analysis we transcribed the interviews and then studied the resulting texts with the qualitative data analysis software Maxqda. The first stage of the analysis was coding the data, an analytical process through which data is fragmented, conceptualised, and integrated as theory through successive comparison processes (Strauss & Corbin, 1990). The analysis led to developing 500 codes and identifying 3,547 text segments from the interviews that were identified through open codification—focusing on the main idea and not on pre-established dimensions.

The analysis results allowed us to identify three categories: 1) institutional components of OER adoption; 2) practices of use, creation, and sharing OER; and 3) knowledge, attitudes, and perceptions towards OER.

Results

Institutional Components of OER Adoption

Policies. The results showcase the shortage of institutional policies to promote the development and adoption of OER in LATAM universities. Although some policies have been implemented, these are individual and contradictory initiatives, linked to schools, institutes, or faculties, and their adoption does not seem to be established or standardized. (In this section, supporting quotations for these findings are linked to the bracketed numbers.) [1] [2]

Nor are there any references to specific funding or incentive policies for OER creation. However, we must consider the opinion of teachers regarding the fact that the open sharing of educational resources would be part of their current salary. Therefore, it would not be right to expect higher remuneration on account of copyright, which is a strong attitude towards open publication [3], [4].

Teacher's agency. As there are no institutional policies, this depends on the initiative and willingness of teachers. This leads to several problems, mainly the invisibility and non-remuneration of the hours spent creating content, the value the institution places on research output at the expense of teaching outputs, and the lack of explicit reference in the curriculum linked to the development of educational resources [5], [6].

Organisational components. Despite the lack of specific policies, it is relevant to have work teams that facilitate and encourage the development of OER. These teams have organisational structures that reflect three clear models: 1) network, 2) hierarchical, and 3) centralised.

1. Model 1 includes teams located in schools and university services, coordinated by a central team, making up a *network* (UDELAR) [7].
2. Model 2 is a specialised board formed by departments, with a *hierarchical* and institutionalised structure (UNED) [8].
3. Model 3, which is *centralised*, includes lecturers coordinated by another lecturer who works as a techno-pedagogical advisor. The advisor works for the school level and acts as a leader. The lecturers do not work together, and only work with the leader The strategies are not at a central level, since the model includes students OER development practices (UCV) [9].

Workflow and methods for the creation of OER are similar for UCV and UDELAR, as they stem from the joint and collaborative development by teachers and experts within initiatives connected to teaching needs and problems [10] [11].

In UNED, we identified a structured, standardised, and planned work method to produce resources, based on the work of content experts, instructional designers, and graphic designers, in addition to a connection with distance education [12].

All the work teams studied have a member who becomes the leader and whom others recognise as a source of reference and initiatives in the field of OER. The academic structures include teams that manage VLEs, libraries, and editorial committees.

Practices of Use, Creation, and Sharing of Open Educational Resources

Reasons that drive the creation of OER. We identified the following reasons driving the creation of educational resources in the respondents' discourse: how widespread classrooms are; distance education; students' academic paths (high school-university transition and graduation); the demand for making teaching methodologies more active; use of digital technologies in education; personalisation of learning; motivating students; theory-practice relationship; practice, experimentation, and simulation; students' need to have a good command of scientific language; support to students so they develop specific expertise; and encouraging reflexivity and critical thinking [13], [14], [15].

Process flow of creation and reuse of OER. The creation of educational resources begins, for all respondents, with a search for existing resources on the topic in which they are working. This search focuses on updating the educational resources created by them (with additions, improvements, or adaptation of material already created) or resources created by colleagues. They reuse their own resources and work in successive stages to validate, review, and improve them. They relate these continuous improvement processes of educational resources to the reflection and transformation of one's own educational practices [16], [17].

Within these validation processes, they assess various aspects of educational resources: multimedia and digital design, content, compliance with learning objectives, and their contribution to academic performance.

The review process gives rise to changes in formats and media, within the process of integration of technologies to education.

Within reuse, there is an emerging concept: the so-called "inspiration," which refers to the process of browsing and searching for ideas that inspire new creations of their own. This emerging concept is close to copying, and includes research on the state-of-the-art, the educational use of content not specifically designed for educational use, the development of lists and content curation, and adaptation of existing resources. The concept of inspiration is especially relevant in the flow of the respondents' discourse to the topic of licensing of works [18], [19].

Attitudes and Perceptions Towards OER

Attitudes towards open authorship and publishing. There is wide knowledge about the potential of educational and research work when it is openly published. A relevant finding is that they relate this work to the characteristics and mission of public universities in LATAM [20], [21].

Regarding the use of open licenses, most respondents mention Creative Commons as usual practice, as well as attribution to the authors whose work is reused or cited. However, knowledge about open licenses is not homogeneous, and in some cases, there is a lack of general operational knowledge the copyright and open licensing [22], [23].

All respondents mention authorship attribution as a requirement for sharing educational resources. They agree that licensed resources must be shared in the same way, and there is evidence of a broad rejection of the use of licenses that allow derivative works to be marketed. Commercial use is linked with the need to monitor the balance between creation and consumption of educational resources, in particular between institutions. In addition, they link the licensing that allows for its commercial use with problems related to the globalisation and privatisation of higher education and the fear of indiscriminate appropriation of the resources developed by them [24].

They also discuss about attitudes to be promoted in the areas in which material is shared, particularly regarding caring for resources, rejecting copyright infringement and for-profit use. Another emerging and significant aspect is the requirement to monitor and approve modifications.

Regarding authorship practices, there are several emerging models. First, individual authorship, according to which the work belongs to the teacher that created it. A second model acknowledges the role of the university within which the work was produced. Here, authorship would be shared between the teacher and the university. The third model integrates the two above, and includes the relevance of other roles that participate in the creation of the work: graphic designers, educators, content specialists, etc. This points to a model of collaborative or collective authorship.

Enablers for OER adoption. Pleasure and willingness to contribute are the first reasons mentioned for adopting open creation and publication models. The second reason is the promotion of professionalisation and academic development associated with a teaching career, regarding concepts such as recognition, internationalisation, and visibility.

Willingness to share comes in third in order of relevance, and respondents link it to other concepts such as reuse, utility, quality of content, openness, use, and comparison.

Other relevant reasons identified were socialising knowledge, collaborating, making other people's work easier, helping others, collaborative work, and support teaching. These ideas appear linked to concepts such as facilitating students' access, motivating students, and promoting knowledge creation.

The creation of communities (establishing links, exchanging experiences, and receiving contributions from others) is a motivation that appears in their discourse, though not significantly. The same happens with the improvement and transformation of practices (associated to concepts such as change, analysis, and reflection). Though less frequently, there are reasons related to catering to the needs of the digital society, multidisciplinarity, being a way of life, or a duty. Remuneration is the least relevant aspect in the list of motivations for adopting open publishing models.

Perceived barriers for OER adoption. As identified in the interviews, the main barrier to the adoption of open publishing is the lack of understanding regarding copyright, as well as the fear of appropriating others' works. The following aspect in order of relevance is the time it takes to search for, reuse, and create educational resources. The reference made to the quality of the works and the conditions that would determine the "publishability" of resources is also relevant; these are works designed, in principle, to support teaching, so they feel a fear of exposure. The lack of training and knowledge on OER are also barriers, as well as the lack of recognition and of institutional support. Other barriers found less frequently are problems in the searching processes, and finally, localisation and adaptation of educational resources to educational contexts and situations.

Discussion

This study identifies dimensions of the adoption of OER in higher education in Latin America.

Working in three countries, with 12 cases including respondents from three public universities, we aimed to contribute to the studies on adoption conducted within the Open Education movement in a variety of contexts and regions.

Our research contributes to the development of substantive theory, identifying practices and modalities followed by university teachers for creating, publishing, sharing, and reusing educational resources, as well as the inclusion of OER philosophy in these processes.

First, it contributes to the study of the barriers and motivations involved in the adoption of OER in university teaching practices, including the Latin American perspective, allowing for additional comparisons across the vast corpus of existing research at an international level on the subject.

The results are consistent with research conducted by Allen and Seaman (2014) and Hilton (2016). Not all the cases studied reflect a wide knowledge of OER as a concept, knowledge of open licensing systems, or the use of OER repositories for searches. However, in relation to perceptions of, and attitudes toward, open publication and sharing, these findings showcase a general willingness to adopt open publishing models. Therefore the adoption of OER appears to be encouraged in university education (See also Nkuyubwatsi, 2017; Cox, 2017; Reed, 2012; Rolfe, 2012).

This study has identified the role of decision-making as key for teachers regarding the development of educational resources, which is consistent with previous findings (See Allen & Seaman, 2014; Cox, 2017; D'Antoni, 2008; Rolfe, 2012). Given the lack of regulation and systematic and widespread action frameworks, both the creation of educational resources and publication procedures depend on the will and decision of the faculty (Cox, 2017; Reed, 2012; Rolfe, 2012). Therefore, faculty empowerment is essential for the adoption of open publication practices.

The barriers identified in our study are also consistent with those surveyed in the literature, such as enabling policies (Nkuyubwatsi, 2017), time (Allen & Seaman, 2014; Rolfe, 2012), skills (Atenas et al., 2015; Rolfe, 2012), confusion over copyright (Atenas et al., 2014; Rolfe, 2012), recognition (Atenas et al., 2014; Jhangiani et al., 2016; Nkuyubwatsi, 2017) , self-confidence about the quality of their materials (Cox, 2017), and the fear of exposure, as the most prevalent.

Our study showcases the links between the educators' experiences of online teaching and the adoption of OER, which was also identified in Zhang and Li (2017). This can be seen in both the origins and formation of work groups, and in the close connection between the development and adaptation of teaching resources into digital formats, as a way to embed technologies in university teaching.

The findings on reuse practices are relevant as well because they allow us to observe the processes of searching and reusing as naturalised strategies that are part of the development of educational resources, in context with availability to technology. Consistent with Petrides et al. (2008), we found that the digitisation of pre-existing materials was one of the versioning practices, but not the only nor the most prevalent one.

The emerging concept of "inspiration" is another vector identified for the adoption of the OER philosophy, as long as promotion and training strategies are developed to empower teachers with essential information on open source licensing, OER repositories and good versioning practices.

Commercial use and misappropriation of the works is one of the main tensions identified in our study, similar to the findings of Falconer et al. (2016). As in Cox and Trotter (2016) and Rolfe (2012), core motivation is one of the factors for contributing and sharing, which is typical of academic communities focused on the common good. The educational communities studied follow an altruistic philosophy that includes the traditions and missions of the free, co-governed public universities in Latin America, showing the impact of institutional culture. These traditions collide with practices of misappropriation, imbalances between creation and consumption in the privatisation of education and the potential for-profit use of the works. However, contrary to numerous studies (e.g., Annand & Jensen, 2017; Conole, 2013; Hylén, 2006; McAndrew et al., 2012; Nkuyubwatsi, 2017), a very relevant finding was identifying the creation of teaching resources as part of the tasks already compensated through an academics' salary, and the use of this argument as a basis for the adoption of open publication practices that promote the dissemination of knowledge as part of the social function of their teaching role and of the Latin American universities'social missions.

Conclusions

Regarding the factors influencing the adoption of OER among lecturers in LATAM universities, the results of this study show that the creation, use, and reuse of OER in Latin American HEIs requires supportive institutional policies to be improved. However, a significant number of communities and work teams support their adoption. The collaborative component is an interface between the teaching staff and the institution allowing to overcome the absence of institutional policies, favoring the adoption of OER.

We identified a series of vectors for the adoption, showing great potential for the design of widespread and coordinated strategies and policies that promote the visibility, articulation, and consolidation of actions in OER for Latin America, in particular from the public universities and as part of its egalitarian tradition and mission .

Among the barriers to the adoption of OER, the lack of knowledge in copyright, issues related to the quality of works, and fear of exposure, are the findings that may guide the design of strategies for dissemination and training, empowering teachers with the necessary knowledge to act with confidence in the contexts of open digital publication.

The reasons that have driven the creation of OER are mainly intrinsic factors, such as the pleasure of contributing and sharing, and professional development from reflecting on their own practice, as well as external demands. It is here that it becomes essential to evaluate the resources created so that they can be reused for continuous improvement processes .

The community factor of teaching guides most behaviours in educational institutions and is presented as an inherent part of the development and transformation of the curriculum . In that sense, any technological tool and methodological framework around OER, in particular those linked to the development of educational repositories, should integrate the sharing and collaborative planning of activities and training courses within the creation of educational communities, allowing for features such as version tracking and tracing, collaborative creation, collaborative evaluation, among others.

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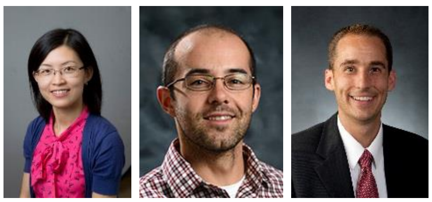
On the Efficacy of Open Educational Resources: Parametric and Nonparametric Analyses of a University Calculus Class



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Abstract

Open educational resources (OER), which are free and openly licensed educational materials, have been a widely discussed topic in response to high textbook costs, the need for more pedagogical flexibility, and inequality in access to educational materials. In this study we examine the efficacy of OER through a quantitative analysis of the impact of OER on student final exam performance in a large calculus course. Our dataset affords us a relatively large sample size, allows us to classify students in both treatment and control groups, and includes a variety of covariates that allow us to control for multiple correlated factors. We estimate causal treatment effects using several econometric approaches. Our study adds the following insights into the research on OER efficacy: (i) OER materials do not, in general, lead to any significant change in student final exam performance; and (ii) OER materials have a significantly positive impact on both international students and Pell Grant eligible students.

Keywords: open education resources, teaching calculus, treatment effects, OER

Introduction

Open Educational Resources (OER) are "teaching, learning, and research resources that reside in the public domain or have been released under an intellectual property license that permits their free use and repurposing by others" (Hewlett, 2017, para. 7), and recent years have seen a surge in interest in open education and the use of OER. Among many potential virtues that we will describe, OER have been touted as a solution to the problem of high textbook costs – the general hypothesis is that with access to educational materials at no cost, students will save money, and may perform better. For instance, a survey of 22,906 post-secondary students in Florida found that 67% of students reported that they did not purchase a required textbook because of its high cost. As well, this same survey found that because of the lack of access to learning materials, 37.6% had earned a poor grade and 19.8% had failed a course. Nearly half the students surveyed said they occasionally or frequently take fewer courses because of the cost of textbooks, and one-quarter of students drop courses for the same reason (Florida Virtual Campus, 2016). Moreover, if, as Florida Virtual Campus (2016) indicates, the cost of textbooks leads students to withdraw from courses, we might expect to see fewer withdrawals if costly learning materials are substituted with OER.

In this paper, we rigorously analyze the efficacy of OER materials in a large college calculus class, and provide insight into the different ways in which OER have a positive or negative impact on student learning outcomes. We begin in the following section with a review of the literature surrounding research on OER that examines its quality and efficacy.

Review of Literature

In terms of trusted quality, those who have used OER generally believe that OER are high quality. Watson, Domizi, and Clouser (2017) surveyed 1,299 students at the University of Georgia who used the OpenStax biology textbook. Students were directly asked to rate the quality of the OpenStax textbook relative to other textbooks they had used. The majority of students (64%) reported that the OpenStax book had approximately the same quality as traditional books, while 22% said it had higher quality. Jhangiani, Pitt, Hendricks, Key, and Lalonde (2016) examined awareness, usage, outcomes, and perceptions of OER among a survey of 78 British Columbia post-secondary faculty. Of the respondents, 77% had used OER and most respondents rated OER quality as comparable or superior to that of traditional materials. The California OER Council (2016) surveyed 351 college students and found that of those who had used OER, 42% said that OER was better than traditional materials, 39% said they were about the same, 11% rated OER as worse, and 8% declined to answer. Hilton (2016) reviews an additional nine published studies of OER perceptions and found that across 2,366 students and 2,144 surveyed or interviewed, a strong majority perceive that OER have the same or higher quality as traditional resources.

Although a large number of faculty and students have been surveyed in a variety of contexts, perception of quality is not the same as proven efficacy. To date, only a handful of empirical studies have been published that examine the impact of OER adoption on student learning. Through his review, Hilton (2016) draws a general consensus across the literature that OER students typically perform just as well as students using commercial materials. At the same time he acknowledges that many of the published studies assessing OER efficacy are weak. For example, Lovett, Meyer, and Thille (2008) studied those who used OER across multiple semesters, but their total number of OER adopters was only n = 66, a significant limitation.

In some cases, there are serious methodological problems with OER efficacy studies. For example, Feldstein et al. (2012) compares courses that use OER with *different* courses that are not using OER. Given that the comparison courses are different, it is unclear whether any measured differences across OER and traditional courses can be attributed to the use of OER. Hilton and Laman (2012) has a different weakness; they compared the grades, withdrawal rates, and pass rates of students who took a psychology course in Spring 2011 (traditional textbooks) with those who took the same course in Fall 2011 (OER); yet, they did not account for any difference between the two student populations. Moreover, changes were made in the course learning outcomes and final exam during the time period of the study, significantly weakening any ability to link the change in student outcomes with the introduction of OER. Pawlyshyn, Braddlee, Casper, and Miller (2013) reported dramatic improvement when OER was adopted; however, their results are confounded by the fact that simultaneous with the new curriculum materials was a new form of instruction (flipped classrooms). Bowen, Chingos, Lack, and Nygren (2014) did control for student differences by randomly selected treatment and control groups and used multiple characteristics to determine that the two groups were equivalent. However, their design also introduced elements of blended learning for students who used OER, possibly confounding their results that both treatment and control performed equally well. Other recent studies such as Grewe and Davis (2017) and Ozdemir and Hendricks (2017) find similar or slightly better student outcomes when using OER, but lack rigorous controls.

Thus, a serious issue with OER research to date is that more than half of the efficacy studies conducted do not make any attempt to control for student variables that could be influencing the difference in their performance. This critique was raised by Gurung (2017), who argues that “The results highlight limitations of current attempts to assess learning in psychology and underline the need for robust comparisons of a wider variety of OER, with a focus on lower ability students” (p. 233).

Colvard, Watson, and Park (2018) examined course-level faculty adoption of OER at the University of Georgia, by evaluating eight undergraduate courses that switched from commercial textbooks to OpenStax (OER) textbooks. They only included sections of these courses where instructors had taught with both textbook versions to control for teacher effect. This was the first published study to examine the relationship between OER and Pell Grant recipients; researchers found a 6.90% GPA increase for non-Pell recipients and an 11.0% increase for Pell recipients. Furthermore, OER adoption resulted in a 2.1% reduction in DFW grades for non-Pell eligible students versus a 4.4% reduction for Pell-eligible students, indicating that the OER effect was stronger for these students with greater financial needs. While these results are promising for OER advocacy, one limitation of this study their approach was that results were only reported at an aggregate (not student) level. This level of reporting may have masked or created differences that would not have been present had results been disaggregated. Thus further research is needed in this area.

We examine the results of 1,488 students who took a calculus course using traditional learning materials with 1,521 students who took the same course but used OER. We account for specific gaps in the literature by (1) rigorously accounting for relevant student variables, and (2) examining whether there is an OER intervention effect that varies across student sub-groups. Our specific research questions are as follows:

1. Do students who use OER withdraw at the same rate as students who do not use OER?

2. Do students who use OER perform as well, worse, or better than their counterparts who use traditional learning materials on the final exam?

3. Do students who are Pell Grant eligible perform better on the final exam when using OER?

4. Do international students perform better on the final exam when using OER?

Method

Setting

Our analysis pertains to student performance in *MA16010: Applied Calculus I*, which is the first course in a two-semester applied calculus sequence for non-science and non-engineering majors at Purdue University. This course was selected because one of the authors of the present study is responsible for the curriculum of this course, and as such was in a position to implement this study. The course is offered all year round, but the student composition is substantially different among the fall, spring, and summer classes. To maintain the consistency of population composition, our analysis compares two fall semesters: Fall 2014 (traditional learning materials) and Fall 2015 (OER).

Within each semester, the entire course is centrally coordinated; students are divided into sections of approximately 40 for lectures that are taught primarily by graduate student teaching assistants and limited term lecturers. All course policies and exams are identical for all sections. For each section, lectures are given three times a week for 50 minutes each. In both Fall 2014 and Fall 2015 semesters, sections were offered throughout the day between 7:30am and 5:20pm with a 10-minute gap in between any two consecutive sections. Multiple sections (3-6 sections) were offered simultaneously at each time slot. In Fall 2015, four sections that were either flipped or online were offered; these sections are excluded from the present study so that the results are not biased by different instructional formats.

Participants

The adoption of OER in this course was done systematically, allowing us to carefully define treatment and control groups of students (i.e., students are “treated” if they used OER, and are in the “control” group if they used commercial materials). The full sample of students includes 1,372 students from the Fall 2014 (control) semester and 1,437 students from the Fall 2015 (treatment) semester. This includes all students who were registered in a traditional section of the course and received a letter grade, and includes withdraws and incompletes. We exclude any student who took an alternate final. As an important covariate, we used the students’ SAT math scores (or SAT math scores converted from ACT math scores) as a measure of mathematical training prior to taking this course. These scores are not available for all students in each semester, and as a result we consider two samples: the full sample, excluding SAT scores, and a reduced sample that includes the SAT scores. Specifically, the reduced sample contains 1,245 students from Fall 2014 and 1,357 students from Fall 2015.

Procedures

The dependent variable in this study is the students' scores on the end-of-semester final exam. The exact same final exam was used in both Fall 2014 and Fall 2015. Within each semester, all students in the entire course were given the same homework assignments and exams (though not quizzes). There were three one-hour midterms and one two-hour final, which all the students in the course took at the same time and in the same location. The exams were entirely multiple-choice questions and were machine graded, with final exams administered in both Fall 2014 and Fall 2015.

The course is highly centralized, which eliminates much of the variation that might otherwise exist across sections, such as difficulty of the exams, equity in grading, and consistency of policies. In addition, both courses were taught in the fall semester, allowing us to avoid any concern that fall and spring courses have nontrivial differences.

Materials

In the Fall 2014 semester, all sections were taught using traditional course materials, which included a textbook and an online homework system. Every student was required to purchase a commercial online access code ($121.00) that provided access to an online homework system and the online version of the commercial textbook that would be valid for two semesters of calculus courses. Students also had the option of purchasing a bundle of the access code and a hard copy textbook for $168.50, but it was not an option to purchase only the hard copy. The most conservative estimate of cost to students assumes that each student only purchased the online access code.

In Fall 2015, students used OER, which consisted of an e-text, videos, and online homework problems, centrally hosted on an open online learning platform. The course coordinator extensively modified an open textbook called *Calculus: Early Transcendentals*, by David Guichard. The coordinator also recorded a series of lecture videos and online homework problems. All materials were free to students.

Minor Differences Between Fall 2014 and 2015

There were a few minor differences between Fall 2014 and 2015. We note these differences because while we do not have any data regarding whether they would affect the results, we acknowledge the possibility that they could. First, the grading policy for the course changed from Fall 2014 to Fall 2015. In Fall 2014, final letter grades were given on a curve, whereas in Fall 2015 letter grades were assigned based on a pre-determined scale. Another difference between semesters concerns the final exam schedule, which is assigned by the Registrar's office. In Fall 2015, the final exam took place on the first day of finals (Monday, December 14) from 8:00-10:00 AM, and in the Fall 2014 semester the final was on the second day of finals week (Tuesday, December 16) from 7:00-9:00 PM. Finally, while both the questions and ordering of the questions on the exams were identical across semesters, the multiple-choice response ordering was different across versions. In Fall 2014 there were two versions, and in Fall 2015 there were 10 versions.

Data Analysis

Table 1 provides a list of variables included in our statistical analyses.

Table 1

List of Variables and Definitions

Variable	Type	Definition
Outcome		
Final exam grade	Continuous	MA16010 final exam grade, measured as percentage of total points earned out of maximum points possible on the final.
Control Variables		
Gender	Binary	Male and female.
Ethnicity	Categorical	American Indian or Alaska Native, Asian, Black or African American, Hispanic/Latino, International, White, 2 or more races, Unknown.
College	Categorical	
Student classification	Categorical	Freshman (0-29 hours), Sophomore (30-60 hours), Junior (61-89 hours), Senior (90-105+ hours).
GPA	Continuous	Overall GPA; ranges from 0.0 to 4.0.
Class time	Categorical	7:30am, 8:30am, 9:30am, 10:30am, 11:30am, 12:30pm, 1:30pm, 2:30pm, 3:30pm, 4:30pm.
Pell grant eligibility	Binary	1 = eligible, 0 = ineligible.
Repeat course	Binary	1 = yes, 0 = no.
SAT mathematics	Continuous	Ranges from 400 to 800, and is computed from either SAT Math scores or ACT Math scores converted to SAT units.
Instructor	Categorical	Unordered indicator to control for unobservable instructor effects.

The dependent variable is the final exam grade, in percent, for each student enrolled in the course in Fall 2014 or Fall 2015. The control variables we include are indicator variables for gender and ethnicity, student academic classification, the college from which the student is a major, the student's overall GPA, the time of day in which each student took the class, indicators for whether or not the student is Pell Grant eligible or is repeating the course, the student's SAT mathematics score (or ACT math score converted to SAT units), and the instructor of the student’s session. We use these variables to control for student socio-economic characteristics, academic standing and background, and classroom environment for his/her section of calculus.

Our purpose in examining these covariates is to assess whether there are substantial differences in the distributions of the control variables between semesters that may, if not adjusted for, lead to biased estimates. Our assessment of these distributions is based on the normalized difference, log ratio of standard deviations, and the fraction of the distribution of each variable that lies in the tails of the distribution for the opposing semester. The normalized difference is a unit-free measure of difference in the central tendency of the variable distribution, and the other two measures provide indication of distributional overlap (Imbens & Rubin, 2015).

We examine the impact of OER in two ways. First, our benchmark model of an average overall effect of OER is a linear-in-parameters conditional mean regression model, in which we regress the student's final exam score on the OER indicator variable and controls. The statistical model is

$$Exam_i = \beta_0 + \beta_1 OER_i + X_i\gamma + \varepsilon_i \tag{1}$$

for $i = 1,2, \dots, n$ being an index of students and X_i being a vector of control variables. We are interested in β_1 as the parameter that captures the impact of using OER on student final exam performance. We estimate this model using ordinary least squares. Consistent with our first hypothesis, we expect that β_1 is statistically insignificant. A significantly positive β_1 would imply that OER have a positive overall impact on final exam performance, whereas a significantly negative estimate would indicate that OER have an overall detrimental impact. A standard t-test for statistical significance of β_1 provides a means of testing our first hypothesis.

As a secondary model, we consider a nonparametric specification that is analogous to Equation (1) except that we no longer impose strict functional form assumptions (i.e., linearity, additive separability, and parameter homogeneity). The nonparametric model is written

$$Exam_i = g(OER_i, X_i) + \varepsilon_i \tag{2}$$

where we assume that the function $g(\cdot)$ is a twice differentiable conditional mean function, but otherwise do not place any restraints on the nature of (non)linearities or interactions between variables. In Equation (1), the OER effect is given by β_1, and is constant for each student in the course, regardless of his/her characteristics or background. In contrast, in the nonparametric specification, the OER effect is given by $\mathbb{E}[Exam_i|OER_i = 1, X_i = x] - \mathbb{E}[Exam_i|OER_i = 0, X_i = x] = g(OER_i, X_i)_{OER_i=1} - g(OER_i, X_i)_{OER_i=0}$, which is not constant across students and is allowed to vary generally with student characteristics or background. For instance, if OER have a different effect on domestic vs international students, or Pell Grant eligible vs ineligible students, then the constant β_1 will not adequately capture these differences; the nonparametric OER effect, on the other hand, provides a way for us to assess these differences. Note that since the linear structure in (1) is a special, restricted case of the nonparametric structure in (2), if, in fact, the OER effect is not different for different students, the nonparametric effect will itself be constant. We estimate the nonparametric model using kernel regression methods (Li & Racine 2007).

Results

First, we compare overall withdrawal rates between the Fall 2014 and Fall 2015 semesters (Table 2). These statistics are based on the total number of students that stayed in the course after the last day to drop without any record on the transcript had already passed. We find that the withdrawal rate in Fall 2015 is statistically significantly lower than the withdrawal rate in Fall 2014 (p=.012).

Table 2

Enrollment and Withdrawal Rates

	Fall 2014	Fall 2015
Number of students enrolled	1,488	1,521
Withdrawal (W)	7.80%	5.52%

We report descriptive statistics for all the variables in the model, separated by semester, in Table 3.

Table 3

Descriptive Statistics

	Fall 2014				Fall 2015			
Variable	Mean	Std. Dev.	Min	Max	Mean	Std. Dev.	Min	Max
Final exam grade	65.312	25.199	0	100	63.903	24.577	0	100
Male	0.480	0.500	0	1	0.530	0.499	0	1
White	0.603	0.49	0	1	0.596	0.491	0	1
Asian	0.074	0.261	0	1	0.081	0.274	0	1
Hispanic	0.058	0.234	0	1	0.049	0.217	0	1
Black	0.037	0.189	0	1	0.042	0.200	0	1
International	0.184	0.388	0	1	0.175	0.380	0	1
Other	0.044	0.205	0	1	0.057	0.232	0	1
Freshman	0.521	0.500	0	1	0.515	0.500	0	1
Sophomore	0.391	0.488	0	1	0.390	0.488	0	1
Junior	0.063	0.242	0	1	0.070	0.255	0	1
Senior	0.026	0.158	0	1	0.025	0.156	0	1
GPA	2.980	0.675	0	4	3.019	0.690	0	4
SAT Math	613.257	75.629	400	800	612.085	77.415	330	800
Pell grant eligible	0.204	0.403	0	1	0.203	0.403	0	1
Repeated course	0.197	0.398	0	1	0.173	0.379	0	1

Across most of the variables, we do not see large differences in the sample means across the Fall 2014 and Fall 2015 groups, indicating no systematic differences in student characteristics across the two semesters. Several facts are noteworthy from Table 3. First, about 18% of the students enrolled in this course (in either semester) are international students, and above half are freshman with another 40% being sophomores. The average SAT Math score for students in this course is just under 615, and about 20% of students enrolled are Pell Grant eligible. Likewise, just under 20% of the students are repeating the course.

In Table 4, we report the balance and overlap measures for the full sample of observations (excluding SAT Math scores) and for the reduced sample that includes SAT Math scores. All of the normalized differences for both samples lie below 0.1 (in absolute value), and the overlap measures are all relatively small – the variables are well balanced and have sufficient overlap between semesters. Thus, there is no evidence of any systematic difference in student groups across the commercial and OER semesters. This implies that our regression analyses will be robust.

Table 4

Pre-Match Balance and Overlap Assessment Between Fall 2014 and Fall 2015

	Normalized difference	Log ratio	Tails treated	Tails control
Full sample -- Excludes math SAT				
Gender	0.099	-0.001	0.470	0.520
Ethnicity	0.016	0.028	0.629	0.604
College	0.017	-0.067	0.100	0.131
Student classification	0.030	-0.006	0.128	0.149
GPA	0.057	0.022	0.062	0.027
Class time	-0.037	0.087	0.127	0.101
Pell grant eligibility	-0.002	-0.002	0.797	0.796
Repeated course	-0.061	-0.049	0.827	0.803
Reduced sample -- Includes math SAT				
Gender	0.097	-0.002	0.468	0.516
Ethnicity	0.059	0.041	0.655	0.652
College	0.002	-0.066	0.103	0.133
Student classification	-0.002	0.017	0.117	0.113
GPA	0.045	0.036	0.071	0.027
Class time	-0.025	0.087	0.130	0.107
SAT math score	-0.015	0.023	0.066	0.036
Pell grant eligibility	-0.015	-0.010	0.789	0.783
Repeated course	-0.067	-0.055	0.829	0.803

**Note*. Full sample: 2,809 observations, 1,437 treated Fall 2015 students; reduced sample: 2,602 observations, 1,357 treated Fall 2015 students.

In Table 5 we report the parameter estimates from our parametric, linear-in-parameters model in which β_1 is the effect of OER materials on student final exam performance. We consider three models: Model 1 is the baseline model that includes student and class-time control variables; Model 2 augments the specification to include instructor fixed effects; and Model 3 augments the Model 1 specification to include fixed effects for the college in which each student is a major.

Table 5

Least Squares Regressions of the Final Exam Score of the OER Indicator and Controls

	Dependent variable in the regression: Final exam grade in percentage		
	Model 1	Model 2	Model 3
OER indicator	-1.784** (0.768)	-3.332** (1.534)	-1.831** (0.763)
Male	-2.724*** (0.766)	-2.618*** (0.767)	-1.108 (0.824)
Asian	-1.505 (1.432)	-1.326 (1.435)	-1.660 (1.424)
Hispanic	0.206 (1.693)	0.299 (1.695)	-0.030 (1.682)
Black	-0.764 (1.965)	-0.497 (1.968)	-1.184 (1.952)
International	-0.637 (1.310)	-0.688 (1.319)	0.868 (1.364)
Other	1.569 (1.716)	1.419 (1.723)	1.671 (1.701)
Freshman	-2.914 (2.748)	-3.030 (2.760)	-4.451 (2.794)
Sophomore	1.430 (2.744)	1.179 (2.757)	0.048 (2.787)
Junior	-0.112 (3.078)	-0.315 (3.095)	-0.930 (3.101)
8:30am class	-0.443 (1.486)	-0.492 (1.502)	0.104 (1.479)
9:30am class	-3.589** (1.615)	-5.058* (2.772)	-2.879* (1.608)
10:30am class	-1.747 (1.695)	-3.743 (2.930)	-1.277 (1.689)
11:30am class	-0.684 (1.689)	0.692 (3.093)	0.218 (1.704)
12:30pm class	-1.853 (1.613)	0.089 (3.085)	-1.116 (1.609)
1:30pm class	-2.204 (1.543)	0.247 (3.392)	-1.573 (1.539)
2:30pm class	-4.931*** (1.781)	-2.650 (3.305)	-3.907** (1.795)
3:30pm class	-3.801** (1.729)	-4.897** (2.445)	-3.090* (1.729)
4:30pm class	-2.072 (1.673)	-3.148 (2.505)	-1.261 (1.668)
SAT math	0.136*** (0.006)	0.137*** (0.006)	0.131*** (0.006)
Pell grant eligible	0.340 (0.974)	0.127 (0.977)	0.311 (0.967)
Repeated course	-24.816*** (1.017)	-24.665*** (1.023)	-25.094*** (1.012)
Constant	-9.373** (4.358)	-9.585 (5.895)	-3.834 (4.437)
Instructor FEs	No	Yes	No
College FEs	No	No	Yes
Observations	2,602	2,602	2,602
R-Squared	0.403	0.415	0.418
Adj. R-Squared	0.398	0.402	0.41
Residual Std. Error	19.198	19.139	19.006
F Statistic	79.254***	32.786***	52.701***

Note*. Statistical significance at the 1, 5, and 10 percent level is denoted by *, **, * respectively.

We find that in each model specification, the effect of OER on final exam performance is negative and statistically significant, ranging from -3.332 to -1.784. These estimates mean that, on average, OER students scored about 2 or 3 percentage points lower on their final exam compared to non-OER students in Fall 2014. We also find that many of the student characteristic variables are not significant predictors of student final exam performance, but there is some evidence that students taking the course at different times of the day perform differently. In addition, our estimates show that male students tend to perform worse than females (in Models 1 and 2); students with higher SAT Math scores perform better; and students who are repeating the course perform substantially worse.

The nonparametric model of the effect of OER on final exam performance is student-specific, providing us with a distribution of marginal impacts of OER grade effects. Specifically, for each OER student we compute the difference between his/her expected exam score following Equation (2) and his/her counterfactual predicted exam score had the same student been without OER. To provide a summary of these effects, we report the kernel density of these impacts in Figure 1 for three nonparametric models that correspond to the three linear-in-parameters models reported in Table 5 – that is, the baseline model, and the models that add instructor and college fixed effects, respectively. In all models the distribution of OER effects spans both the negative and positive regions; the distributions of effects in Models 1 and 2 are nearly identical, and are centered around -2.00, whereas the distribution of OER effects in Model 3 is centered just below zero and has a much larger tail in the positive region. When controlling for the college from which the student is a major, the distribution of nonparametric OER effects changes shape, and shifts to the right.

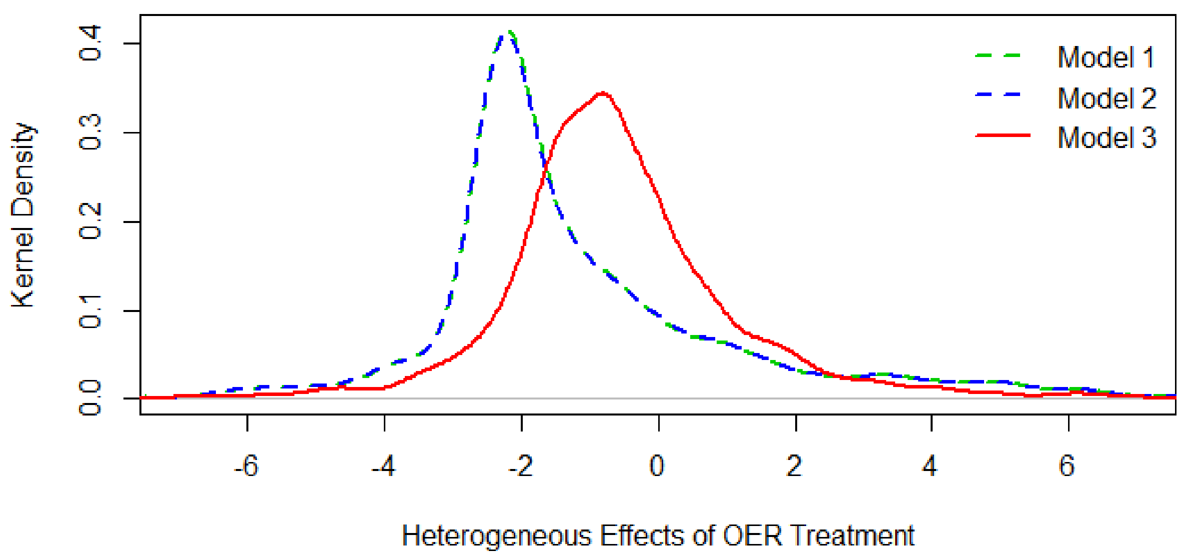

Figure 1. Kernel densities of the heterogeneous OER effects on student final exam scores from three nonparametric specifications.

To examine the grade effects of OER on various student sub-populations, we regress the student-specific nonparametric OER effects on the control variables to ascertain which variables explain the OER effect on final exam performance. We report these regression estimates in Table 6.

Table 6

Regression of Nonparametric Gradient on Student and Class Characteristics

	Dependent variable: Nonparametric OER gradient		
	Model 1	Model 2	Model 3
Male	0.208* (0.112)	0.211* (0.113)	0.057 (0.087)
Asian	0.641*** (0.206)	0.648*** (0.207)	0.364** (0.160)
Hispanic	-0.060 (0.260)	-0.062 (0.262)	0.068 (0.202)
Black	-0.153 (0.282)	-0.160 (0.283)	-0.142 (0.219)
International	2.209*** (0.187)	2.238*** (0.188)	1.438*** (0.145)
Other	0.900*** (0.238)	0.916*** (0.239)	0.663*** (0.185)
Freshman	-3.512*** (0.401)	-3.524*** (0.403)	-2.039*** (0.312)
Sophomore	-1.847*** (0.401)	-1.856*** (0.402)	-1.158*** (0.311)
Junior	-0.714 (0.446)	-0.720 (0.448)	-0.500 (0.346)
8:30am class	0.302 (0.208)	0.300 (0.209)	0.247 (0.162)
9:30am class	0.499** (0.230)	0.496** (0.232)	0.241 (0.179)
10:30am class	0.524** (0.247)	0.519** (0.248)	0.435** (0.192)
11:30am class	0.024 (0.249)	0.015 (0.250)	0.222 (0.194)
12:30pm class	0.652*** (0.229)	0.653*** (0.230)	0.475*** (0.178)
1:30pm class	0.137 (0.252)	0.127 (0.253)	0.131 (0.196)
2:30pm class	0.011 (0.257)	0.007 (0.258)	-0.022 (0.200)
3:30pm class	0.349 (0.233)	0.343 (0.234)	-0.004 (0.181)
4:30pm class	0.374 (0.234)	0.371 (0.235)	0.134 (0.182)
SAT Math	-0.005*** (0.001)	-0.005*** (0.001)	-0.002*** (0.001)
Pell eligible	0.262* (0.145)	0.261* (0.146)	0.208* (0.113)
Repeated course	0.115 (0.153)	0.115 (0.154)	-0.018 (0.119)
Constant	3.570*** (0.620)	3.624*** (0.623)	1.675*** (0.482)
Observations	1,357	1,357	1,357
R-Squared	0.249	0.249	0.148
Adj. R-Squared	0.237	0.237	0.135
Residual std. error	2.012	2.03	1.57

Note.* Statistical significance at the 1, 5, and 10 percent level is denoted by *, **, * respectively.

Table 6 answers our third research question, by showing that there is a positive and statistically significant relationship between Pell Grant eligibility and the student-specific effects of OER on exam performance – in Models 1 and 2 the coefficient estimate is approximately 0.26. We find that for Asians, international students, and "other" students, the effect of OER on final exam performance is significantly higher compared to that of whites and domestic students, with the impact being particularly large for international students. In addition, the effect of OER on final exam performance for freshman and sophomores is significantly lower compared to juniors and seniors. We find that students who took morning sections of the course tend to have higher OER gradients, and students with higher SAT Math scores had marginally lower OER effects.

Keeping with our preferred nonparametric Model 3, we next turn to whether these nonparametric estimates are statistically significant throughout the distribution of effects. We use a residual bootstrap to recover pointwise standard errors for each of the nonparametric point estimates (i.e., each student receives his/her own OER effect estimate, and each of these effect estimates has its own standard error). We summarize these effects in Figure 2, which allows us to simultaneously assess the magnitude as well as statistical significance of each of these point estimates. All the nonparametric OER estimates are placed on the 45-degree line, shown by the black dots. We then overlay the 95% confidence interval above and below each point; these confidence intervals are point-specific, and are shown by the red dots above and below each black point estimate. If the horizontal line at zero cuts between the confidence interval for any particular point, that point estimate is statistically insignificant, while if the horizontal line at zero runs outside of the confidence interval, then that point is statistically significant (at the 95% level).

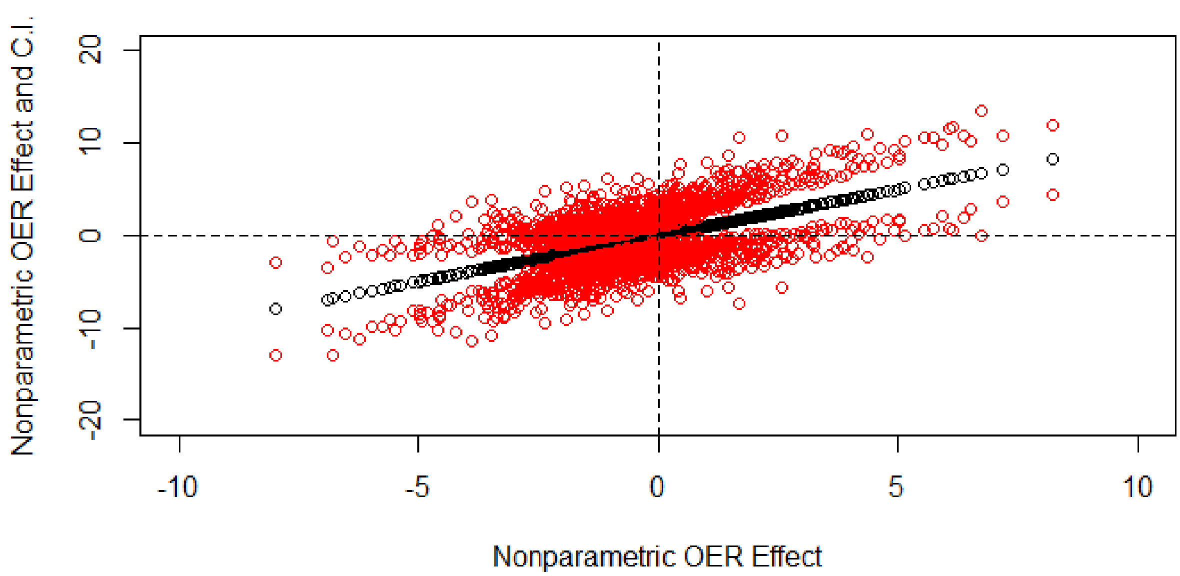

Figure 2. A 45 degree gradient plot of the OER effect from nonparametric Model 3.

We can clearly see that many of the point estimates are statistically insignificant; specifically, out of the 1,357 total point estimates, 1,035 are statistically insignificant, 281 are negative and significant, and 41 are positive and significant. To provide further description, in Figure 3 we plot the kernel densities of the OER effects by group: the group that is negative and significant, statistically insignificant, and positive and significant. It is clear that the group that is negative or positive and significant are the smallest and largest point estimates of the OER effects, whereas the insignificant effects are those that lie closest to zero. Further, the group with positive and significant OER effects average about 4 percentage points higher on the final exam when using OER, compared to their expected performance when using commercial textbook materials. Students who performed significantly worse averaged about 2.5 percentage points lower when using OER. Thus, for the majority of students, OER do not generally lead to a significant difference in student final exam performance, relative to commercial materials. When OER have a negative effect, the effect tends to be relatively small compared to when OER have a positive effect.

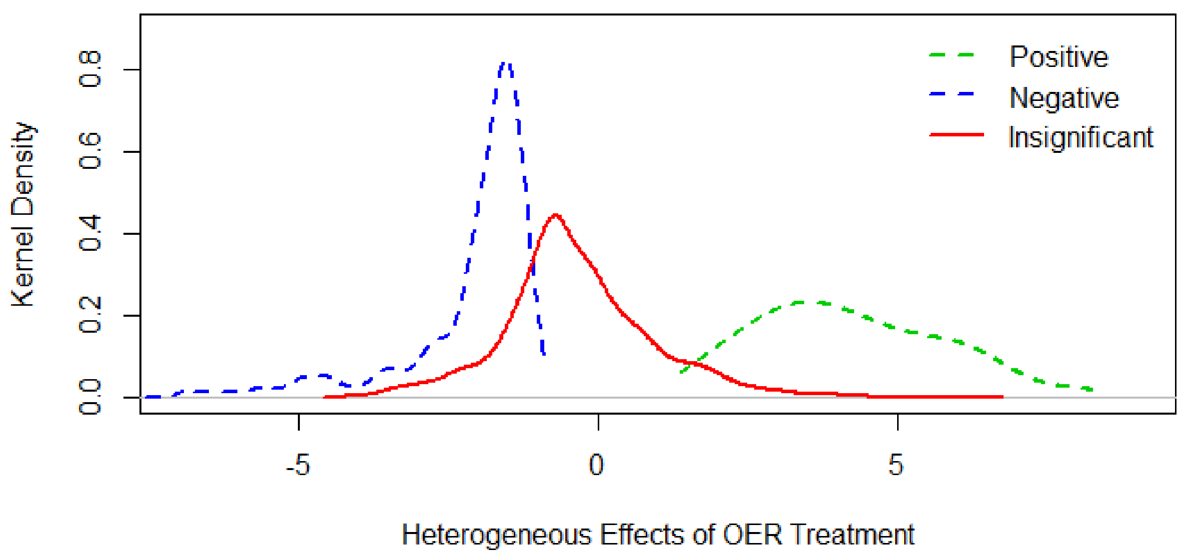

Figure 3. Distributions of heterogeneous OER effects from nonparametric Model 3.

As a final analysis, we would like to uncover exactly which types of students perform better, worse, or no different when using OER. To make this determination, we estimate a multinomial regression in order to predict the probability that each student falls into the negative, insignificant, or positive OER effects category. We have shown that the majority of students have an insignificant effect of OER on grade performance; however, we are interested in understanding if there are systematic differences between students who fall into these three categories of OER effects on final exam performance. In the multinomial model, we estimate parameters for each category (for the base category, negative, the coefficients are constrained to zero for identification), and assess statistical significance of these parameters via standard errors. However, since the multinomial logit is nonlinear, we compute average marginal effects for each category for each student characteristic, in order to understand how characteristics influence the probability that the student ends up in one of the three groups of OER effects. We report these results in Table 7.

Table 7

Multinomial Logit Regression Estimates and Implied Marginal Effects

	Dependent variable: Nature of OER effect		
	Negative	Insignificant	Positive
Male	-	0.032 (0.152)	-0.268 (0.365)
	[-0.003]	[0.012]	[-0.009]
Asian	-	1.360*** (0.319)	1.632** (0.718)
	[-0.225]	[0.209]	[0.016]
Hispanic	-	1.173*** (0.388)	0.553 (0.864)
	[-0.189]	[0.200]	[-0.011]
Black	-	0.652* (0.382)	0.755 (0.696)
	[-0.108]	[0.101]	[0.007]
International	-	3.273*** (0.482)	4.719*** (0.729)
	[-0.546]	[0.484]	[0.063]
Other	-	0.909*** (0.320)	0.545 (0.838)
	[-0.147]	[0.152]	[-0.005]
Freshman	-	-3.452*** (0.727)	-4.412*** (0.987)
	[0.573]	[-0.523]	[-0.050]
Sophomore	-	-2.578*** (0.729)	-1.682* (0.893)
	[0.418]	[-0.428]	[0.010]
8:30am class	-	0.132 (0.269)	0.024 (0.615)
	[-0.021]	[0.023]	[-0.002]
9:30am class	-	-0.374 (0.282)	-0.471 (0.706)
	[0.062]	[-0.057]	[-0.005]
10:30am class	-	0.394 (0.333)	0.708 (0.697)
	[-0.067]	[0.055]	[0.012]
11:30am class	-	-0.190 (0.310)	-0.908 (0.886)
	[0.036]	[-0.014]	[-0.022]
12:30pm class	-	1.124*** (0.343)	0.108 (0.892)
	[-0.178]	[0.201]	[-0.023]
1:30pm class	-	0.002 (0.327)	0.822 (0.667)
	[-0.006]	[-0.019]	[0.024]
2:30pm class	-	-0.456 (0.335)	-1.043 (0.903)
	[0.079]	[-0.058]	[-0.020]
3:30pm class	-	0.298 (0.331)	-0.565 (0.886)
	[-0.044]	[0.067]	[-0.023]

4:30pm class	-	-0.361 (0.301)	-0.317 (0.715)
	[0.059]	[-0.058]	[-0.001]
SAT math	-	0.0001 (0.001)	-0.008*** (0.003)
	[0.000]	[0.000]	[0.000]
Pell eligible	-	-0.109 (0.186)	0.607 (0.414)
	[0.013]	[-0.034]	[0.020]
Repeated course	-	1.366*** (0.280)	1.877*** (0.452)
	[-0.227]	[0.204]	[0.024]
Constant	-	3.553*** (1.021)	4.442** (1.794)
Frequencies	0.207	0.763	0.03
McFadden R-Squared		0.172	
Log-Likelihood		-717.625	
Likelihood ratio test		297.386 (0.000)	

Note*. Table reports coefficient estimates with standard errors in parentheses. The numbers in square brackets are implied average marginal effects. Statistical significance at the 1, 5, and 10 percent level is denoted by *, **, * respectively. Note that for identification, the coefficients in the negative category are constrained to zero.

Looking first at the estimated parameters, shown in the first line for each variable in the table, we see that the most significant predictor variables are indicators for Asian, international, freshman, and sophomore students, as well as for those repeating the course. Many of the parameters on the other covariates are not statistically significant, which simply means that students of these other types are not systematically winding up in different OER effect groups. For example, the gender of the student, or the student's Pell Grant eligibility status, do not influence the likelihood of ending up in one of these three OER effect groups. To interpret these Pell Grant eligibility estimates in the context of the significantly positive effect of Pell Grant eligibility on the OER gradient in Table 6, we find that while Pell Grant eligible students have a larger OER gradient than non-eligible students (Table 6), Pell Grant eligibility does not lead to a systematic grouping of students into the positive, insignificant, or negative OER effect groups. Thus, we find that OER materials have a significantly positive effect on exam performance for Pell Grant eligible students, though not to the extent that Pell Grant eligibility leads to systematic differences in overall OER effects.

Asian students are 22.5% less likely to be in the negative OER group, compared to white students, and are 21% and 2% more likely to be in the insignificant and positive effect groups, respectively. Similarly, we find that international students are 55% less likely to be in the negative group, and are 48% and 6% more likely to end up in the insignificant or positive effect groups, respectively. Freshman and sophomores are 57% and 42% more likely to end up in the negative OER effect group. Finally, students who are repeating the course are 23% less likely to be in the negative effect group, and are 20% and 2% more likely to end up in the insignificant and positive groups, respectively.

Discussion

During the semester that OER were implemented, students were significantly less likely to withdraw from the course (7.8% withdrew in 2014, 5.5% in 2015). This appears to be a potentially important benefit of OER; other studies (e.g., Hilton, Fischer, Wiley, & Williams, 2016) have found a similar benefit of lower withdrawal rates with OER.

When looking at an overall, average effect, we find that students using OER materials performed about 2% worse in the course compared to students who used commercial materials. This finding is unique in OER efficacy literature; to date, only Robinson (2015) has found that more students did worse using OER than better. To provide some perspective on the relative size of these effects, we see that the magnitude of the OER effect in Model 1 (-1.784) is less than half the magnitude of the coefficients on the 2:30 and 3:30 PM class time indicators (respectively, -4.931 and -3.801). This means that if OER have a detrimental effect on student course performance, the effect is substantially smaller than moving a student from one section to another. We also note that for 76% of students, OER had no effect. There were more students negatively affected than were positively affected; however, those who were positively affected had a larger overall effect. We speculate that the fact that fewer students withdrew from the course may also have had an influence on the average final exam scores.

We find that freshmen and sophomores did not perform as well when using OER. Pell Grant eligible students performed statistically better using OER materials compared to statistically identical students who used commercial materials. This effect, however, is small, and does not translate into systematic qualitative differences in exam performance for Pell Grant eligible versus ineligible students – i.e., while Pell grant eligible students, on average, scored about 0.26% higher on their final exam compared to non-eligible students, Pell grant eligibility does not help us predict whether a student will have a positive, insignificant, or negative OER effect. These results are different from those of Colvard et al. (2018), indicating that further work needs to be done in this area.

Evidence suggests that OER has a substantial, positive impact on exam performance for international students. Not only do international students using OER score higher on their final exam than domestic students using OER, they also consistently rank in either the insignificant or positive OER effect group. At a minimum, international students are not harmed by the OER we used, and at best are positively impacted. We conjecture that the online materials associated with this course were beneficial to students who are not native English speakers because there were videos and they were subtitled, providing them with an opportunity to repeat the materials as needed until mastery is attained.

This study only focuses on one discrete set of OER used in one context. This discussion cannot be construed to mean that all OER will have similar results. What this study does do is, in a rigorous way, examine the influence of one set of OER in one particular context. These results suggest that additional rigorous studies of OER should be done to confirm these results with other OER in different contexts.

Conclusion

While cost-savings is not an explicit part of our study, we do feel that it is notable that the adoption of OER collectively saved students in Fall 2015 at least of $101,700.50 (given the actual minimum per-student cost of $60.50 costs in Fall 2014). This is a deliberate underestimate; depending on the number of students who would have purchased a hard copy and/or only took one semester of calculus, the savings could be much higher. This leads us to wonder about the relative cost/benefit ratio for OER materials in the context of heterogeneous, student-specific OER effects. Clearly for students who have positive or insignificant OER effects, it is advantageous to use an open textbook that is free and can be retained by the students for years to come. Yet, for students who have a negative OER effect, if in fact, students can save significant amounts of money through the use of OER with only a small decrease in their final exam score, should OER be utilized? How low would the savings need to be (or how severe the drop in exam score) before OER was not considered to be a potentially good choice? Is there a threshold in terms of the percentage of students in the course with a negative OER effect that would make it undesirable to adopt OER? These questions are difficult to answer, and we recognize that the optimal instructional approach may not be one-size-fits-all. And so, while we are reluctant to provide an answer these questions, the very existence of OER invites their consideration.

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Meaningful Learner Information for MOOC Instructors Examined Through a Contextualized Evaluation Framework

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Abstract

Improving STEM MOOC evaluation requires an understanding of the current state of STEM MOOC evaluation, as perceived by all stakeholders. To this end, we investigated what kinds of information STEM MOOC instructors currently use to evaluate their courses and what kinds of information they feel would be valuable for that purpose. We conducted semi-structured interviews with 14 faculty members from a variety of fields and research institutions who had taught STEM MOOCs on edX, Coursera, or Udacity. Four major themes emerged related to instructors' desires: (1) to informally assess learners as an instructor might in a traditional classroom, (2) to assess learners' attainment of personal learning goals, (3) to obtain in-depth qualitative feedback from learners, and (4) to access more detailed learner analytics regarding the use of course materials. These four themes contribute to a broader sentiment expressed by the instructors that they have access to a wide variety of quantitative data for use in evaluation, but are largely missing the qualitative information that plays a significant role in traditional evaluation. Finally, we provide our recommendations for MOOC evaluation criteria, based on these findings.

Keywords: MOOCs, evaluation, MOOC instructors

Introduction

Massive open online courses, MOOCs, have been able to capture the investment of higher education institutions and have been accessed by millions of users worldwide. By 2016, 6,850 courses from over 700 universities had been offered as MOOCs, reaching an estimated audience of 58 million learners in 2016 alone (Hollands & Tirthali, 2014; Shah, 2016). Considering the $39,000 to $325,000 price tag for any given MOOC, these numbers reveal a significant financial investment (Hollands & Tirthali, 2014). Yet, despite these significant investments, very little evidence has been given to justify the cost expenditure or demonstrate the quality of the learning opportunities provided. Evaluation of MOOCs has been a somewhat controversial topic, as there has been much discussion concerning the inapplicability of traditional educational metrics to a MOOC environment, and a general acceptance of the low completion rates. There has been less conversation about what metrics would actually provide information on the quality of learning that could be used to further improve the pedagogical strategies employed in MOOCs. Consequently, the most commonly reported outcomes of MOOCs still primarily rely on high enrollment numbers and access to materials, rather than information that could assist one in coming to a conclusion on the quality of the learning opportunity in a particular MOOC. Criticizing evaluation metrics without providing justifiable alternatives risks preventing authentic evaluation that could lead to informed decision-making and improved courses and learner experiences. Speaking of open education resources broadly, UNESCO's 2015 *Education 2030* report states, "Access is not enough; we need a new focus on the quality of education and the relevance of learning and on what children, youth and adults are actually learning" (UNESCO, 2015, p. 4).

For MOOC platforms and institutions to justify cost expenditure and instructors to identify areas for pedagogical improvement, a comprehensive model of evaluation is needed which addresses the unique challenges of operating in an open educational environment, where learners are vastly heterogeneous and free to come and go as desired. Institutions are seeking to determine the most effective MOOC platforms; making rational choices requires establishing and applying appropriate evaluation criteria. Likewise, institutional staff and others tasked with providing evaluative information regarding institutional investments in MOOCs must establish evaluation criteria in determining the institution's merit of investment.

Although the word evaluation is used in everyday language, professional evaluation refers to a systematic determination of the merit or quality of something (Scriven, 1991). In order to determine merit or quality, one must first understand what is meaningful to stakeholders in a particular context. Therefore, principled approaches to evaluation begin with an assessment of stakeholder values (Scriven, 1983).

The *Contextualized Evaluation Framework* (Douglas et al., 2017) is based on the understanding that evaluation questions as to the overall worth of MOOCs (and any individual MOOC), can only be addressed by answering questions concerning the background and context of MOOCs, stakeholder values (specifically in terms of the basis for claims of quality or merit), MOOC learner characteristics and values, and the resources available to create MOOCs. A thorough understanding of context, stakeholder and learner values, and resources, can then be used to interpret course characteristics and learners' interactions (behavior and outcomes) within a course. This Contextualized Evaluation Framework is based upon the work of Scriven's (2015) Key Evaluation Checklist and Davidson's (2005) Genuine Evaluation. According to Scriven, evaluation is more than simply providing data or results; it is the science of valuing, specifying what is valued, and how a judgment regarding quality will be made (Shadish, Cook, & Leviton, 1991). Although evaluation judgement can be subjective, it is not arbitrary, but rather based on stakeholder values. Different groups of stakeholders may value different things, and could therefore come to different conclusions of worth (Scriven, 1983). Under this approach, before any process or outcome evaluation information is interpreted, the evaluator must first understand the intended outcomes for all stakeholder and user groups. Evaluation metrics for MOOCs, like completion rates, would become valuable if such an outcome is important to a particular stakeholder group, such as the learners themselves. Evaluation findings are therefore interpreted through the lens of what stakeholders and learners value. Specific to MOOCs, the Contextualized Evaluation Framework, as an extension of the evaluation methodology proposed by Davidson (2005), includes a theoretical perspective that, in an open educational context, learner characteristics (e.g., intentions for learning content, level of preparedness for content, current career state, socio-economic demographics) and course characteristics (e.g., content, pedagogy, instructional design) influence learner behavior and ultimately the learning outcomes.

Researchers have begun to explore instructors' perspectives regarding the benefits provided by MOOCs, both to institutions, instructors, and the learners themselves. MOOC instructors have communicated a variety of reasons for teaching MOOCs, not all of which are directly related to the MOOC learners. For example, Najafi, Rolheiser, Harrison, & Håklev (2015) found that instructors believe teaching MOOCs would ultimately encourage better teaching practices on their campus. Instructors also have discussed the perceived benefit of show-casing their institutions "best courses" to a world audience (Evans & Myrick, 2015). Some instructors have discussed that MOOCs provide the opportunity to conduct research on student learning, behavior, and attitudes at a large scale (Zheng, Rosson, Shih, & Carroll, 2015). While researchers have found MOOC instructors to have some self-serving intended benefits from MOOCs, it is also true that many instructors are motivated by a sense of altruism and a genuine belief in the democratization of higher-education (Hew & Cheung, 2014). The literature provides much evidence to conclude that many instructors truly endorse MOOCs main value proposition: to provide high-quality education to those that could not otherwise access it (Evans & Myrick, 2015; Najafi et al., 2015; Zheng et al., 2015). How exactly "high-quality" open online education is defined has yet to be determined. Researchers have found some instructors question the quality of MOOCs in comparison to more traditional instruction, perhaps in part because they struggle with pedagogies for a massive open environment (Evans & Myrick, 2015).

One important pedagogical consideration for online distance education courses is the instructor presence (Baker, 2010). With enrollment easily in the thousands, the nature of the relationship between an individual instructor and their students in a MOOC is distinct from traditional classrooms (Haavind & Sistek-Chandler, 2015). While not all instructors, there is a group of MOOC instructors who have communicated a dislike for the often low levels of personal interaction with students (Hew & Cheung, 2014). Relatedly, instructors struggle with translating their classroom-based teaching practices to large numbers of learners (Zheng et al., 2015). Pedagogies that lend themselves to interpersonal contact have not found a place in MOOCs. There is an opportunity for both course developers and instructors to reconsider the role of the instructor and how to support MOOC students, perhaps through mechanisms to fulfill the roles of instructors or to aid instructors in effective class management. Supporting instructors with information that will enable new strategies for increasing their impact in terms of teaching and learning will require deeper understanding of what value an individual instructor can bring to a mass of students and what instructors find valuable about the MOOC experience.

The range of educational objectives in MOOCs varies from personal health and financial choices to learning goals intended to prepare someone for highly-technical work. Instructor goals likely vary based on their educational objectives for the MOOC. Here, we focus on instructors who teach science, technology, engineering, or mathematics (STEM) MOOCs. In recent years, improving STEM education has been identified as a major goal by organizations such as the U.S. National Academy of Engineering and the National Science and Technology Council (National Academy of Engineering, 2004; National Nanotechnology Initiative, 2016). The push for STEM education has not gone unnoticed by MOOC providers. STEM MOOC initiatives include Georgia Tech's 2017 announcement that the school would offer an online Master of Science in Data Analytics in collaboration with edX (Diamond, 2017). A review of the literature found that while researchers have begun to explore MOOC instructors' goals, there is still a limited understanding of what STEM instructors hope will be the outcome of teaching a MOOC and what information would be useful to inform their teaching. Considering the foundation of evaluation is a needs assessment of the stakeholders, the purpose of this study is to explore STEM MOOC instructors' perspectives on teaching MOOCs and explore what information would be beneficial to them. Specifically, we asked what outcomes STEM MOOC instructors hope to achieve and what types of evaluation information are currently available to them. We aim to identify information that would be valuable to STEM MOOC instructors and could be used to inform their teaching and learning in open online educational contexts. In addition, administrators and members of instructional support team could use this information to guide the generation of outcome reports and to help in evaluating courses. Therefore, in this work, we consider the following two research questions: (1) What kind of course and learner information is available to STEM MOOC instructors for the purpose of evaluation? and (2) What kind of evaluative information would STEM MOOC instructors like to have available?

Methods

Participants and Data Collection

STEM MOOCs from a variety of institutions, fields, and nations were identified through a search of three large MOOC platforms: Udacity, edX, and Coursera. Emails were sent to the instructors of these MOOCs to recruit for interviews, with a $25 Amazon gift card offered as compensation. Interviews were conducted with instructors who agreed to participate until saturation was reached, indicated by a clear repetition of responses. Phone interviews were conducted with 17 instructors between April 2016 and July 2016. Of the 17 interviewees, 14 held tenure-track faculty positions, two were graduate students, and one was an industry professional and guest lecturer at an academic institution. We made the decision to exclude the interviews conducted with two graduate students from our results, as we felt that their perspective on evaluation might differ from that of the typical MOOC instructor. The fields of discipline and job titles for the remaining interviewees are listed in Table 1.

The interview protocol included an introductory statement to procure informed consent and inform interviewees that their responses were being recorded for research purposes. Interviews were conducted by two researchers using the responsive interviewing method described by Rubin and Rubin (2005). A semi-structured interview protocol consisting of open-ended questions was used for the phone interviews, allowing researchers to develop follow-up questions based on instructor responses. The recordings were transcribed by a third party. Upon completion, the transcriptions were checked and subsequently reviewed for quality.

The aim of the interviews was to capture and explore the experiences of various instructors and the design and implementation of their respective MOOCs. Interview questions were designed to focus on three areas of the relationship between instructors and their MOOCs: reasons for teaching a MOOC, information that would be useful for the instructor, and details about their experience teaching a MOOC. In the present study, we focus on the questions about information that would be useful for the instructor.

Table 1

Interviewees, Disciplinary Affiliations, and Job Titles

Instructor number	Instructor information Discipline	Job title
01	Computer Science	Full Professor
03	Nanomaterials	Lecturer
04	Industrial Engineering/ Operations Research	Professor
05	Electrical Engineering	Professor
06	Mechanics	Department Head
07	Comparative Media Studies	Visiting Lecturer
08	Computer Science	Associate Professor
09	Agricultural and Biological Engineering, Biomedical Engineering	Full Professor
10	Nanomaterials	Lecturer
11	Physics	Assistant Professor
13	Physics	Full Professor
14	Information Systems	Faculty
15	Mechanical Engineering	Professor
16	Mechanical Engineering	Senior Academic Professional
17	Information and Communication Technology	Associate Professor

[a] Missing numbers correspond to excluded participants.

Data Analysis

We followed qualitative methods based on a phenomenological perspective (Patton, 2002) to understand more about instructors' experiences with teaching MOOCs and their perspectives on what information would be beneficial to them. We followed Patton's guidelines for qualitative analysis, which include several steps. First, three of the authors explored the transcripts, writing memos, and taking notes on a line-by-line level. Next, based on the notes, a large number of initial codes were developed through consensus by two researchers, representing a wide variety of topics potentially relevant to instructor information use and pedagogical considerations. These codes were applied to the interview transcripts by segmenting and labeling text, and the resulting excerpts were grouped by code and further analyzed through a consensus process between two of the authors. Codes were tested for strength across interviews and similar codes were collapsed into larger categories that were reflective of all instructors. The authors then went back to review the transcripts to make meaning of each category and identify the themes. The remaining themes with example excerpts are provided. These themes are summarized in Table 2.

Table 2

Summaries of Themes in MOOC Instructor Feedback

Theme	Summary
Informal learner assessment	Instructors desire the kinds of personal interaction and immediate learner feedback that they use to supplement formal assessment and adjust their courses when teaching in person.
Learner audience	Instructors desire more information about who learners are, and what kinds of personal learning goals they are pursuing.
Course feedback	Instructors receive ratings and short reviews, but they desire more in-depth qualitative feedback from learners.
Learner usage data	Instructors report receiving different amounts of learner analytics. They want usage information that will enable them to improve their courses and predict learner performance.

Results

Our research team identified four major themes related to instructor information use that emerged during the coding process. These were informal learner assessment, learner information, course feedback, and learner usage data. These themes represent topics that were discussed consistently throughout the interviews and carry implications for MOOC evaluation.

Informal Learner Assessment

When asked about the differences between teaching MOOCs and teaching traditional courses, the most common topic brought up by instructors was the lack of information that could be used for informal or formative assessment of learner performance in MOOCs. Specifically, many instructors talked about desiring "learner presence," or the face-to-face interaction that learners have with instructors and teaching assistants in a traditional classroom setting. Instructor 01 talked about how one-on-one interactions are used to assess students in the on-campus course on which their MOOC is based.

> Even if I personally don't know all those students, there is some TA who does know every student. Each TA has a section of twenty to twenty-five students that they meet with regularly. At the end of the semester, if I have any doubts about whether someone's on the borderline between an A and an A-, I can always talk to their TA and say, "Tell me about this person. Do they ask questions a lot? Do they come to office hours? Do they appear to be a solid contributor to their project group?" There's a human element of subjectivity when you're assessing student's performance at the end of the course.

Instructor 06 mentioned learner presence from the perspective of evaluating the course itself, saying that in a traditional classroom they can adjust their lectures in real-time based on the reaction of the learners.

> When you teach in a lecture room, for example, you have lots of lecture rooms where the lecture room is too big and I don't see the students. If you don't see the students, and you can hear if it's too silent or too noisy, and then you can adapt with what you are saying. But if you don't see them behaving, it's really difficult to adapt. As soon as you see them, when you say something they don't understand, you can say it again or do a summary and adapt something.

Instructors also expressed concerns about specific assessment techniques used in MOOCs, in particular those used for the assessment of open-ended assignments. Open-ended assignments can be assessed using peer grading or automated grading tools. Both approaches provide a final score for the assessment, but provide little information that would allow for instructors to evaluate whether or not learners are correctly applying their knowledge. When on-campus instructors personally grade an assignment or discuss grading with the TAs, there is an informal sense of what is going with students in the class. However, MOOC instructors discussed how their removal from the grading process can make them feel disconnected from the students. Instructor 01 explained the difficulties encountered when attempting to automate the grading of programming assignments.

> (W)hat we're finding is the automation actually is not always capturing if the students are getting it right. In particular, there are ways that you can either game the automation, or that the automation is just not perceptive enough, if you will. Sometimes the automation can measure if the student got the right result, but it's not always able to measure if the process that the student followed is the right process.

What the instructors' comments make clear is that, in a traditional classroom, informal forms of assessment are used to not only supplement formal forms of assessment, but to validate them as well. Instructor 05 described how the lack of information necessary to make informal assessments in their MOOC lowers their confidence in the effectiveness of the assessments used.

> There is no way for me to tell whether students who have successfully completed this assignment are in fact able to do some of the things that we would, for example, we would expect from our students [on campus]. The type of assessment that I'm thinking about is the type of assessment that

> you see when you have the chance to have a conversation with students. I might not be able to do that with these people taking this class. You never know unless there is some clever mechanism to find that out. I will never think or know exactly how well this really works.

Learner Audience

Throughout the interviews, the instructors made it clear that they design their MOOCs to target a specific audience and to enable that audience to achieve specific learning objectives. Some MOOCs are intended for a specific set of learners, and others for more general audiences, but every instructor could clearly state for whom they had designed their MOOC. However, as Instructor 13 pointed out, they lack information that would let them know whether or not the learners who actually participate in a MOOC are a part of that intended audience.

> So I was basically planning that [the audience] would be just, you know, people with some knowledge of physics and science in general. It turns out that I was wrong. People who signed on, they were all over the place. You know, I [previously mentioned] high school students. We had some people who were retired. We had some students, people from other countries, where they just don't have access to physics. In fact, people who I thought would be interested didn't sign up. People who already go to the U.S. universities don't need my course, they can just, you know, get their own courses, real ones. Not what I thought would be the audience. I think I was just wrong.

In addition, learners who sign up for a MOOC may have learning goals that are completely different from those intended by the instructor. Even if their learning objectives do align, the learners may not choose to fully participate, as Instructor 13 continued to explain: "There are a lot of people who are just curious or interested to listen to some lectures but don't want to do any homework."

Some instructors noted that assessments in MOOCs are generally defined by alignment with the course's learning objectives, rather than also allowing learners to specify assessment of their own learning goals. Whether or not any given learner met her personal learning goals and got what she wanted out of the course is difficult to gauge using the information provided by these assessments. Unsurprisingly, many of the instructors described traditional measures of learner performance, such as completion rates and final grades, as being meaningless in the MOOC context. Instructor 15 described the gap between traditional assessments of course success and their idea of what would make their MOOC a success:

> (W)e've set this thing up as an educational opportunity. Our view, even though it wasn't measured, [is that] so long as you learn something...maybe you just watched the first 10 minutes of the first video that we've pretty carefully set up to introduce this whole field...and maybe from that you learned something about it that you didn't know before. To us, that would be a success. We're glad some people completed [the MOOC], but we weren't too hung up on the completion rates because we had a broader mission of providing education on a number of different levels.

A couple of instructors provided ideas on information that would enable problems related to meeting individual learner needs to be addressed. Instructor 09 believes that it would be helpful to have a more detailed breakdown of learner performance.

> It would be interesting to know [a learner's performance] as a function of how much of the course they actually did, because I think it's possible that somebody did a quarter of the course but still got something out of it.

Instructor 03 suggested that their MOOC could accommodate a wider variety of learning objectives simply by giving learners the opportunity to provide more information about themselves and using that data to modify or add additional course material.

> (H)aving a breakdown, having certain categories that people can put themselves into or their current level of qualification or categories for why they were attending the course or what they expecting to get out of it. That kind of thing would certainly be very useful.

Course Feedback

Feedback from learners is one of the primary sources of information that instructors make use of when evaluating a course in any setting. In MOOCs, feedback generally comes in the form of course ratings, short reviews, and end-of-course surveys. For example, instructors 16 and 05 summarized the feedback they received concerning their MOOC: "(T)here's a rating system. The students rate my courses out of 5.0. They give it so many stars. They can write comments, and they can write learner stories. New learners can see the ratings for my courses."

> They have opportunities to provide ratings. They have opportunities to provide stories or reviews. Some of them do. Those are relatively short messages that basically stress satisfaction or some suggestion and so on. They don't reveal the level of the type of assessment that I would be interested in.

Some instructors attempt to glean course feedback from discussion board posts, but Instructor 07 provided an example of why this approach isn't always as useful as hoped.

> I mean I get tons of comments in the forum, which is how I can gauge [satisfaction with the MOOC's assessments], but those are only the people who are kind of active and loud and saying things in the forums, right? It's not maybe necessarily the average student who's going to be posting in there and giving feedback.

The consensus among the instructors was that the course feedback currently received from learners, such as numerical ratings and short reviews, is sometimes useful, but it does not provide the depth of information that instructors would like to have available. Some instructors expressed a desire for more in-depth, qualitative feedback from some or all learners. Others gave specific examples of communication they had with individual learners after the MOOC was over that they found valuable. Instructor 05 expressed the belief that: "It would be nice to come up with some way of post-course interviewing students." Instructor 17 saw obtaining meaningful feedback as a major challenge in a MOOC and believed that the difficulty may be a symptom of large enrollments.

> (I)t's such a huge number of people, that most people, they are completely silent, and for me, very frustrating that you don't get any feedback from [them]. Then the forum is very noisy, so it's very

> difficult to...there are so many posts, that it's very difficult to find the good ones, so ways of filtering, cleaning, prioritizing all this information should be much nicer. I don't know. I don't have a specific solution, but I think it's a very common problem in these very large MOOCs, getting lost in all these big things, big numbers. Then the meaningful information is not there.

Learner Usage Data

Instructors reported receiving very different levels of learner analytics (e.g., clickstream usage data, material access counts, grading breakdowns, discussion board usage data), even when speaking about the same course platform. This is due to the different levels of data access available for purchase from major MOOC platform providers, as well as the constantly evolving capabilities of the course platforms themselves. A divide became apparent between instructors who were satisfied with the amount of learner usage data that they received from the course platform and those who were not. The instructors who were not satisfied with the amount of data that they received described two main ways that they wanted to apply learner usage data: making improvements to their course and predicting learner performance. Instructor 07 said that the data available to them limits their ability to evaluate and improve their course for the next offering.

> Learning the points where they drop off would be extremely valuable in updating the course content. Now, I just sort of get week-to-week where they drop off. By the time the course is over I have that. For the next year I could say, "Oh, we're getting a lot of people dropping off." You know, the week where they're building the prototype or something like that, so let's focus on that a little bit more. I can't get down to the level of what particular video did they drop out on, or what particular question did they drop out on?

Instructor 08 explains that having a more detailed breakdown of learner quiz performance would allow them to correlate lecture-viewing behavior with performance.

> I'd like to see for each question, what students' performance is on that question. It would be good to correlate whether students see the lecture or how much of the lecture they see, with their performance on the quiz questions themselves. That would be kind of interesting to study.

No matter how they intended to use the information, instructors who wanted more information expressed a desire to know more about the way that learners were interacting with their course. The common theme expressed by the instructors was a desire for useful, actionable information about the way that learners use course materials. Instructor 10 summarizes this desire:

> (C)an you create an instructor dashboard to monitor the students' behavior? To some extent, there's potential to do that. I don't think we fully realized that yet, but I think, ideally, what you want to see is, first of all, are our students actually keeping up with the material? Are they just using the material on a regular basis, consistently, or are they basically just skipping everything? Are they all doing binge watching, like just watch everything and do everything in the course of an hour, which is not necessarily bad, but the point is that you want to be able to at least see what are the patterns there.

Discussion

In this study, by following a process of interviewing MOOC instructors and coding their responses, we found four main instructor values that are relevant for informing criteria and metrics to evaluate MOOCs. The first is that instructors value high-quality assessment. Despite knowing that the bulk of learners are not using MOOCs as an actual course, these instructors still discussed a desire to use assessment to inform their teaching. In a traditional classroom setting, learners show evidence of understanding in a variety of ways, including assessment scores, interactions with instructors, and "showing their work" on open-ended assessments. The instructor can use this evidence as part of their pedagogy; such as posing questions to learners to assess understanding of the topic before moving on or even re-designing assessments to focus on topics with which the instructor feels learners may be struggling. However, MOOC learners are limited to the specific forms of expression defined by the course platforms. Interpersonal forms of assessment are generally limited to those that might occur on discussion boards and can be onerous for instructors to manage. In a MOOC, both content and assessments are generally static and developed well before any interaction with learners. Therefore, instructors are unable to use the assessments in a truly formative way to adjust instruction in real-time, even if they know a significant proportion of their learners did not understand a concept.

MOOC instructors complain about the feeling of speaking into a vacuum and missing "learner presence" when recording online lectures, both in the present study and in others' work (Hew & Cheung, 2014). Instructors in the present study explained that the lack of learner presence and other informal sources of information about learners forces them to rely entirely on formal assessments for evidence of learning. Unfortunately, MOOC platforms have fairly limited capabilities for assessment. Certainly, with the bulk of MOOC learners not engaged throughout the course, it would be prudent to focus higher-quality assessment on the smaller percentage of learners who actually do intend to use the materials as designed. This could also help instructors not to feel so overwhelmed by the masses, but rather have opportunities to support those few learners that want to gain the depth of information an entire course provides. The difficulty of implementing open-ended assignments in a MOOC environment precludes most forms of qualitative assessment of learner work. Attempts to implement open-ended assignments in MOOCs have generally involved peer grading or automated grading systems. Previous studies have called into question the reliability of both approaches (Hew & Cheung, 2014), a concern that was echoed by instructors in the present study. When evaluating the learning quality of MOOC platforms, institutions may consider what mechanisms are available for instructors to obtain direct and specific feedback on learners' understanding separate from graded work.

The instructors in our interviews agreed that learners in MOOCs often have personal learning goals that differ from those intended by the course designers, but differed on whether or not an attempt should be made to evaluate these goals. Currently, MOOC platforms offer limited capability to accommodate learners who have different goals, and therefore all learner assessment scores are lumped together in instructor dashboards. The instructors who wish to evaluate the attainment of personal learning goals discussed that they do not currently have opportunities to interpret outcomes based on an individual's desired goal. This points to one ongoing inconsistency in MOOCs: completion is regarded as an unimportant outcome because of the diversity of learner intent, but on the other hand, the outcomes provided to instructors are largely based on the extent to which learners met the course learning goals (i.e., performance on homework, quizzes, and exams). Additionally, the specialized information being presented in STEM MOOCs can lead to very specific intended learning objectives. Even when the intended learning objectives are more general, the pre-requisite knowledge required to participate in some STEM MOOCs means the intended audience can be very narrow. As mentioned previously, other instructors simply do not see a need to evaluate whether or not learners have met their personal learning objectives. Instead, they see their MOOC as an open resource that learners are free to use as they wish. This view agrees with work by Liyanagunawardena, Lundqvist, & Williams (2015), which concluded that MOOCs should focus on serving their intended audience.

Instructors expressed a desire for improved feedback from learners, but providing this information presents a challenge for course platforms. Instructors agreed that in-depth post-course feedback allows them to understand the perspectives of learners in their course and make improvements to the curriculum. However, few learners are willing to provide such in-depth feedback when given the opportunity, and there is no way to guarantee that these learners form a representative sample of the course's participants. Many more learners are willing to provide feedback in the form of ratings and short comments, but instructors don't always feel that these forms of feedback are particularly helpful. Even if every learner in a MOOC could be persuaded to leave an in-depth review, how could instructors condense thousands of course reviews into usable information? Following the suggestion of one of the instructors interviewed in this study, a potential solution to the feedback problem could involve instructors contacting a sample of learners for post-course interviews. Our findings agree with work by Knox et al. (2014) which concluded that learner feedback must go beyond simple satisfaction ratings in order to be useful.

Similar to the divide between instructors who are interested in knowing their learners' learning objectives and those who are not, a split exists between instructors who want more detailed analytic information on learner behavior and those who are content with a general overview. The instructors who said that they want more detailed information on the ways in which learners are using their course made it clear that raw data itself is not necessarily useful. They need learner behavior data translated into actionable information that they can use to improve their course or predict further behavior and performance. Some instructors are doing this on their own, but currently, the process of gleaning information from the enormous sets of raw data provided by the course provider is rather cumbersome. Instructors expressed a desire for strong data visualization capabilities and real-time instructor dashboards, capabilities that major MOOC providers have been working to improve since the instructors of MOOCs in the present study were conducted.

Examining the results of the present study, an overarching theme emerges that unites the themes discussed thus far: similar to work by Stephens-Martinez, Hearst, & Fox (2014) we found that MOOCs provide an enormous amount of quantitative data for use in evaluation, but traditional evaluation also has a qualitative component that is largely missing. The focus on quantitative assessment is to be expected from the current limitations of online learning environments, but several instructors pointed out a troubling implication of that focus. In some cases, the lack of qualitative assessment capabilities in MOOCs can actually devalue the existing quantitative assessments. Without interpersonal and open-ended assessments, instructors have no way to validate the scores that learners receive on quantitative assessments. Instructors expressed concern that, while they receive exam scores and final grades for the learners who complete their course, they can't be as sure that those students are actually capable of applying the knowledge that they received in the course as they would be in a traditional course setting. Similarly, instructors find it difficult to draw conclusions from learner analytics data such as completion and drop-out rates because they have no qualitative evidence that might explain the behavior. A learner who drops out because a course was too difficult and a learner who drops out because they achieved their personal learning objective make the same contribution to a course's completion rate despite achieving drastically different outcomes, rendering completion rate a significantly incomplete metric for instructors to use when evaluating their course. The research required to address these challenges aligns with the suggested research questions by London et al. (2016) regarding participants in MOOCs.

One limitation of the current study is that the instructors interviewed all taught on U.S.-based MOOC platforms (Udacity, edX, and Coursera). Their perspectives may be different from those who teach through other non-U.S. based platforms (e.g., Future Learn). However, the instructors themselves were from a number of different regions, including northern Europe, Asia, and India. Different course platforms employ a wide variety of instructional design techniques and emphasize different aspects of the online learning experience. Future research should have a search strategy to locate instructors that teach on other platforms with different pedagogical strategies. Additionally, the capabilities of MOOC course platforms are constantly evolving. Given the rapid pace of advancements in learning analytics, some of the concerns held by instructors in these interviews may have already been addressed by the time of this article's publication.

Conclusions

The primary aim of this research was to identify information that STEM MOOC instructors would find valuable. We found four main themes regarding instructors desire to: 1) informally assess learners, 2) assess learners' achievement of own learning goals, 3) have more representative learner feedback on course materials, and 4) have more detailed analytics regarding usage of course materials. From our findings, we recommend that evaluation criteria for MOOCs include: the quality of assessments, extent to which authentic formative assessment is possible, the capability to interpret learner outcomes based on learner goals, mechanisms for feedback, and metrics for evaluating specific course content. Instructors desire opportunities to formatively assess learners in an authentic way. One implication would be for platforms to create ways for instructors to have more authentic interaction with learners without being bogged down by the masses, perhaps employing sampling strategies. Instructors recognized that few learners participate in the end-of course surveys, limiting the type of learners from whom they receive feedback. One possibility might be for platforms to provide the end-of-course survey benchmarks that instructors could use to compare their feedback with other courses. Another would be for platforms to assist instructors in reaching out to learners who either disengaged or were sporadic to get feedback. Others have noted that learner intentions should be used to contextualize completion outcomes (Koller, Ng, & Chen, 2013), yet based on our interviews, these capabilities for individual instructors still appear to require further development. Instructors have accepted that not all learners want to fully engage with materials; however, they are often frustrated by their inability to sort out the extent to which learners did meet their goals. The quality of any learning resource is based on characteristics of both the learner and the resource. To go beyond simple reporting of access toward improved quality educational opportunities, it is imperative that outcomes are reported based on learner characteristics.

It is our intention that MOOC platforms could use these findings to inform the analytics they provide to instructors and partner institutions. In addition, administrators and members of instructional support teams could use our findings to evaluate the degree to which different platforms provide instructors with relevant information. MOOCs provide a great deal of data, but data alone is not sufficient for evaluative decision-making; more work is needed to contextualize raw data, to translate it into actionable information. Thus, future research should consider how instructors could use the analytics and dashboards currently or potentially provided by MOOC platforms now and in the future to inform and potentially improve their teaching and learning.

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Understanding Participant's Behaviour in Massively Open Online Courses

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Abstract

As the offer of Massive Open Online Courses (MOOCs) continues to grow around the world, a great deal of MOOC research has focused on their low success rates and used indicators that might be more appropriate for traditional degree-seeking students than for MOOC learners, who, because of the openness of MOOCs, represent a more diverse clientele who exhibit different characteristics and behaviours. In this study, conducted in a French MOOC that is part of the EDUlib initiative, we systematically classified MOOC user profiles based on their behaviour in the open-source learning management system (LMS) — in this case, Sakai — and studied their survival in the MOOC. After formatting the logs in ordinal variables in order to reflect a continuum of participation central to the behavioural engagement concept (Fredricks, Blumenfeld, & Paris, 2004), we incrementally executed a two-step cluster analysis procedure that led us to identify five different user profiles, after having manually excluded Ghots : Browser, Self-Assessor, Serious Reader, Active-Independent, and Active-Social. These five profiles differed both qualitatively and quantitatively on the continuum of engagement, and a significant proportion of the less active profiles did not drop out of the MOOC. Our results confirm the importance of social behaviours, as in recent typologies, but also point out a new Self-Assessor category. The implications of these profiles for MOOC design are discussed.

Keywords: MOOC, participant profiles, cluster analysis, survival analysis, behavioural engagement

Introduction

Massive Open Online Courses (MOOCs), a recent form of distance courses essentially based on short videos and quizzes, have received a great deal of public attention lately, and the debate about the future of MOOCs and their impact on education continues. While some argue that MOOCs are now in the disillusionment phase of the Gartner Hype Cycle (White, 2014), i.e., the point in time when "interest wanes as experiments and implementations fail to deliver" (Gartner, 2019), data from the Open Education Scoreboard (European Commission, 2015), a European site that monitors MOOC offerings around the world, indicate that global MOOC offerings have been picking up since May 2015, corresponding, rather, to the "plateau of productivity" in the Gartner Cycle, referring to a certain maturity of the innovation. In fact, as demonstrated by Peters (2018), the MOOC offering is now much more diverse, with small MOOCs, private MOOCs and credential MOOCs, suggesting that students who register for MOOCs have diverse needs. While MOOCs contribute to wider accessibility of higher education and have a place in the distance education offering, many questions remain on persistence rates and on who registers, what their profiles are, how they use MOOCs and their motivation to do so.

A body of scientific literature on MOOC research is now emerging, with many journals publishing special issues on the topic. While MOOCs have drawn substantial attention by reaching millions of students, many of their biggest drawbacks relate to the near-catastrophic completion rate reported by many (Jordan, 2013, 2014). This is unsurprising, given that poor completion rates have been the subject of many articles on distance education (Simpson, 2003), and that MOOCs are a particular instance of distance courses. Although completion and success rates have been the golden standards for assessing the quality of both face-to-face and online courses, we question whether such standards are representative of the main objectives of MOOCs. Moreover, do they correspond to the expectations of MOOC learners?

The first O in the MOOC acronym stands for Open, in the original sense of accessibility and absence of barriers to instruction, the meaning also conveyed by the designation of Open Universities (Anderson, 2013). Registering for a for-credit course, whether distance or in-person, at any postsecondary institution requires a considerable investment of time and often money: applying to a program, supplying documentation of prior learning (e.g., transcripts and diplomas), waiting for an acceptance which may be conditional, paying tuition fees, choosing and registering for courses, doing course readings and activities, and taking exams. Barriers are present at many of these steps. Simply registering in a course demonstrates a high level of commitment. In contrast, registering for a MOOC is a low-barrier process that often requires no more than entering your name, email, and password, at first. Furthermore, the flexibility offered by MOOCs in terms of time and logistics is the main reason learners opt for them (Roy, Poellhuber & Bouchoucha, 2015), followed by the fact that MOOCs are free at registration. However, this is nowadays debatable since most MOOCs platforms offer a paying form of authenticated certificate or monthly subscribtion, and even integration in for credits programs that are quite expensive, but still quite less than the same programs offered on campus.

The argument we present in this study is that the openness and accessibility of MOOCs attract or at least used to attract a clientele who may, compared to traditional degree-seeking students who register in for credit courses in universities, have a far more diverse profile in many dimensions: sex, age, occupation, country of residence, motivations, reasons for taking the MOOC, etc. (Poellhuber, Roy & Levasseur, 2017). The openness concept has evolved significantly and taken on new meanings. In the context of Open Distance Education, openness in Europe has expanded to include flexibility and adaptation to learners' needs, as in the French definition of Open and Distance Education ("formations ouvertes et à distance"; Carré, 2001). While MOOCs have been criticized for being not so free or open (Anderson, 2013), they still remain an important vector of openness in the original sense of removing barriers. With more than 100 million learners (Shah, 2018), they are now a trend in the distance education movement and they make eLearning available to new types of learners. Analysis of the age curve of the learners in the EDUlib initiative indicates that learners are older than regular HEC (Hautes édudes commerciales) Montreal (a business school) students and that fewer than 1% are actually registered students. MOOC designers and authors tend to view MOOC learners as students, anticipating that their behaviour will conform to what is expected from students, but this is far from certain. Much of the research in MOOC literature use implicitly success rates as the golden standard of MOOC quality, but this assumption may be false. Indeed, a large number of MOOC registrants never log in once the MOOC is opened (Hill, 2013). Furthermore, emerging research on MOOC participant typologies shows that the behaviour of a large number of MOOC learners differs substantially from what is expected from more traditional students.

MOOC Participant Typologies

Work on MOOC participant typologies began with manual and rational classifications (Hill, 2013; Ho et al., 2014; Milligan, 2012) and gradually evolved toward a more robust and systematic classification schemes that rely on cluster analysis. From very small studies to large-scale studies, a variety of attempts have been made to classify student engagement behaviour patterns in MOOCs, as synthesized in Table 1.

Table 1

Literature Review on MOOC Participant Typologies in Chronological Order

Authors	Sample	Type of analysis	Variables	Typologies
Milligan (2012) and Hill (2013)	1 connectivist MOOC (Change 11)	Rational analysis	Questionnaire (self-regulated learning, Motivated Strategies for Learning Questionnaire) and interview data	(1) No-shows, (2) Lurkers, (3) Passive Participants, (4) Active Participants
Kizilcec et al. (2013)	3 Stanford University MOOCs	Cluster analysis (k-mean)	On-time or late assessments, video watching, quizzes	(1) Completing, (2) Auditing, (3) Disengaging, (4) Sampling
Ho et al. (2014)	17 edX MOOCs	Rational analysis	Registrations, certifications, resource viewing	(1) Only Registered, (2) Only Viewed, (3) Only Explored, (4) Certified
Ferguson & Clow (2015)	4 Future Learn MOOCs	Cluster analysis (k-mean)	Activities (visits or on-time or late comments) on content and assessments	(1) Samplers, (2) Strong Starters, (3) Returners, (4) Mid-way Dropouts, (5) Nearly There, (6) Late Completers, (7) Keen Completers
Tseng et al. (2016)	5 Taiwan Yuan Ze University MOOCs	Cluster analysis	Logins, video viewing, assignment submission	(1) Bystanders, (2) Passive Learners, (3) Active Learners
Kovanovic et al. (2016)	28 offerings of 11 Coursera MOOCs	Cluster analysis (k-mean)	Activities in videos, assignments, quizzes, wikis, discussion forums	(1) Enrollees, (2) Low Engagement, (3) Videos, (4) Videos & Quizzes, (5) Social
Khalil & Ebner (2017)	1 Gratz University MOOC	Cluster analysis (k-mean)	Reading and writing frequencies, videos watched, quiz attempts	(1) Dropouts, (2) Perfect Students, (3) Gaming the System, (4) Socials
Kahan, Soffer & Nachmias (2017)	1 Coursera MOOC	Cluster analysis	Video, discussion forums, quizzes and assessment activities, grades, certification, demographics	(1) Tasters, (2) Downloaders, (3) Disengagers (4) Offline Engagers, (5) Online Engagers, (6) Moderately Social Engagers, (7) Social Engagers

Milligan's work inspired Hill (2013), who reinterpreted his typology outside the original conceptual framework, but in a very user-friendly way, and developed a well-known image (see Figure 1) of a popular MOOC typology.

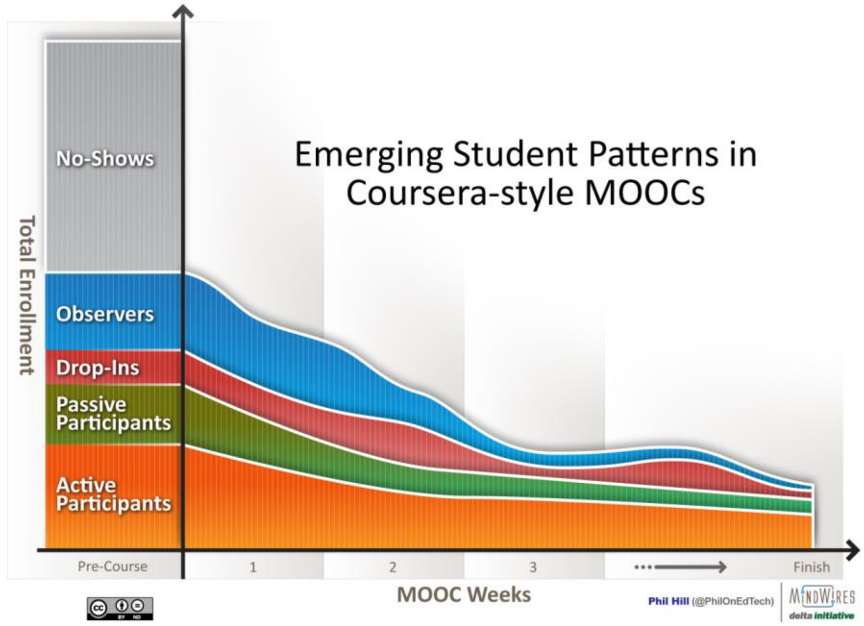

Figure 1. Hill's MOOC participant typology. From "Emerging patterns in MOOCs: A graphical view." P. Hill, *E-literate,* 2013. (mfeldstein.com/emerging_student_patterns_in_moocs_graphical_view/) CC/BY/ND

The first typologies used similar variables to understand MOOCs, mostly based on platform connection and the consultation of different types of resources, from lectures and documents (Milligan, 2012) to videos and assessments (Kizilcec, Piech, & Schneider, 2013). Although the terminology varies among the studies, they are mostly self-explanatory.

Most of the early typologies (pre-2016) center on the assumption that all learners should turn in assignments and attend the MOOC until the end. But can we really consider the "Auditing" and "Disengaging" to be disengaged? (Kahan, Soffer, & Nachmias, 2017). The strategy used to create these typologies relies on simple indicators or ones that are aligned with a classical view of what is expected of students, with assignment submissions used as a key indicator in the classification schemes. They suggest classification schemes that are both quantitative (focused on the level of engagement) and qualitative (focused on the type of engagement, as in Milligan, 2012). If we want to meaningfully classify students on both of these aspects, we need to ask what the most appropriate classification scheme is. Kovanović et al. (2016) shed light on an important category: the registered, who only register but do not log in. This represent a known fact on MOOCs and explains a large proportion of the dropouts (Jordan, 2014). Gradually, efforts have been made to integrate a wider level of activities in the classification variables, such as quiz attempts (Khalil & Ebner, 2017) and activity in discussion forums (Kovanović et al., 2016). Kahan, Soffer, and Nachmias (2017) went further, taking a novel approach in which activities in all resource categories were the subject of a cluster analysis, without preference to activities tied to assessment or completion.

In our study, the objective was to create MOOC participant profiles with an appropriate and systematic classification methodology based on participant interactions with MOOC resources, drawing on a conceptual framework of behavioural engagement. Rather than relying on pre-existing conceptual categories, we propose a sound and systematic strategy to characterize the different MOOC participant profiles, based on their pattern of engagement or interaction with any type of MOOC resources. We also wished to examine the dropout behaviours of these different profiles.

Conceptual Framework

The construct of engagement enjoys a wide variety of definitions, in games as well as in education, ranging from a broad acceptation of the term (e.g., any type of interaction) to precise types of engagement such as "gaming the system" (Baker et al., 2004). In educational research, engagement is closely related to motivation, especially in socio-cognitive expectancy-value motivational models (Eccles & Wigfield, 2002; Pintrich, 2003), inspired by Bandura's triadic interaction model (1986, 1997). In these motivational models, engagement is sometimes seen as equivalent to motivation (Clark, 1999; Viau, 2003), while others (Pintrich, 2003) make a subtle distinction between engagement and motivation, with engagement viewed as a behavioural consequence of a favourable combination of expectancy beliefs and perceived value. Expectancy beliefs refer to the learner beliefs to succed in a given task while value perception is the overall assessment of the utility, importance, or interest of the task (Pintrich, 2003).

Prominent authors on the construct of engagement distinguish among three aspects of engagement: behavioural engagement, cognitive engagement, and emotional engagement (Fredricks, Blumenfeld & Paris, 2004; Linnenbrink & Pintrich, 2003). Behavioural engagement refers to the observable indicators of participation, such as paying attention in class, avoiding distraction, and so on. Behavioural engagement can be conceptualized as a continuum: from the absence of disturbing behaviours, to respect for class rules, to active participation in class discussions and even participation in extracurricular activities. Emotional engagement refers to the display of positive or negative emotions involved in a learning context or the learning process itself. Cognitive engagement is rooted in the idea of mental effort and investment. This effort can be measured quantitatively (e.g., the intensity and duration of the cognitive resources invested in the task), but also qualitatively (e.g. the degree of appropriateness, sophistication, and efficiency of the cognitive investment) (Molinari et al., 2016). Cognitive engagement relates to cognitive strategies and to metacognition, which refers to the choice, monitoring, and regulation of these strategies. Pintrich, Smith, Garcia & Mckeachie (1991) differentiate between cognitive strategies (repetition, elaboration, organization) and metacognitive strategies (critical thinking, regulation, resource management).

While behavioural engagement indicators are often also indicators of the cognitive investment that defines cognitive engagement, they are not always reliable. A student can look at the teacher while letting their mind wander. In this particular study, we submit that the learners' actions that are logged in the learning management system (LMS) can be considered behavioural engagement indicators, or manifestations of it. They are no more nor less reliable than behavioural engagement indicators that can be used in a face-to-face class setting. They focus on learner-content interactions, the most important type of interaction in distance education (Bernard & Amundsen, 2008). We submit the idea that if formatted properly, these logs reflect a continuum of participation, i.e., behavioural engagement. While they may be related to the level of cognitive investment (cognitive engagement), they may also be a poor indicator of it. For example, it is difficult to tell whether viewing a particular video five or six times is an indicator of cognitive engagement or of something else, such as connection problems or distractions at home. Whether we are observing merely behavioural engagement or cognitive engagement in traces is a matter of debate and interpretation; thus, interpreting traces as "observable behaviour" corresponding to behavioural engagement seems more appropriate. Furthermore, theory predicts links between behavioural engagement and cognitive engagement. To analyse computer traces from the perspective of behavioural engagement is, as observed in Table 2, a sound practice.

In summary, behavioural engagement pertains to visible manifestations of engagement and exists along a continuum. The more visible participation is, the more behaviourally engaged the participant is considered to be. Thus, we argue that in the MOOC context, traces of participant activities in the environment can be considered indicators of behavioural engagement.

Methods

This quantitative study relied on big data and learning analytics methodology based on traces of participant behaviour in the MOOC learning management system (LMS) and on classical statistical categorization techniques such as cluster analysis, multiple correspondence analysis and principal component analysis. The data pertaining to participant behaviour in the Sakai LMS were extracted, cleansed, and formatted using a combination of procedures in Stata and SPSS.

Context

The data used in this study come from a French-language MOOC (*Economic Problems and Policies* course), offered as part of the EDUlib initiative through the Sakaï LMS, which was offered in the Spring 2013 semester. Four Thousand Eight Hundred and Fifty people registered for the course. The MOOC had six one-week modules. The course material for each week included, in general, six videos, six PDFs files corresponding to the lecture slides, and at least one required and one complementary reading. In this course, each week corresponded to a module that offered six short (10-12 min.) video lectures, the slides used in these lectures, a required reading, some suggested readings, a formative quiz, and a discussion board. Two discussion forums were offered (module content and general discussion). At the end of each module there was a summative test, and the students had one week to complete it. The same structure continued all through the MOOC.

Data

Learners' traces were first extracted in three different files: resources (document, video, etc.), events (discussion, communication, etc.), and visits (logging in the course webpage). We collected date and time, as well as counts, on three types of behaviours: the specific resources learners accessed (forums, tests, quizzes, resource, visits), events (new thread in forum, read thread, response thread, test and quiz assessment submit, test and quiz published assessment revise, read, site visit), and visits to the site. We then aggregated dates and times of traces by creating eight variables associated with each week of the six-week course, the final exam period, and the post-exam period.

Each activity carried out by the participant during each period was counted. Then, after data cleansing and integrity checking, the data were aggregated based on the activities and resources associated with each course module and week. For each week, we assigned variables, based on how many of the videos, PDF lecture slides, and required or optional readings learners accessed. We assigned a value of 0 if the person had not consulted any of the course material for the week, 1 if they consulted some, and 2 if they consulted all of the material.

Of the 4,850 registrants, 1,691 logged in at least once after Week 1 (this being our criterion to define them as learners). Of these, 185 learners dropped out of the course during the second week (their last login was in Week 2), and 323 others did no activities in Week 2, but did activities later in the course. These were considered to be "ghosts" and removed from our analysis because they had little or no trace of activity in Week 2 and to make the classification more precise. Of the 1,691 learners, 30% were female, with an overall median age of 35.8 years old. The learners were mostly full-time workers (65.2%) with a higher education diploma (post-graduate or PhD) (54.2%). Learners were mostly French-speaking from the province of Quebec in Canada (44%), but they also came from a variety of other French-speaking countries.

Data and Variables

At the end of Week 1, the Module 1 exam became available for a full week, and the material for Module 2 was made available at the same time (we thus have differentiated between Course week period and Examination period).

Prior to analyzing the data, we transformed it to align with the behavioural engagement concept and its central idea of a continuum of participation. We defined participation as any type of activity in the MOOC with any type of resource. Four types of resources were available: video lectures, quizzes and tests, the discussion forums, and PDF files consisting of the required reading (usually a book chapter), optional readings, or the lecture slides. For each of these resources, we created ordinal variables representing a continuum of participation. For example, instead of using the total weight of forum interactions, we differentiated among types of forum participation: no participation, reading, responding to a question asked by someone else, and asking a question, which we considered the highest level of engagement because it creates a new thread visible by all. While this choice entails some information loss, it is much more consistent with the underlying conceptual framework (behavioural engagement) than the weight of forum interactions. Total time spent on activities would have been an obvious measure to include, but it was not available. Furthermore, the LMS had no automatic logout after a period of inactivity, a characteristic that would make that measure unreliable. We also introduce a categorization of the activities based on the timeframe to put into evidence if activities were completed "on time," i.e. during the week dedicated to those activities, or "late," in subsequent weeks. We conclude that this refinement added little to the model, and we ultimately chose seven different variables for each week's activities, as displayed in Table 2. It is to be noted that there were no optional reading for the Module 2, for which we report the analysis in this paper.

Table 2

Description of the Variables Used for Cluster Analysis

Variable	**Description**
PDF lecture slides viewed (module 2)	Proportion of PDF files (lecture slides) viewed in the second week of the course.
Streamed videos viewed (module 2)	Proportion of the six videos viewed in streaming mode in the second week of the course (note: a link was made available for students who wanted to download a complete version of the videos, but activities on these links were not recorded).
Required readings downloaded (module 2)	Proportion of required reading downloaded.
Test & quiz submitted (module 2)	Number of tests and quizzes completed and submitted.
Test & quiz attempted, but un-submitted (module 2)	Number of tests and quizzes attempted (incomplete and un-submitted).
Forum questions asked (module 2)	Number of interactions in discussion forums to ask questions during the course week and the test week.
Forum answers contributed (module 2)	Number of interactions in discussion forums to answer questions during the course week and the test week.

Data Analysis

We used cluster analysis to place each participant in a group sharing similar characteristics. We used the traces from the beginning of Week 2 to the end of Week 3, corresponding to Module 2, which was the first module for which we had all the traces. In preliminary analysis, we distinguished three phases: the "on-time" activities carried out during the course week, Week 2 activities carried out later than Week 2, and activities carried out during the test week (which extended one week more). Exploratory analysis of all the variables for these three periods revealed that only the behaviour variables during the course week period helped distinguish among profiles. We therefore used only these variables for our final cluster procedure.

Two-step cluster analysis is a technique used to create homogeneous subsample groupings by identifying similar learners while minimize within-group variation and maximize between-group variation (Garson, 2014). First, the two-step procedure allows us to work with a continuous and categorical variable. Second, the method is effective with large datasets (Tuffery, 2011; Garson, 2014). Our main objective was to systematically divide the large number of learners into categories or patterns that would make sense from a behavioural engagement perspective. Performing this analysis on our dataset allowed us to group users who shared common behaviours on the MOOC platform, with obvious distinctions among the groups. We introduced the seven variables described earlier in a two-step cluster analysis using SPSS 21. Automatic sampling yielded three main categories, but to determine the optimal solution, we tested four, five, six, seven, and eight categories, comparing the quality of the different models and the meanings of the classes produced. We sought a classification model in which the profiles would be qualitatively and meaningfully different from a behavioural engagement perspective, while preserving the quality of the classification solution. This relates to the meaningfulness criterion in Garson's (2014) three ways to assess cluster validity: criterion (or variable) validity, distance (or proximities), and meaningfulness. The SPSS analysis showed that in the four-, five-, and six-group solutions, all included variables (criteria) provided useful information in all models, with a relative importance between 0.1 and 1.0. Based on cluster proximities, the results also indicated that all models presented a good solution. Therefore, while validity and distance did not provide enough evidence to select between the four-and six-factor solutions, the five-factor solution gave us a clearer qualitative portrait of each cluster by introducing forum activity as a variable separating the two most active profiles. We repeated the cluster analysis process for activities later in the MOOC (in Module 4) and the results (not presented here) replicated the clusters found in the present analysis.

While a great deal of MOOC research focuses on successful completion, the description of how long the learners of each profile remain active is particularly relevant to understanding these profiles. Survival analysis studies the time before some "death" event occurs (Tabachnick & Fidell, 2007) — here, dropping out or disappearing from the MOOC. We used it to estimate a survival function in relation to dropping out, which we defined as the week in which the participant last logged in. Because our dropout variable did not have a normal distribution and our variables were not perfectly continuous, we ran a discrete survival analysis, which gave the probability of dropping out at each week. Using function $F(x) = P(X \leq t)$, we computed the mortality ratio, i.e., the probability or risk that learners "surviving" a particular week will "die" the following week.

Results

The final results of the two-step cluster analysis procedure differentiated among five different groups that constitute a continuum in terms of the level of behavioural engagement and that also differ qualitatively. We do end up with seven groups because we did not take into consideration the participants who registered and never logged in after Week 1. These actually represent the largest group (n = 3,159), accounting for 65.1% of everyone who registered. Of the 1,691 learners, which we defined as those who logged in after Week 1, 508 learners were members of the *Ghost* profile, described below, which was manually excluded from the cluster analysis procedure, and of whom we know little. Five additional profiles were created; *Browser, Self-Assessor, Serious Reader, Active-Independent* and *Active-Social*.

Table 3 presents the "on time" activities of the members of these five additional profiles for the second module of the course, on each modality of the seven variables selected for classification. The second line of Table 3 presents the number of learners in each particular profile and its proportion of the total. In this table, each variable is presented in bold in a row, and each variable modality is presented under the variable. The percentages, which must be read vertically, represent the proportion of the profile members that corresponds to the particular response modality for each variable. For example, if we look at the first variable presented in Table 3, we can see in the fourth row that 25.3% of the *Serious Readers* downloaded no PDF files, 24.9% downloaded some of them and 49.8% downloaded all of them. The column after the % column indicates the results of a column proportion test. This test is applied to see which variable profiles are significantly different from one another. For example, 66.7% of the *Active-Socials* downloaded all of the PDF files associated with Week 3. This differs significantly from the proportion of *Serious Readers* (column C) and *Active-Independents* (column D), of whom respectively 50% and 46% downloaded all files. It also differs from the *Browsers* (column A) and the *Self-Assessors* (column B), but since the proportion is 0% for these, they are not taken into account in the proportion test.

Table 3

Engagement Profile Based on Learners' Behavioural Engagement Variables

	A. Browser		**B. Self-Assessor**		**C. Serious Reader**		**D. Active/In-dependent**		**E. Active-Social**		**Total**		χ^2
n	271		186		277		350		99		1183		
%	22.9%		15.7%		23.4%		29.6%		8.4%		100.0%		
PDF lecture slides viewed (module 2)													
None	99.3%	C D E	99.5%	C D E	25.3%	NS	37.4%	C E	16.2%	NS	69.7%	671	
Some	0.7%	NS	0.5%	NS	24.9%	A B	16.3%	A B	17.2%	A B	8.6%	146	
All		a		a	49.8%	NS	46.3%	NS	66.7%	A C	21.6%	366	
Total												1183	579.5 ***
Streamed videos viewed (module2)													
None	98.5%	C D E	99.5%	C D E	72.9%	E	66.3%	E	46.5%	NS	69.7%	671	
Some	1.1%	NS	0.5%	NS	18.1%	A B	19.1%	A B	31.3%	A B	8.6%	146	
All	0.4%	NS		a	9.0%	A	14.6%	A	22.2%	C D	21.6%	366	
Total												1183	213.9 ***
Required readings downloaded (module 2)													
None	100%	a	100%	a	41.9%	E	48.9%	E	19.2%	NS	75.2%	763	
All		a		a	58.1%	NS	51.1%	NS	80.8%	C D	24.8%	420	
Total												1183	439.6 ***

Test & quiz submitted (module 2)								
None	100% [a]	42.5% [E]	52.7% [E]	[a]	1.0% [NS]	42.0%	497	
1 or more	[a]	57.5% [NS]	47.3% [NS]	100% [a]	99.0% [B C]	58.0%	686	
Total							1183	709.0 ***
Test & quiz attempted. but un-submitted (module 2)								
None	100% [a]	[a]	26.4%	[a]	[a]	29.1%	344	
1 or more	[a]	100% [a]	73.6%	100% [a]	100% [a]	70.9%	839	
Total							1183	922.3 ***
Forum questions asked (module 2)								
None	100% [a]	99.5% [E]	97.8% [E]	100% [a]	48.5% [NS]	95.1%	1125	
1 or more	[a]	0.5% [NS]	2.2% [NS]	[a]	51.5% [B C]	4.9%	58	
Total							1183	505.4 ***
Forum answers contributed (module 2)								
None	99.6% [C]	99.5% [C]	91.0% [NS]	100% [a]	[a]	89.3%	1057	
1 or more	0.4% [NS]	0.5% [NS]	9.0% [A B]	[a]	100% [a]	10.7%	126	
Total							1183	923.0 ***

Note. Results are based on two-tailed tests, $p < 0.05$. For each significant pair, the key of the category with the smaller column proportion appears under the category with the larger column proportion.

***: $p < 0.001$

[ABCDE]Exponents represent "Comparisons of column proportions" tests.

[NS]There is no significant relationship.

[a]This category is not used in comparisons because its column proportion is equal to zero or one, but it does not mean that there is no significant relationship.

The Six Profiles

In our analysis, we identified six distinct profiles of behavioural engagement: Ghost, Browser, Self-Assessor, Serious Reader, Active-Independent, and Active-Social.

Ghost (n = 508, 30,0%). We identify Ghosts as potential learners who had no or almost no activity during the second week of the course. They represent a little over 30% of MOOC learners. Because Ghosts engaged in no or almost no activity in the second and third weeks, we have little to say about them. After Week 2, most of them did very few activities. In this way, they resemble Browsers.

Browser (n = 271, 16.0%). Like Ghosts, Browsers' activity level was very low. Many Browsers did not consult any resources in Week 2. Small numbers of them viewed some videos or written files or participated in the forums. No member of this group attempted or submitted any tests. They were comparable to the "lurkers" in Milligan's classification (2012).

Self-Assessor (n = 186, 11.0%). Self-Assessors are a surprising emerging profile. As the name suggests, Self-Assessors' main activities were quizzes and tests. They engaged little, if at all, with any other type of activity. Less than 1% of Self-Assessors viewed the streaming videos or PDF files, and only 0.5% of them interacted on the discussion forums. While they did not consult any resources, they all attempted quizzes and 57.5% of them completed and submitted quizzes or tests for the second module.

Serious Reader (n = 277, 16.4%). Serious Readers were much more active than Self-Assessors in terms of viewing and reading course materials; 75% of learners with this profile downloaded at least one PDF lecture slides, 58% downloaded the required reading, and 27% viewed at least one video in streaming mode. This level of activity is fairly high and video-watching activity is underestimated because only data from video streaming and not from video downloads were collected. A large proportion of Serious Readers (74%) made at least one attempt at a quiz without submitting it, and 47% completed and submitted at least one test. Serious Readers were not active on the forums, however, where their participation was almost zero.

Active-Independent (n = 350, 20.7%). Active-Independents were more active than the preceding profiles. They behaved similarly to what we would expect from students, except that they did not engage in the discussion forums. However, they engaged more with all of the other resources than Self-Assessors and Serious Readers did. Active-Independents actively engaged with quizzes and tests, with all of them attempting at least one and submitting at least one. A substantial proportion of these learners viewed and downloaded the course materials: 63% viewed at least one PDF lecture slides, 51% downloaded the required reading, and 34% watched at least one video.

Active-Social (n = 99, 5.6%). Representing only 5.6% of learners, the Active-Socials did everything that is expected from MOOC learners and resembled regular students in their behaviour. They closely resembled Active-Independents in their engagement with readings, videos, and assessments, albeit with a slightly higher level of activity. Almost all Active-Socials attempted at least one quiz or test and submitted at least one. Over 80% of Active-Socials viewed and/or downloaded at least one PDF lecture slides and one required reading, and 54% of them viewed at least one video. Active-Socials distinguished themselves from Active-Independents through their discussion forum activity. All learners in this profile answered at least one question in the discussion forums, and 52% of them asked at least one new question.

Results of Survival Analysis

Figures 2 and 3 present the results of the discrete survival analysis procedure. Figure 2 shows the percentage of learners in each profile who "survived" (did not drop out) through the entire regular MOOC period.

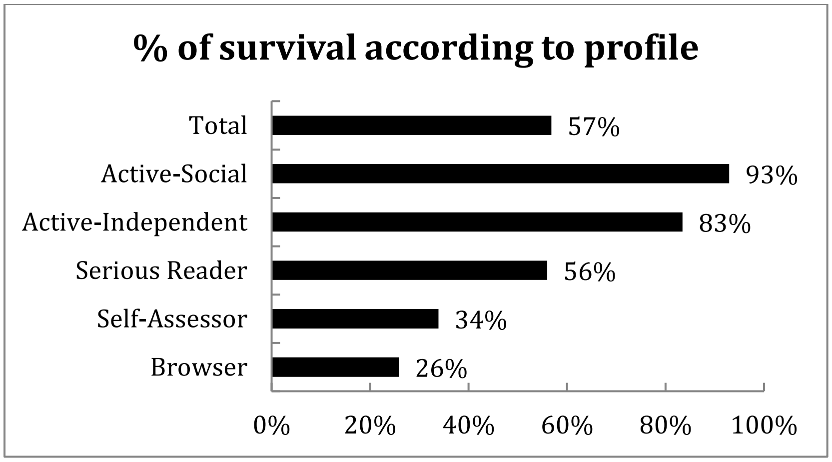

Figure 2. Results of survival analysis until week 7 for the five profiles obtained with cluster analysis (excluding Ghost).

Figure 3 shows the risk of dropping out in each week. The most active learners are represented by solid lines. The risk of dropping out is the highest in Week 2 for Self-Assessors and in Week 3 for Browsers. For Serious Readers, the proportional hazard is much lower.

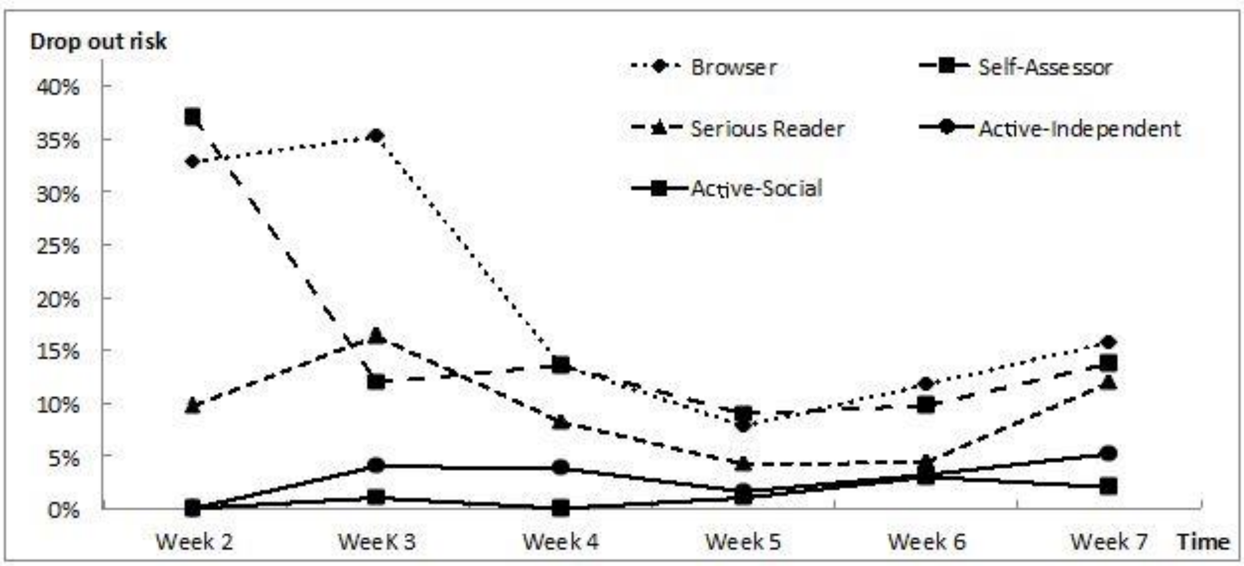

Figure 3. Time vs. dropout risk proportion for each of the participant profiles.

A log-rank test used to compare several survival curves that take into account all the follow-up time (Alberti, Timsit, & Chevret, 2005) shows significant differences between the different engagement profiles ($\chi^2(4) = 355.71$, $p < .001$).

Discussion

Our cluster analysis permitted us to differentiate among five different profiles of MOOC learners: *Browsers, Self-Assessors, Serious Readers, Active-Independents,* and *Active-Socials*, in addition to the *Ghosts* we excluded manually. Only two of our participant profiles, representing 38% of learners, engaged in ways that resembled student behaviour. Can we really therefore consider the other ones to be students? Many of those with less-engaged profiles (Browsers, Self-Assessors, and Serious Readers) survived the entire course, especially Serious Readers. Most Serious Readers stayed in the course for its whole duration but did not complete the MOOC because only a few of them took the weekly tests and the final exam (less than half actually completed the submission process for at least one quiz or one test).

In almost all of the literature on MOOC user profiles, we find some disengaged learners who start the activities but drop them very quickly, in addition to a very large number of registered learners who never show up in the course but are still included in the course statistics (Kizilcec et al., 2013; Whitmer, Schiorring, James, & Miley, 2015). This is confirmed in our analysis, but we were able to offer a more nuanced view of the profiles tagged in other research as "disengaged."

What we refer to as Browsers resemble the "Observer" category in Hill's typology (2013). These learners may not have had the intention to complete anything or do anything seriously. Even so, some Browsers may have come to the MOOC to get a glimpse of the content, see what a university course is like in that domain, or to access a subset of the content that was of interest to them.

We were puzzled by Self-Assessors. This profile represents learners who only accessed quizzes and tests, but who viewed no videos and read no files. Perhaps they used the MOOC for some sort of prior learning self-recognition. Alternatively, they might have used these profiles for cheating, i.e., trying the tests and quizzes on one account while completing the course on another. Their motivations are unclear and warrant further investigation.

The Serious Reader is an interesting profile and was quite common in our study, representing nearly one-fourth of the analysed profiles. Serious Readers were quite active compared to Browsers and Self-Assessors, and their participation seemed oriented towards print (PDF) materials. Serious Readers did not seem to care much about grades, since fewer than half of them completed and submitted tests. It is interesting to note, however, that more Serious Readers than Active-Independents (58.1% vs. 51.3%) consulted the required reading files. They may have been more intrinsically motivated than Active-Independents. Serious Readers resembled the "auditing" profile in Kizilcec et al. (2013). These users do not earn a grade and are likely to be considered failures by the institution, but are they really? Because MOOCs have fewer barriers, they permit new types of user behaviours. Whitmer et al. (2015) refer to a similar profile, which they named "Declining users." This type of behaviour is not usually seen in presence or distance courses, for which admission and registration are costly. Serious Readers' behaviour could be seen as an easier way to access the content in cases of low bandwidth, or it may simply represent a learning preference.

Users in the two most active profiles, Active-Independent and Active-Social, interacted with a variety of resources. Active-Independents look similar to the typical profile of independent learner in distance education who does most of the expected activities but has no time or interest in collaboration (Diaz & Cartnal, 1999). Most of Active-Independents (83%) stayed in the MOOC for its duration.

Discussion forum activity is what distinguishes the Active-Social from the Active-Independent, the two profiles that are the most active and have the least risk of dropping out.

The Active-Social profile support results from other studies that found that learners who are socially active, interacting with others in the discussion forums, are the most engaged and the most successful (Jiang, Williams, Schenke, Warschauer, & O'Dowd, 2014). It may be that the people who are the most motivated to participate in MOOCs (those with the highest expectancy beliefs and value perceptions) engage with a maximum of course components, but it may also be that the peer communication they derived from the discussion forums, which were almost the sole means of communication available to the learners in our study, fostered greater engagement in the course.

The classification scheme we produced from our analysis suggests that these profiles should not be defined in terms of grades or success rates, as they typically have been in MOOC research. Our results suggest that we need to rethink the names and definitions used in MOOC research, especially concerning who is a student, what persevering means, and what success is from the MOOC participant's perspective.

Conclusion

In this study, we used a systematic classification procedure (two-step cluster analysis) to create five different user profiles, based on their pattern of interaction and behavioural engagement with MOOC resources for the second module of the course, after having manually removed the Ghosts (a sixth profile, not associated with the cluster analysis). In addition to the Ghost profile, of which we can say little due to the Ghosts' lack of activity in the period analysed, our classification procedures resulted in five different profiles, corresponding to an increasing level of engagement, in the following order:

1. *Browsers*, who consulted just a few resources.
2. *Self-Assessors*, whose main, almost sole activity was taking quizzes, and tests.
3. *Serious Readers*, who consulted a fairly high proportion of course materials, particularly those in print form (PDF), but who are not as active in taking quizzes and tests.
4. *Active-Independents*, who interacted with all course resources except discussion forums.

5. *Active-Socials*, who differed little from *Active-Independents* except for their discussion forum activities.

These profiles differed from those created with traditional course success or completion in mind (Hill, 2013; Kizilcec et al., 2013; Whitmer et al., 2015).

The implications of our findings for MOOC design are important. MOOCs attract a wide variety of learners, many of whom do not adopt typical student behaviours. It is difficult to know in advance the objectives and needs of different types of learners, and therefore difficult to apply a classical top-down instructional design approach such as ADDIE (Analysis, Design, Development, Implementation, and Evaluation; Gagne, Wager, Golas, Keller, & Russell, 2005). Survival analysis showed that an early understanding of learner behaviour can help us determine learning outcomes. Knowing the different patterns of participation may help us design MOOCs not only for students, but also for other types of learners, in a way that supports diverse participation styles and encourages transitions to more engaged patterns of behaviour. MOOCs may also be an ideal ground not only for personalized learning, but also for adaptive learning tailored to the needs and objectives of different types of learners.

These results raise questions about the general tendency to consider MOOC learners as equivalent to students, to design MOOC courses as if learners will only follow the path dictated by their instructors, and to judge the success of the MOOC by the standards of for-credit courses. They shed light on the characteristics, motivations, and perspectives of learners with profiles different from students' profiles. These results suggest that the way MOOCs are designed might have to be reconsidered in order to permit and encourage these alternative forms of participation in a MOOC, but a better understanding of these profiles would be needed for that.

Our analysis and classification were carried out in the context of a single MOOC, in a very specific French-Canadian context, the EDUlib initiative (www.edulib.org). The fact that the LMS data were not available for the first week of the course is also a limitation. Because the classification procedures rely solely on traces in the LMS, analysis of these profiles is subject to interpretation. Our understanding of them may benefit from both survey data and in-depth qualitative investigations of the reasons behind each of these characteristic behaviours. More research should be conducted to determine whether these profiles hold in a larger number of MOOCs, both within the EDUlib initiative and outside it. Further research is needed on the qualitative characteristics and motivations of these diverse MOOC users.

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The PERLA Framework: Blending Personalization and Learning Analytics


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Abstract

Personalization is crucial for achieving smart learning environments in different lifelong learning contexts. There is a need to shift from one-size-fits-all systems to personalized learning environments that give control to the learners. Recently, learning analytics (LA) is opening up new opportunities for promoting personalization by providing insights and understanding into how learners learn and supporting customized learning experiences that meet their goals and needs. This paper discusses the Personalization and Learning Analytics (PERLA) framework which represents the convergence of personalization and learning analytics and provides a theoretical foundation for effective analytics-enhanced personalized learning. The main aim of the PERLA framework is to guide the systematic design and development of effective indicators for personalized learning.

Keywords: Personalization, self-regulated learning, human-centered learning analytics, learning analytics reference model, goal-oriented learning analytics

Introduction

The technology-enhanced learning (TEL) landscape is changing. Learning technologies have moved away from only institutionally managed learning systems to learning environments mediated by personal and social tools. In these environments, the challenge is to adopt personalized learning models that engage learners and give them control over the learning experience (Chatti, 2010).

Personalization is a key issue in different lifelong learning settings. In formal learning, different institutions are developing strategies to put a heavier focus on the learner. In informal learning, new trends have emerged over the last years, such as personal learning environments (PLEs), massive open online courses (MOOCs), and open educational resources (OER), where the learners are in control of their own development and learning. In professional learning, there is an increasing interest in the "Workplace 4.0." It cannot be predicted what the workplace of the future will look like, but there is a wide agreement among researchers and practitioners that the learning in the new workplace is personalized and seamlessly integrated into the work process. One of the often cited theoretical models that stresses the great importance of personalized learning at the workplace is the 70–20–10 model, in which 10% of learning at the workplace is formal through seminars, workshops, and e-learning courses; 20% is social through collaboration, coaching, and mentoring activities; and 70% is represented by personalized learning during daily work (Lombardo & Eichinger, 1996).

To support personalized learning, there is a crucial need for smart learning environments to help learners achieve their learning goals by providing mechanisms that foster awareness, recommendation, self-reflection, assessment, feedback, and motivation. In this perspective, learning analytics (LA) can play an important role by analyzing data collected from various learning environments, supporting customized activities that meet the different learners' needs and goals, as well as providing insights and understanding into how learners perform in these environments and how to best support this process.

There is an increased interest in the application of LA to promote personalized learning. For instance, Roll and Winne (2015) point out that LA offers exciting opportunities for analyzing and supporting personalized learning. According to the authors, LA can provide affordances and interventions for learners to more productively regulate their learning. Marzouk et al. (2016) state that LA, which inform learners about learning activities and respect motivational features of learning, can promote productive personalized learning. Nussbaumer, Hillemann, Gütl, and Albert (2015) also note that LA can provide personalized scaffolds that assist learners in a self-regulated manner. Winne and Baker (2013) posit that educational data mining (EDM)—a research field closely related to LA—can play a significant role advancing research on motivation, metacognition, and self-regulated learning. Further, a variety of LA dashboards and indicators were proposed to support different crucial personalized learning processes, such as awareness, self-reflection feedback, and motivation (Verbert et al., 2014; Gašević, Dawson, & Siemens, 2015; Bodily et al., 2018). However, while a range of theories and models for personalized learning have been proposed, there remain important gaps in the theory from which to conduct structured research on analytics-enhanced personalized learning. Particularly, there is a lack of theoretically sound frameworks to guide the systematic design and development of LA indicators to scaffold personalized learning.

Our vision is to blend personalization and LA to design and implement smart learning environments capable to continuously analyze and support the performance of learners, and offer them learning experiences in context. The theme and guiding focus for this work is: How can LA support personalization in different lifelong learning settings (i.e., formal, informal, professional learning) in terms of awareness, recommendation, self-reflection, assessment, feedback, and motivation? To answer this question, we focus on the middle space between personalization and LA through the discussion of the Personalization and Learning Analytics (PERLA) framework, as a learner-centered, analytics-driven conceptual framework that (1) presents crucial requirements to achieve effective analytics-enhanced personalized learning and (2) provides a guideline for designing and developing effective indicators for personalized learning.

Personalization

One of the core issues in TEL is the personalization of the learning experience (Chatti 2010). There is a crucial need to develop smart learning environments that put the learners at the center and give them more autonomy and control over the learning experience. These environments should help learners decide on and continuously shape their activities to achieve their individual goals. It is important to mention that personalization is different from adaptation. Adaptation is system-driven; the system decides what to do next. Personalization is learner-driven; the system only helps learners decide what to do next. In the following, we present the theoretical background of personalized learning, based on different theories and models.

Chatti (2010) discusses the Learning as a Network (LaaN) theory, as a learner-centered theoretical framework for understanding personalized learning. LaaN draws together some of the concepts behind complexity theory, connectivism, and double-loop learning. The author stresses that personalized learning is a complex activity that must be the product of self-organization. He further points out that connectivism misses some of the double-loop learning concepts, which are crucial for learning, such as learning from failures, reflection, and inquiry. On the other hand, double-loop learning does not recognize the power of connections and networks. According to the author, the LaaN theory starts from the learner and views learning as the continuous creation of a personal knowledge network (PKN), which is a unique repertoire of (a) tacit and explicit knowledge nodes (i.e., people and information) at the external level; and (b) one's theories-in-use at the conceptual/internal level. Theories-in-use can be seen as mental models of ourselves, others, and the environments with which we interact, formed through learning, experience, and culture. These models serve as guides to help achieve our goals (Norman, 2013). In LaaN, the result of learning is a restructuring of one's PKN, that is, an extension of one's external network with new knowledge nodes (external level) and a reframing of one's theories-in-use (conceptual/internal level).

Personalized learning requires self-organization (self-regulation). Self-regulated learning (SRL) is one of the most important areas of research within educational psychology over the last two decades. It includes the cognitive, metacognitive, behavioral, motivational, and emotional/affective aspects of learning (Panadero, 2017). SRL is generally defined as "an active, constructive process whereby learners set goals for their learning and then attempt to monitor, regulate, and control their cognition, motivation, and behavior, guided and constrained by their goals and the contextual features in the environment" (Pintrich, 2000, p. 453). Panadero (2017) provides an excellent analysis and comparison of different SRL models. Next, we outline the five most influential SRL models, with a focus on the phases and processes included in these models.

Zimmerman's (2000) SRL model is organized in three cyclical phases: forethought, performance, and self-reflection. In the forethought phase, the learners analyze the task, set goals, and plan how to reach them. In the performance phase, the learners actually execute the task. And, in the self-reflection phase, the learners evaluate how they have performed the task, which can positively or negatively influence their later performances (Zimmerman, 2000; Zimmerman & Moylan, 2009; Zimmerman, 2013).

Pintrich's (2000) SRL model emphasizes the role of motivation in SRL. It encompasses four phases: (a) forethought, planning, and activation; (b) monitoring; (c) control; and (d) reaction and reflection. Each of them has four different areas for regulation: cognition, motivation/affect, behavior, and context. The combination of those phases and areas offers a comprehensive picture on different SRL processes (Pintrich, 2000).

Winne and Hadwin's (1998) SRL model stresses the cognitive and metacognitive aspects of SRL and explains how learners' cognitive processing operates while planning, performing, and evaluating a task. The model builds on the COPES (i.e., conditions, operations, products, evaluation, and standards) to describe how learners use tactics and strategies to perform tasks and constantly monitor their activities against standards, based on four recursive linked phases: (a) definition of task: the learners generate an understanding of the task to be performed and the factors that may affect that task; (b) goals and plan(s): the learners set goals and plans for reaching them; (c) studying tactics: the strategies and actions needed to reach the goals; and (d) adaptations: long term changes in the learner's beliefs, motivations, and strategies for the future (Winne & Hadwin, 1998; Winne, 2011).

Boekaerts' (1992) first SRL model, namely, the Adaptable Learning Model, describes the dynamic aspects of SRL based on two parallel processing modes: (a) a mastery or learning mode, and (b) a coping or well-being mode. The appraisals made by the learners determine which mode they will activate (Boekaerts, 1992, 1996; Boekaerts & Niemivirta, 2000). The Adaptable Learning Model evolved later into the Dual Processing Self-Regulation model, which adds the top-down and bottom-up concepts (Boekaerts & Cascallar, 2006; Boekaerts, 2011). According to Boekaerts (2011), there are two goal pathways for self-regulation. The first is the mastery/growth pathway (or what she called top-down) that the learners activate if the task goal is congruent with their goals and needs. The second is the well-being pathway (or bottom-up) that the learners activate if they experience a mismatch between the task goals and their personal goals, and to protect their ego from being damaged. In Boekaerts' Dual Processing model, positive and negative emotions play a key role to determine which goal pathway the learners will activate.

Efklides (2011) proposes the Metacognitive and Affective Model of Self-Regulated Learning (MASRL) with an emphasis on the metacognitive, motivational, and affective aspects of SRL. In the MASRL, there are two levels. First, the Person level (also called macrolevel), represents the general learners' characteristics, such as cognitive ability, motivation, self-concept, and affect. Efklides considers the Person level to be top–down because goals are set in accordance with the learner's characteristics and the task is guided based on those personal goals. Second, the Task x Person level (microlevel) where the interaction between the task and the learner's characteristics takes place. This level is bottom-up, because the task directs and regulates the learner's actions.

The personalized learning models outlined above address different aspects of learning. However, all of them assert the goal-driven nature of personalized learning and view personalized learning as a cyclical process, composed of different phases. Although expressed using different labels, all models share three identifiable phases: (a) goal setting (forethought, task analysis, planning, activation of goals, self-motivation); (b) executing (performance, processing); and (c) evaluating (self-reflection, feedback, monitoring, controlling, appraisal, regulating, adapting, reacting; Panadero, 2017). In the next sections, we discuss in detail how the emerging research field of learning analytics can support these phases and thus promote personalized learning.

Learning Analytics

A large volume of data about learners and learning is being generated. This data is mainly traces that learners leave as they interact with various learning environments. Learning analytics (LA) focuses on the development of methods for analyzing and detecting patterns within this data, and leverages those methods to support the learning experience. Different definitions have been provided for LA. The most commonly cited LA definition which was adopted by the first international conference on learning analytics and knowledge (LAK11) is "the measurement, collection, analysis and reporting of data about learners and their contexts, for purposes of understanding and optimizing learning and the environments in which it occurs" (Siemens & Gašević, 2012).

The Learning Analytics Reference Model

Chatti et al. (2012, 2014) propose a reference model for LA that provides a systematic overview on LA and fosters a common understanding of the key components of the LA ecosystem, based on four dimensions of the LA reference model, namely:

- **What?** What kind of data does the system gather, manage, and use for the analysis? This dimension refers to the data used in the LA task. It also refers to the environments and contexts in which learning occurs.
- **Why?** Why does the system analyze the collected data? There are many objectives in LA according to the particular point of view of the different stakeholders.
- **Who?** Who is targeted by the analysis? The application of LA can be oriented toward different stakeholders with different perspectives, goals, and expectations from the LA task.
- **How?** How does the system perform the analysis of the collected data? LA applies different methods to detect interesting patterns hidden in educational data sets.

The Learning Analytics Cycle

LA is an iterative and cyclical process generally carried out in six major steps (Figure 1). These steps are iterated; that is, they are repeated over and over, with each cycle yielding more effective learning activities:

- **Learning Activities**. The LA cycle starts with a concrete learning activity, which is a crucial part for LA (Griffiths Hoel, & Cooper, 2016). A learning activity can occur in centralized educational systems (e.g., LMS) or in open and networked learning environments (e.g., social media, MOOCs, PLEs).

- **Data Collection**. LA is a data-driven approach. Collecting data from different learning environments is the foundation of the LA process. Today we have broad access to high-volume data from a variety of sources. The data can come from multiple, fragmented, often heterogeneous, formal, as well as informal, learning channels. It can also come in different formats, distributed across space, time, and media.

- **Data Storage and Processing**. The collected data then needs to be stored properly. The data can be stored in the platform that generates them (e.g., LMS) or transferred to a data warehouse (e.g., Learning Record Store). The quantity and quality of the data determine the discovery of useful patterns in the data. The data may be heterogeneous with different formats and granularity levels. In this case, a data integration step is required to match data against each other. The data may involve unnecessary attributes, and thus needs to be processed. Data processing may also be required to transform the data into an appropriate format that can be used as input for a particular LA method.

- **Analysis**. The data can then be analyzed using different analysis methods such as statistics, data mining, and social network analysis to find patterns and generate insights from the data.

- **Visualization**. The analysis results can then be represented as an indicator in a user-friendly visual form that can help to understand and interpret the results as well to infer from the data conclusions that can improve the learning process.

- **Action**. Taking actions is the primary aim of the whole LA process. These actions include intervention, self-reflection, goal or strategy adaptation, and planning of new learning activities.

Figure 1. The learning analytics cycle.

Human-Centered Learning Analytics

LA aims at optimizing the learning achievement, as well as the learning process. In the ideal case, LA is a continuous movement from data to analysis to action to learning. While several studies have revealed the importance of using and analyzing data, few have highlighted how the move will be made from analyzing the data to optimizing the learning. Consequently, we are still lacking evidence that LA is having any positive impact on learning (Ferguson & Clow, 2017; Gašević et al., 2015). This hinders the adoption of LA at scale in schools, universities, and workplaces. The solution is human-centered LA (HCLA), an approach that emphasizes the human factors in LA and truly meets the user's needs. User involvement in the design, deployment, and evaluation of LA is a key requirement to serve the needs of different users with diverse goals in an effective way. It is vital to engage the various LA stakeholders (learners, teachers, institutions, researchers, developers, etc.) in the LA process. Especially, the learner should take an active role in the LA process, if LA tools are to serve the intended objective of improving learning.

Adopting a HCLA approach to support personalized learning requires that LA researchers and developers use qualitative studies where they go to the learners, observe their activities, and try to understand what they really need. Thereby, it is important to have a good understanding of the requirements for a successful analytics-enhanced personalized learning system as well as to find the right set of questions to ask in the study in order to generate effective indicators for personalized learning. To get at this, we present and discuss the PERLA framework as a theoretical foundation for effective analytics-enhanced personalized learning.

The PERLA Framework

The Personalization and Learning Analytics (PERLA) framework (Figure 2) is an HCLA conceptual framework to effectively support personalization in different lifelong learning settings. The main aim of the PERLA framework is to provide LA researchers and developers with a systematic way to design and develop indicators to support personalized learning, by giving answers to the following questions:

1. What are the requirements that need to be addressed in order to design and develop effective indicators for personalized learning? and
2. Which indicators are needed to support personalized learning?

Figure 2. The PERLA framework.

Requirements

The inner part of the PERLA framework represents the conceptual and technical requirements that need to be addressed in order to design and develop an effective analytics-enhanced personalized learning environment. These requirements are mapped to the four dimensions of the LA reference model. In the following, we discuss these requirements in some detail by taking a learner perspective.

LA in open learning environments. Learning is increasingly taking place in open and networked learning environments (e.g., social media, MOOCs, PLEs). These environments capture and store large data sets from distributed learners' activities that can provide insight into the learning processes. Further, these environments house a wide range of learners with diverse interests and needs. Understanding how learners are engaging with learning materials and peers by analyzing their learning activities is a crucial step towards smart learning environments that best meet the needs of different learners through timely personal feedback. In addition, due to the open nature of the new learning environments, learners are often overwhelmed with the flow of knowledge. LA can help to form the basis for increased awareness and effective recommendation by supporting learners in getting knowledge in context from a wide range of sources. It is important to stress that, as learners' activities are ubiquitous, it is crucial to take account of the context in which the data is collected in order to avoid misinterpretations of LA results.

Big LA. A large volume of data—referred to as big data—about learners and learning processes is being generated from learners' activities across various learning environments. Generally, the literature presents a number of fundamental characteristics associated with the notion of big data including volume (amount of data), velocity (speed of data in and out), variety (range of data types and sources), veracity (biases, noise, and abnormality in data generated from various sources and questions of trust and uncertainty associated with the collection, processing, and utilization of data), and value (ability of data in generating useful insights and benefits; Daniel & Butson, 2014). Following these characteristics, data from learning processes can be characterized as big data (Chatti et al., 2017):

- Volume - A single online learning platform can generate thousands of transactions per learner.
- Velocity - The data that is collected should be processed and analyzed in real time to provide accurate and timely feedback.
- Variety - The data that needs to be analyzed comes from a variety of sources, such as LMS log files, assessment scores, social web, etc.
- Veracity - Quality of data, privacy, and security issues need to be resolved in order to build trust and achieve legitimacy in the LA process.
- Value - The main aim of LA is to harness the educational data to provide insight and improve the learning processes.

Thus, there is a need to leverage big data methods, such as NoSQL databases, stream processing, predictive analytics, and visual analytics to develop a better understanding of the learner activities in open and networked learning environments. To stress, however, that the lack of adoption of LA among learners is not due to technological aspects related to the volume, velocity, and variety of educational data but more to pedagogical ones related to veracity and value. In practice, learners still do not see the added-value of LA. It is thus essential to promote learner-centered LA approaches that see learners as the central part of the LA practice and involve them in all the LA steps. Learner involvement is the key to a wider acceptance and adoption of LA.

Multimodal LA. Multimodal LA goes beyond logged-data gained from the direct interactions between learners and learning management systems by combining them with diverse other multimodal learning activity data, such as audio, video, writing, gestures, postures, facial expressions, gaze, and other biometrics captured via biosensors to assess the learning activities and offer new insights into understanding and optimizing learning activities in both digital and physical world scenarios (Blikstein, 2013; Ochoa, 2017). In particular, multimodal data traces can be useful to gain meaningful insights into personalized learning processes.

Context modeling. Context is crucial to achieve personalized learning. Context can be categorized into two types: extrinsic and intrinsic context (Thüs et al., 2012). The extrinsic context deals with the learner's current state of the environment. It may be time, location, relation to other learners, or the current learning activity. Intrinsic context information deals with the inside of a learner, such as the learner's level of attention or the level of motivation. A big challenge to tackle here is context modeling. A context model should reflect a complete picture of the learner's context information. The aim is that the extrinsic and intrinsic context information gathered from different learning channels would be fed into a personal context model, which would build the base for context-aware LA solutions. Different specifications for activity data modeling have been introduced in the LA literature. The most prominent ones to date are the Experience API (xAPI) and IMS Caliper. These data models, however, are event-centered rather than user-centered, which is required to support personalized learning experiences. Moreover, they do not preserve the semantic meaning of the stored events (e.g., the verb-ambiguity problem in xAPI), which could lead to misinterpretations and inaccurate LA results. Further, they do not provide mechanisms to deal with the privacy issue in LA.

Goal-oriented LA. It is important to follow a goal-oriented LA model that tailors the LA task to the learner's goals. There is a need to adopt a learner-in-the-loop LA approach that engages learners in a continuous exploratory and inquiry-based LA process, by supporting them in setting goals, formulating questions, and self-defining the indicators to answer these questions. This would also make the analytics process more transparent, enabling learners to see what kind of data is being used and for which purpose (Muslim et al., 2017).

Lifelong and open learner modeling. Learner modeling is the cornerstone of personalized learning. The six most popular and useful features in learner modeling include the learner's knowledge, interests, goals, background, individual traits, and context (Brusilovsky & Millan, 2007). The capacity to build a detailed picture of the learner across learning contexts would provide a more personalized learning experience. A big challenge to tackle here is lifelong learner modeling. A lifelong learner model is a store for the collection of learning data about an individual learner. Lifelong learner modeling is the continuous collection of personal data related to a learner. It is an ongoing process of creating and modifying a model of a learner, who tends to acquire new or modify his or her existing knowledge, skills, or preferences continuously over a longer time span (Kay & Kummerfeld, 2011). In order to achieve appropriate lifelong learner modeling, several issues have to be taken into account, including questions about integration, interoperability, reusability, extensibility, and privacy. Another important concept is open learning modeling based on user interfaces that enable refection, planning, attention, and forgetting, that can be accessed by learners to control, edit, update, and manage their models (Bull & Kay, 2016). This is important to build trust and improve transparency of LA.

Open assessment. Personalized learning requires new assessment models to recognize and evaluate self-directed and lifelong learning achievements in increasingly open and networked learning environments. Open assessment is an umbrella term for different assessment methods, such as e-assessment, self-assessment, peer-assessment, and feedback. It is an agile way of assessment where anyone, anytime, anywhere, can participate towards the assessment goal. Open assessment is an ongoing process across time, locations, and devices where everyone can be assessor and assessee. LA has the potential to support open assessment by giving timely and personalized feedback in context, providing an explanation on how and why a feedback was given, validating peer-assessment, and visualizing the learning achievements to support awareness, trigger self-reflection, and promote self-assessment.

Privacy-aware LA. Privacy is a big challenge in LA. This challenge is further amplified when learner data is collected from various sources. It is crucial to build privacy into the LA solutions right from the very beginning. Several frameworks are proposed in the literature with guiding principles for privacy-aware LA. These frameworks share the focus on two major principles, namely transparency and learner control over the data. Transparency is vital to drive forward the acceptance of LA and thus should be applied across the complete LA process, without exceptions. This means that at all times, there should be easily accessible and detailed documentation of how is the data collected, who has access to the data, which analytics methods are applied to the data, how long is the data valid and available, the purposes for which the data will be used, under which conditions, and which measures are undertaken to preserve and protect the identity of the learner (Pardo & Siemens, 2014; Slade & Prinsloo, 2013). Further, it is crucial to give learners full control over their data by letting them decide on what kind of data is being used for which purpose. This is important to build trust in LA.

LA evaluation. In analytics-enhanced personalized learning scenarios, it is important to investigate user-centered, mixed-method evaluation approaches that combine both quantitative and qualitative evaluation methods. Further, it is crucial to go beyond the usability evaluation of the LA tool to measure its impact on learning. Usability of LA tools is just the tip of the iceberg and is relatively easy to evaluate. The challenge is to investigate how LA could impact personalized learning and how this could be evaluated. Measuring the impact of LA tools is a challenging task, as the process needs long periods of time as well as a lot of effort and active participation from learners with different goals.

Human-centered design. For the development of usable and useful LA tools for personalized learning, it is vital to adopt a human-centered design approach that starts with a good understanding of users and the needs that the design is intended to meet. Human-centered design is the key to learner acceptance of LA solutions. Learners should be actively involved in the design process, not just mere data subjects and recipients of interventions and services (Slade & Prinsloo, 2013). Moreover, human-centered design principles and guidelines should be taken into account. Important characteristics of good design are discoverability (what actions are possible and where and how to perform them), understanding (what do the system and all the different controls and settings mean), and feedback (immediate and informative information about the impact of the action). Good design also requires good communication, especially from LA tool to learner, indicating for instance what actions are possible and what is happening (Norman, 2013). Appropriate visualizations can make a significant contribution to understanding the large amounts of educational data. Statistical, filtering, and mining tools should be designed in a way that can help learners achieve their analytics goals without the need for having an extensive knowledge of the techniques underlying these tools.

Embedded LA. LA is most effective when it is an integrated part of the learning environment. It is important to embed LA tools into the standard learning toolsets of the learner. Moreover, effective LA tools are those that minimize the time frame between analysis and action. In general, teachers use dashboards to monitor the learning activities in their courses. For learners, however, it is more effective to follow an embedded LA approach by implementing small LA applications in context to give useful information and feedback at the right place and time.

Indicators

The requirements outlined in the previous section need to be taken into consideration when designing and developing indicators for personalized learning. The question that might be raised now is: Which indicators are needed to support personalized learning? It is obvious that in a personalized learning context, the set of required indicators is unpredictable. However, the different phases of the personalized learning process can provide a systematic way to categorize these indicators.

Personalized learning is a cyclical process, composed of three general phases. In his classic book *The Design of Everyday Things*, Norman (2013) discusses seven stages of action that provide a guideline for developing usable and understandable new products or services, following a human-centered design (HCD) approach. By associating the typical three phase personalized learning process and Norman's seven stages of the action cycle, the personalized learning process can be modeled as a cyclical seven stages activity, as shown in Figure 3 as well as the outer part of the PERLA framework (Figure 2). In detail, there are three major phases to a personalized learning activity: goal setting, executing, and evaluating. The execution phase is further subdivided into three stages that follow from the goal: plan, specify, and perform. The evaluation phase is further broken down into three stages: perceive, interpret, and compare.

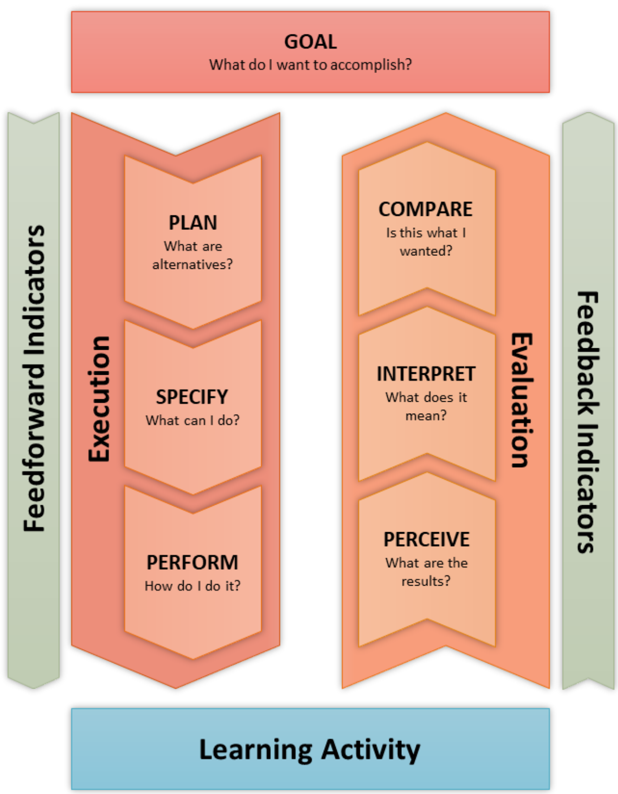

Figure 3. The seven stages of the personalized learning activity cycle.

The personalized learning activity cycle starts from the top with the learning goal (goal) and then goes through the three stages of execution: planning the possible learning activities to achieve those goals (plan), specify a learning activity path (specify), and perform the learning activity (perform). The cycle then goes through the three stages of evaluation: perceiving the results of the learning activity (perceive), trying to make sense of it (interpret), and comparing the learning outcome with the goal (compare). It is important to stress that most personalized learning activities require multiple feedback loops in which goals lead to subgoals, and the results of one activity are used to trigger further ones.

Each of the seven stages represents a possible question to ask towards a personalized learning activity. The seven-stage personalized learning activity cycle provides a useful tool for guiding the design of indicators for personalized learning. The role of LA is to help learners by conveying the information required to answer the learner's question at each stage of the execution and evaluation phases through appropriate indicators. Indicators that provide information that helps answer questions of execution (the left side of Figure 3) are *feedforward indicators*. These include indicators for awareness and recommendation. Indicators providing information that aids in answering questions of evaluation (the right side of Figure 3) are *feedback indicators*. These include indicators for monitoring, self-reflection, assessment, feedback, and motivation. The use of appropriate indicators at each stage enhances the overall personalized learning process. In the following, we summarize the questions related to the stages of the execution and evaluation phases along with the description of the indicators needed to answer these questions:

- Plan (What are alternatives?): Provide information needed to understand how the learning system is supposed to be used as well as what the different features mean.

- Specify (What can I do?): Provide information to help learners decide on the appropriate learning activity path.

- Perform (How do I do it?): Provide information on best strategies in order to perform a task in an effective and efficient way.

- Perceive (What are the results?): Provide information to communicate the results of the performed tasks and the current state of the learning activity.

- Interpret (What does it mean?): Provide information to help learners understand the results and the impact of the learning activity in context.

- Compare (Is this what I wanted?): Provide information about progress towards goals.

Table 1 shows an example of the seven stages of the personalized learning activity cycle in action.

Table 1

Applying the Seven Stages of the Personalized Learning Activity Cycle to Generate Indicators in a MOOC Scenario

	Stages	Indicators	Indicator objectives
	Goal: Active participation in the MOOC • What do I want to accomplish?	• Top 10 contributors in the MOOC.	Motivation
Execution	**Plan** • What are alternatives?	• Overview of activities in the different collaboration modules of the platform (discussion forums, peer- reviews, annotations, etc.).	Awareness
Execution	**Specify** • What can I do?	• Most active threads in discussion forums. • Most annotated learning resources. • Most discussed topics. • Reminder for peer-review deadlines. • Newsfeed.	Recommendation Awareness
Execution	**Perform** • How do I do it?	• Show top rated annotations to be used as reference.	Recommendation
Evaluation	**Perceive** • What are the results?	• Statistics on performed collaboration activities (annotations, peer-reviews, posts in discussion forums, ratings, etc.).	Monitoring
Evaluation	**Interpret** • What does it mean?	• Clustering/classification of participants based on their activities (number of posts, ratings, peer-reviews, annotations, etc.). • Show position in the social network based on the collaboration activities.	Self-reflection Feedback Assessment
Evaluation	**Compare** • Is this what I wanted?	• Scale showing contribution status against the specified goal.	Motivation

The seven stages of the personalized learning activity cycle provide a guideline for developing effective qualitative user studies attempting to understand what learners really need from LA. Rather than asking learners about their abstract expectations of LA indicators, it is more effective to observe (or if not possible ask about) what they do at each of the seven stages and then co-generate ideas for indicators that can support each stage. These indicators will be useful because they do fit real needs. This is at the heart of human-centered learning analytics.

Conclusion

In technology-enhanced learning (TEL) research, there has been a continuous interest in smart learning environments that start from the learner and provide him or her a personalized learning experience in context. In this paper, we stressed that the emerging research field of learning analytics (LA) can be a valuable tool to support personalized learning in terms of awareness, recommendation, self-reflection, assessment, feedback, and motivation. We further demonstrated that LA can be grounded in theoretical research on personalized learning and presented the PERLA framework that aims at blending personalization and LA toward an effective analytics-enhanced personalized learning experience. The PERLA framework is an umbrella to anchor crucial requirements that affect personalized learning, offering, at the same time, a comprehensive framework that provides LA researchers and developers with a systematic way to design and develop indicators to support personalized learning. This work makes a significant contribution to TEL research because it lays down a theoretical foundation that can guide the design of analytics-driven smart learning environments in different lifelong learning contexts and allow future empirical works to be placed within a common framework.

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OER Mainstreaming in Tonga

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Abstract

In the race towards achieving the Education 2030 agenda, open educational resources (OER) act as a key enabler for sustainable development goal 4 (SDG4). Leading to the 2014 Regional Focal Points Meeting, Commonwealth of Learning's (COL) Focal Point for Tonga had identified top priorities for the country where COL can further support the national agenda till 2021. Based on these needs, the Strategic OER Implementation Project in Tonga was initiated by COL in response to a request by the Ministry of Education and Training (MET) of Tonga. The project aims to assist MET in (a) developing a framework for fully utilizing the new fiber optic network infrastructure to deliver online learning to Tongans distributed in the 45 islands; and (b) improve the chances of sustainable livelihoods for Tongan youth by training them in life skills tailored to higher education and employment opportunities in Australia and New Zealand. This paper details the use of the horizontal framework for OER mainstreaming and the OER mainstreaming checklist within this project. The novelty of this project is its approach to mainstreaming OER at an institution in a systemic manner. The contribution this paper makes is to provide a proven plan for sustainable OER mainstreaming in a development setting.

Keywords: open education, open educational resources, OER, OER mainstreaming, OER mainstreaming checklist, OER policy, Tonga

Introduction

The Kingdom of Tonga, unique among Pacific nations, never completely lost its indigenous governance. In 1845, the archipelagos of islands were united into a Polynesian kingdom, then became a constitutional monarchy in 1875, and a British protectorate in 1900. In 1970, Tonga withdrew from the protectorate and joined the Commonwealth of Nations remaining the only monarchy in the Pacific. A major political reform took place in 2010 where the King relinquished his powers and allowed the people to elect 17 representatives of the people. These representatives, in turn, select the Prime Minister. This reform was implemented in 2011 when the first Prime Minister was elected by the people.

Tonga consists of approximately 170 islands scattered across an area of the central Pacific Ocean, to the east of Fiji, although only 45 islands are inhabited (Kaitani & McMurray, 2006). The country has a population of 106,479 with a migration rate of -17.8 migrants/1000 population (Index Mundi, 2018). Tonga's economic freedom score is 63.1, which makes it the 76th freest in 2018. It is also ranked 17th among 43 countries in the Asia–Pacific region with an overall score above the regional and world averages (The Heritage Foundation, 2018). The literacy rate of Tonga, who can read or write Tongan and/or English, is 99.4% (Index Mundi, 2018).

The Commonwealth of Learning (COL) is an intergovernmental organization created by Commonwealth Heads of Government to promote the development and sharing of open learning and distance education knowledge, resources, and technologies. Hosted by the Government of Canada and headquartered in Burnaby, British Columbia, Canada, COL is the world's only intergovernmental organization solely concerned with the promotion and development of distance education and open learning. COL actively helps developing nations improve access to quality education and training (Commonwealth of Learning, 2018).

In the lead-up to the 2014 Regional Focal Points Meeting, COL's Focal Point for Tonga had identified top priorities for the country where COL can further support the national agenda until 2021 (Commonwealth of Learning, 2015). As a follow-up, COL, through the Open Educational Resources for Skills Development (OER for SD) project, looked to focus on the areas of: (a) training teachers to develop online materials at higher education levels; (b) building capacity to upskill teachers in using information and communication technologies (ICTs) in teaching and learning; and (c) establishing new physical infrastructure in the Tonga Institute of Higher Education (TIHE) and the Tonga Institute of Education (TIOE).

The TIHE is a tertiary education branch of the Ministry of Education and Training (MET) of Tonga. Its umbrella spans several programs that focus on educating students in a variety of professional aptitudes and vocations (The Tonga Institute of Higher Education, 2018). TIOE strives to provide relevant teacher education programs to contribute to producing Tongan teachers who will meet the needs and expectations of its stakeholders (Ministry of Education and Training, 2017). Based on the priorities identified, this paper details the mainstreaming of open educational resources (OER) at the TIHE and TIOE under Phase 1 and Phase 2 of the Strategic OER Implementation Project in Tonga. The novelty of this project is its approach to mainstreaming OER at an institution in a systemic manner. The contribution this paper makes is to provide a proven plan for sustainable OER mainstreaming in a development setting.

Methodology

In the race towards achieving the Education 2030 agenda (UNESCO, 2015), OER act as a key enabler for sustainable development goal 4 (SDG4). The Ljubljana Action Plan defines OER as:

> Toward the realization of inclusive Knowledge Societies, Open Educational Resources (OER) support quality education that is equitable, inclusive, open and participatory. OER are teaching, learning and research materials in any medium – digital or otherwise – that reside in the public domain or have been released under an open license that permits no-cost access, use, adaptation and redistribution by others with no or limited restrictions. Open licensing is built within the framework of intellectual property rights as defined by relevant international conventions to respect the authorship of work. OER are a strategic opportunity to improve knowledge sharing, capacity building and universal access to quality learning and teaching resources. (UNESCO, 2017, p. 1).

In 2016, COL's Kuala Lumpur Declaration (Commonwealth of Learning, 2016a) recommends the mainstreaming of OER use by developing strategies and policies at governmental and institutional levels to enhance quality while potentially reducing the cost of education. However, in 2017, the Ljubljana Action Plan identifies five main challenges to mainstreaming OER which are: (a) the capacity of users to find, re-use, create, and share OER; (b) language and cultural issues; (c) ensuring inclusive and equitable access to quality OER; (d) changing sustainability models; and (e) developing supportive policy environments. In response, COL recommends several concrete actions to mainstream OER (Commonwealth of Learning, 2017) which are: (a) develop and implement an institutional OER policy; (b) create institutional mechanisms for OER quality assurance; (c) recognize faculty contribution to OER; (d) institute an award for best OER; (e) create an institutional repository for OER; (f) regularly organize capacity-building programs for teachers; (g) conduct and support research on OER; (h) collaborate with other institutions to avoid reinventing the wheel; (i) take steps to improve the institution's ICT infrastructure; and (j) develop accessible OER. To guide the implementation of these recommendations in a practical scenario, Abeywardena (2017) proposes the horizontal framework for OER mainstreaming (Figure 1) and the OER mainstreaming checklist (Table 1). The methodology of this project is based on this framework and checklist proposed by Abeywardena.

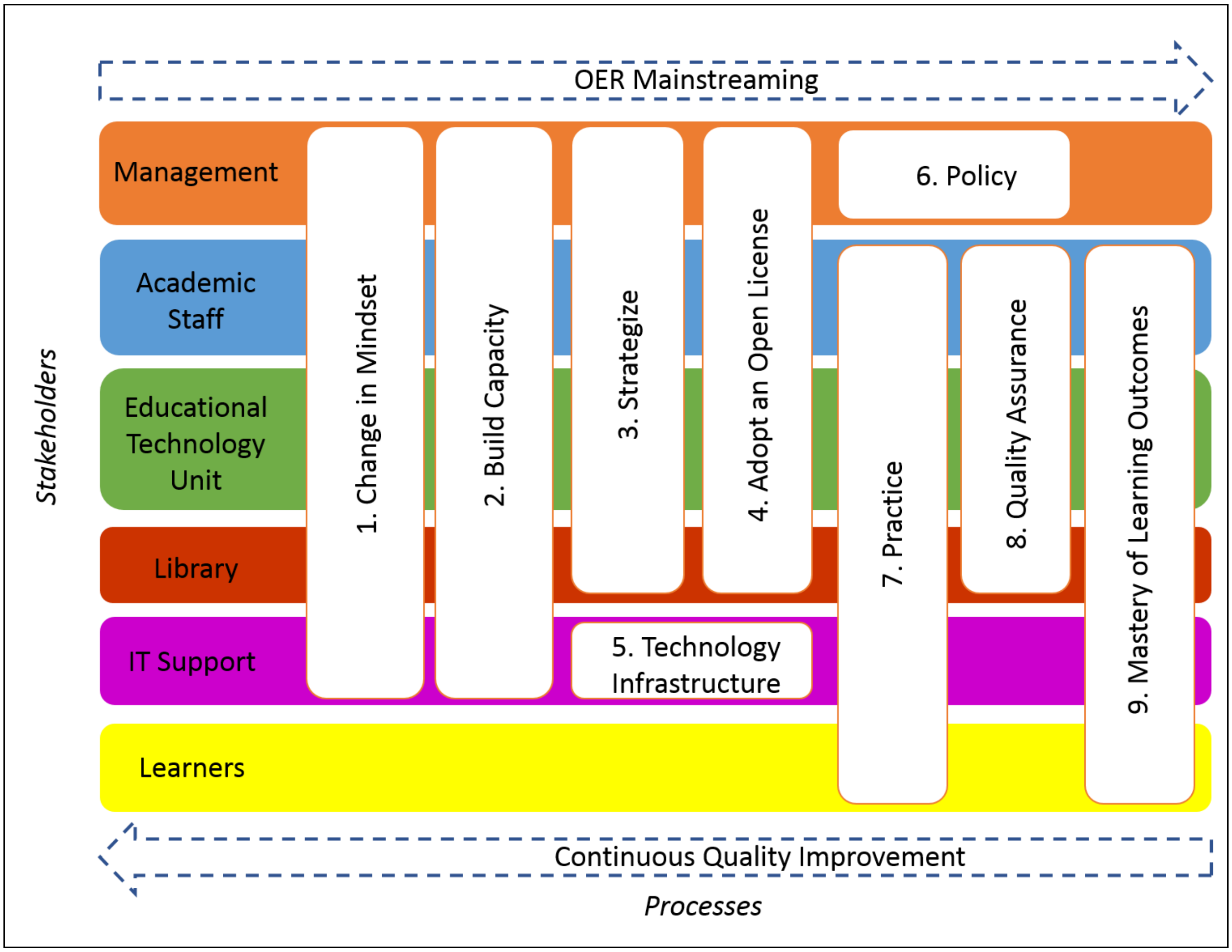

Figure 1. Horizontal framework for OER mainstreaming in an institution. Adapted from "An empirical framework for mainstreaming OER in an academic institution," by I.S. Abeywardena, 2017, *Asian Association of Open Universities Journal, 12(2)*, p. 232. CC BY 4.0.

Table 1

OER Mainstreaming Checklist

Process	**Stakeholder**						**Mainstreaming tasks**
	Management	**Academic staff**	**Educational technology unit**	**Library**	**IT support**	**Learners**	
1. Change in mindset	✓	✓	✓	✓	✓		1.1 Decided to reuse and produce OER? 1.2 Changed mindsets: Open is Good?

2. Build capacity	✓	✓	✓	✓	✓		2.1 What are OER? 2.2 What are the types of OER? 2.3 What is open and accessible? 2.4 What is copyright and open licensing? 2.5 How to create, reuse, revise, and remix OER using FOSS?
3. Strategize	✓	✓	✓	✓			3.1 Identified the need for OER in terms of cost, quality and access? 3.2 Identified short, medium and long-term goals for OER? 3.3 Identified representatives from each stakeholder group for task teams?
4. Adopt an open license	✓	✓	✓	✓			4.1 How open is the institution? 4.2 How open are current materials? 4.3 Allow commercial use? 4.4 Enforce Share-Alike? 4.5 Allow derivatives? 4.6 No Rights Reserved?
5. Technology infrastructure					✓		5.1 Have sufficient technology infrastructure? 5.2 Have sufficient technical personnel? 5.3 Invest in cloud based technologies and services? 5.4 Setup a FOSS repository?
6. Policy	✓						6.1 Adopted an Institutional OER policy? 6.2 Updated HR policies to recognize and reward OER activities? 6.3 Recognize additional work in OER? 6.4 Made OER a Key Performance Indicator (KPI)? 6.5 Developed a system for remuneration and encouragement? 6.6 Mainstreamed open educational practices?
7. Practice		✓	✓	✓		✓	7.1 Which courses to make OER? 7.2 Developed a systematic approach to OER content development? 7.3 Formed course development teams? 7.4 Identified useful OER for course development? 7.5 Developed/adapted course successfully? 7.6 Developed pilot OER? 7.7 Added metadata and built a catalogue?
8. Quality assurance (QA)		✓	✓	✓			8.1 Formed an OER QA Team? 8.2 Is this content suitable for our learners? 8.3 Is it pedagogically sound? 8.4 Is it open and accessible? 8.5 Do we have tech support?

9. Mastery of learning outcomes		✓	✓			✓	9.1 Are assessments correctly mapped against the learning outcomes? 9.2 Learner exceeds the requirement, meets the requirement or needs improvement?

Note. Adapted from "An empirical framework for mainstreaming OER in an academic institution," by I.S. Abeywardena, 2017, *Asian Association of Open Universities Journal, 12(2)*, p. 233. CC BY 4.0.

The Strategic OER Implementation Project in Tonga is a two-year long intervention by COL in response to a request by the MET of Tonga. The four phases of the project (Figure 2) aim to assist MET (a) to develop a framework for fully utilizing the new fiber optic network infrastructure enabling the delivery of online learning to Tongans distributed in the 45 islands; and (b) to improve the chances of sustainable livelihoods for Tongan youth by training them in life skills tailored to higher education and employment opportunities in Australia and New Zealand.

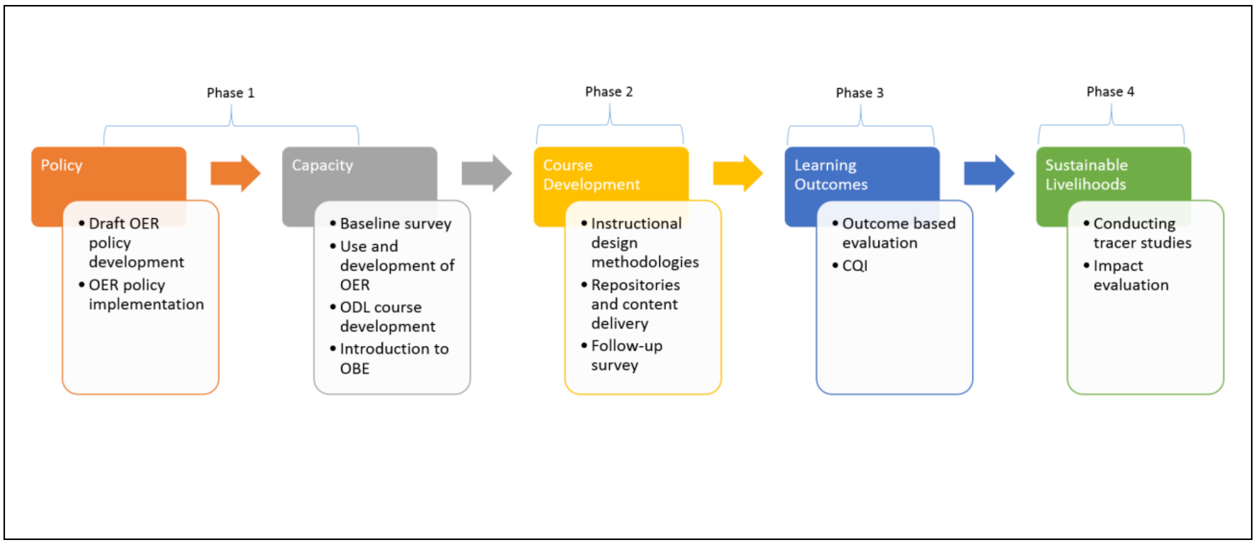

Figure 2. Project flowchart for the strategic OER implementation project in Tonga.

The activities, outputs and expected outcomes of the project are summarized in the project evaluation chart (Table 2). The various stages of the project model that correspond to the key stakeholders are detailed in Figure 3.

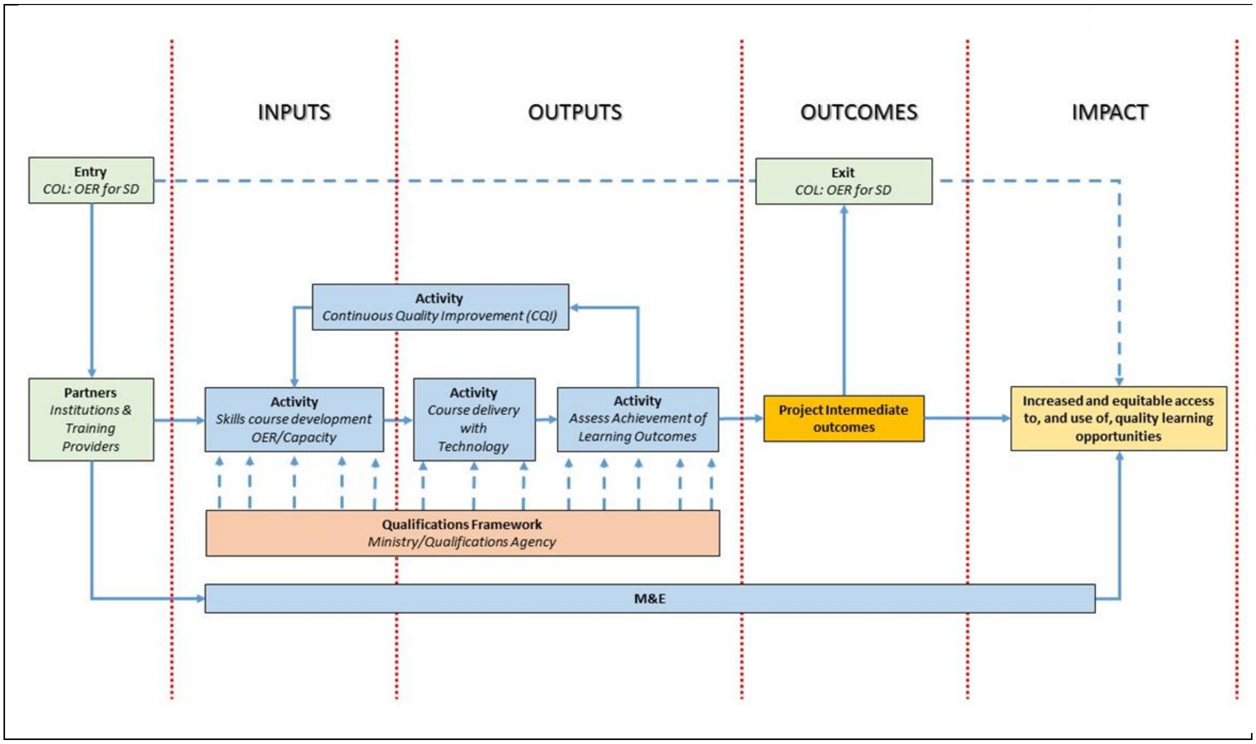

Figure 3. OER for skills development project model.

Table 2

Project Evaluation Chart for the Strategic OER Implementation Project in Tonga

Project phase	**Outcome**	**Activity**	**Indicator and data source**	**Baseline**	**Target**
Phase 1 (Feb – Jun, 2017)	Outcome #1: Strategic implementation of OER practices at TIOE and TIHE through Institutional OER policies under the purview of the MET.	Consultation, advocacy and capacity building for policymakers to develop and implement OER policy frameworks.	Number of institutional OER policies developed • *Data source: institutional documents.*	0	2 (or one national policy depending on protocol).
	Outcome #2: TIOE and TIHE integrate OER in teaching and learning effectively.	Capacity building in use and development of OER in teaching and learning.	Percentage of teachers who use and develop OER for teaching and learning • *Data source: baseline survey, follow-up surveys and portfolio evidence.*	< 5%	25%

Phase 2 (Jun – Dec, 2017)	Outcome #3: TIOE and TIHE develop good quality learning materials and share as OER.	Support OER course development.	Number of courses developed using OER and as OER • *Data source: course materials available on institutional/COL repositories and portfolio evidence.*	0	4
Phase 3 (Jan – Jun, 2018)	Outcome #4: Satisfactory achievement of course learning outcomes by learners viz. the OER courses developed.	Support implementation of outcome based education (OBE), outcomes based evaluation and continuous quality improvement (CQI) strategies.	Percentage of learners who achieve 50% or higher of the course learning outcomes. • *Data source: summative and formative assessment results of learners.*	unknown	80%
Phase 4 (Jun, 2018 – Jun, 2019)	Outcome #5: Improved sustainable livelihoods.	Support tracer studies to approximate the impact of OER.	Number of learners who have been exposed to OER and have been able to achieve sustainable livelihoods. • *Data source: tracer study results.*	unknown	200

Results

Following an official visit to Tonga by the Vice President of COL in September 2016, a few key areas were identified where COL could assist the MET. This included: (a) building capacity in OER and developing OER based courses; (b) supporting MET in developing a policy framework for OER; and (c) strengthening online learning with a focus on the Moodle learning management system (LMS). To address these needs in a structured and holistic manner which will ensure medium-term impact and sustainability, COL and the MET entered into a contribution agreement in January 2017 under the Strategic OER Implementation Project in Tonga (Table 2). Phase 1 of the project, which took place from February to June 2017, saw the drafting of a national OER policy and capacity building in OER reuse in course design. Phase 2 of the project, from June to December 2017, focused on the development and online delivery of four pilot OER courses in the field of life skills.

Phase 1

Consultation, advocacy, and capacity building for policymakers to develop and implement OER policy frameworks. In collaboration with policymakers of the MET, TIHE, and TIOE, strengthened by legal staff at the MET, COL supported the development of a draft national OER policy for government higher education institutions of Tonga based on COL's Institutional OER Policy Template (Commonwealth of Learning, 2016b). The draft policy is currently under review by the MET for adoption.

Capacity building in use and development of OER in teaching and learning. A five-day intensive hands-on capacity building workshop was conducted by a COL expert in June 2017 with the participation of 34 full time academic staff, including some members of the senior management, from TIOE and TIHE. The workshop program was developed to address the major skills gaps identified in the *Open Educational Resources in the Commonwealth 2016* report (Phalachandra & Abeywardena, 2016), which include: (a) teachers' use of OER; (b) perceptions of OER; (c) reuse, revision, remixing, and redistribution; (d) challenges of using OER; (e) adopting and sharing materials; and (f) locating and retrieving OER. The key outputs of the workshop are: (a) identifying specific need for OER at the two institutions; (b) capacity building in the use of OER in course development; (c) training in instructional video production for online courses and MOOC; (d) skills development in the use of free and open source software (FOSS) in repurposing multiple OER formats; (e) introduction to the Moodle LMS; and (f) training in the use of COL's course development resources such as the course blueprint template, course development template, and the external course evaluation toolkit (Smulders, 2016). Based on a follow-up survey of the participants (n=26), only four participants (15.38%) hadn't used OER since undergoing training (Figure 4).

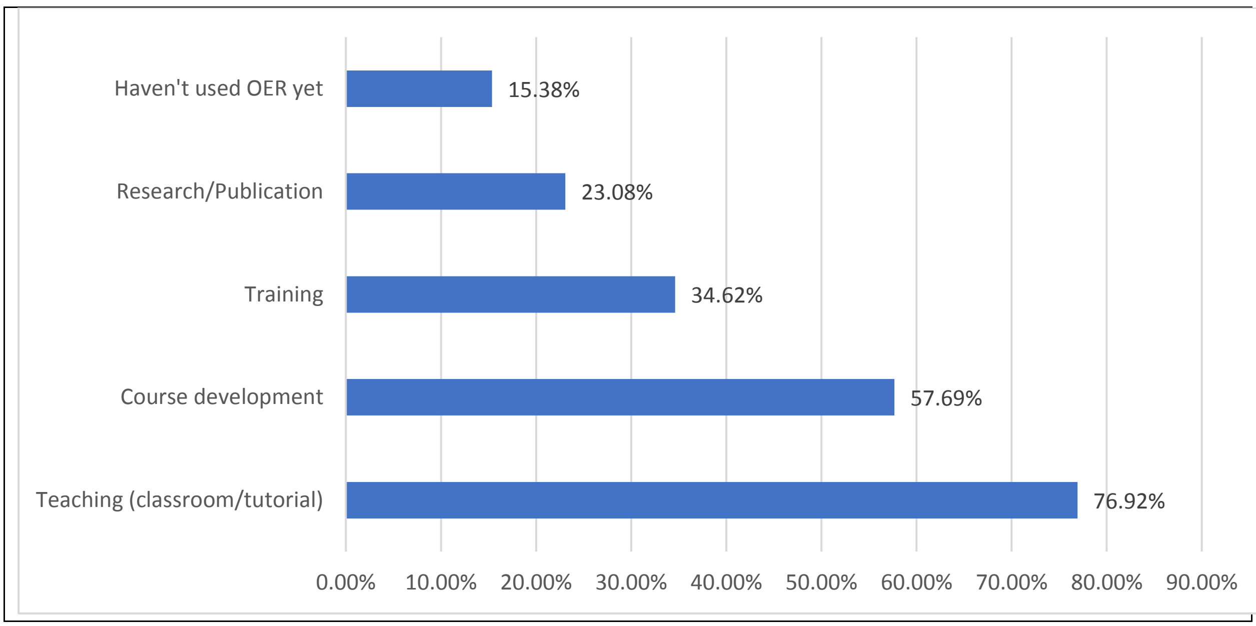

Figure 4. Results of follow-up survey on OER use.

Further, the workshop was used as a successful field test of the 12-part video course on *Instructional Video Production for Teaching and Learning* (The Open University of Sri Lanka, 2017) and the *Creating and Repurposing OER Using FOSS: A How-To Guide for Teachers and Learners* (Kasinathan & Ranganathan, 2017). The participants followed the course on video production to plan, script, and shoot instructional videos on various topics. Then they used the toolkit on repurposing OER using FOSS to edit sound and video resulting in 5-10 minute instructional video clips. The creation of these videos was done from start to finish over two afternoon sessions. These sessions resulted in upskilling the teachers to develop more video based material on their own using accessible technologies such as smart phones and FOSS. The participants said that they felt "surprised and empowered by the new skills they have gained" and would utilize the medium of video more in their content delivery.

Phase 2

Support OER course development. Further to the aims of the project stated in the methodology section, four pilot courses on life skills were proposed to be developed and delivered online using the Moodle LMS. The courses *TIHE WS200 Working and Social Skills* and *TIHE TL100 Thinking and Learning Skills* have been offered in the first semester of 2018 whereas *TIOE ITT101 Information Technology* and *TIOE RP101 Restorative Practices* will be offered in the second semester of 2018.

The course development process was approached in three inter-related stages. First, four independent teams were formed with 4-6 teachers each tasked with completing the course development. The teams engaged with a COL expert through an online forum for 14 days to finalize the course blueprints and compile available OER, such as video clips and case studies, to be used in the courses. Second, a hands-on workshop was conducted in November 2017 for TIHE and TIOE staff (held at the TIHE) facilitated by the COL expert. This workshop aimed to develop participants' skills in online course design and development, delivering online courses using Moodle, and reusing/remixing OER. In addition to the course development team members, staff from the library, educational technology unit, and IT support services participated in several focused sessions which were designed to help them support online delivery. Using the course blueprints as inputs, the participants worked in teams to develop the courses, on institutional Moodle platforms supported by COL, in real-time. It was unrealistic to expect the courses to be 100% completed during the workshop due to the short time frame; however, the course development teams managed to complete approximately 70% of the development within the duration of the workshop. Subsequently, the course development teams continued to complete the courses with virtual support from the COL expert. The courses *TIHE WS200 Working and Social Skills* and *TIHE TL100 Thinking and Learning Skills* are currently being offered in the first semester of 2018 by the TIHE to 139 and 137 learners respectively.

Discussion

The evaluation of this project is twofold. First, the outcomes of the project are evaluated based on the project evaluation chart (Table 2). To elaborate: outcome #1 - strategic implementation of OER practices at TIOE and TIHE through Institutional OER policies under the purview of the MET has been achieved through the development of a national OER policy draft aimed at government higher education institutions; outcome #2 - TIOE and TIHE integrate OER in teaching and learning effectively has been achieved through 84% of the participants using OER in some form in their teaching. Further, cascading training has taken place in TIHE and TIOE to build capacity of temporary teaching staff; and outcome #3 - TIOE and TIHE develop good quality learning materials and share as OER has been achieved through the development of four OER based life skills courses. By evaluating the targets set in Table 2 against the results, we consider the outcomes of Phase 1 and Phase 2 of this project to be successfully achieved.

Second, the methodology for this project is structured around the horizontal framework for OER mainstreaming in an institution (Figure 1) and the OER mainstreaming checklist (Table 1). According to

Abeywardena (2017), each process in the OER mainstreaming checklist vis-à-vis the mainstreaming tasks, need to be completed for the successful mainstreaming of OER in an institution. Table 3 summarizes the outputs of Phase 1 and 2 of the project against the mainstreaming checklist.

Table 3

Summary of Project Outputs from Phase 1 and Phase 2 Against the Mainstreaming Checklist

Process	**Mainstreaming tasks**	**Project outputs**
1. Change in mindset	1.1 Decided to reuse and produce OER? 1.2 Changed mindsets: Open is Good?	Following an official visit to Tonga by the Vice President of COL in September 2016, a few key areas were identified where COL could assist the MET which included: (a) building capacity in OER and developing OER based courses; (b) supporting MET in developing a policy framework for OER; and (c) strengthening online learning with a focus on the Moodle LMS.
2 Build capacity	2.1 What are OER? 2.2 What are the types of OER? 2.3 What is open and accessible? 2.4 What is copyright and open licensing? 2.5 How to create, reuse, revise, and remix OER using FOSS?	The hands-on capacity building workshop conducted in Phase 1 covered many OER related topics, which include understanding OER licensing requirements; understanding the need for OER in course design; converting a resource to OER and redistributing; evaluating and choosing suitable OER; introduction to oerfaq.info community of practice; OER search; applying OER concepts in course design; practical challenges of reusing OER in course design; FOSS tools for OER reuse/remix; and OER repositories and search.
3 Strategize	3.1 Identified the need for OER in terms of cost, quality and access? 3.2 Identified short, medium and long-term goals for OER? 3.3 Identified representatives from	The aims of the project were set (a) to develop a framework for fully utilizing the new fiber optic network infrastructure enabling the delivery of online learning to Tongans distributed in the 45 islands; and (b) to improve the chances of sustainable livelihoods for Tongan youth by training them in life skills tailored to higher education and employment opportunities in Australia and New Zealand. In the short-term, four pilot OER courses on life skills were proposed to be developed and delivered online using the Moodle LMS. In the medium-term, the project builds capacity of staff to develop and deliver OER based courses online. In the long-term, the use of OER and online delivery improves access to education for Tongans and leads to sustainable livelihoods. Representatives from academic staff, IT support, educational technology unit, library, and management participated in phase 1 and phase 2 of

		each stakeholder group for task teams?	the project. Learners will be involved in phase 3 and phase 4.
4	Adopt an open license	4.1 How open is the institution? 4.2 How open are current materials? 4.3 Allow commercial use? 4.4 Enforce Share-Alike? 4.5 Allow derivatives? 4.6 No Rights Reserved?	The draft national OER policy for government higher education institutions of Tonga (see policy section for more details) addresses all related issues under the "copyright and licenses" section, which include ownership of content, access to available content, sharing of intellectual property, license used for all materials developed, responsibility of authors and content creators, declarations, and caveats.
5	Technology infrastructure	5.1 Have sufficient technology infrastructure? 5.2 Have sufficient technical personnel? 5.3 Invest in cloud based technologies and services? 5.4 Setup a FOSS repository?	The technology infrastructure at the TIHE and TIOE is at its infancy. However, the project has prompted the need for upgrading the infrastructure and budgetary allocations for new infrastructure development based on future requirements. IT support staff are available for basic day-to-day support. However, they had limited expertise and resources in terms of setup and support of the Moodle LMS. As an interim arrangement, Moodle support is provided by COL for a duration of two years until the infrastructure is put in place and the staff trained. The MET is exploring the use of Moodle Cloud as a long-term solution. The setup of an OER repository hasn't been discussed yet due to the lack of infrastructure and technical support.
6	Policy	6.1 Adopted an Institutional OER policy? 6.2 Updated HR policies to recognize and reward OER activities? 6.3 Recognize additional work in OER? 6.4 Made OER a Key Performance Indicator (KPI)? 6.5 Developed a system for remuneration and encouragement? 6.6 Mainstreamed open educational practices?	In collaboration with policymakers of the MET, TIHE, and TIOE, strengthened by legal staff at the MET, COL supported the development of a draft national OER policy for government higher education institutions of Tonga based on COL's Institutional OER Policy Template. The statements of this policy include purpose, scope, and applicability; OER definitions; objectives; copyright and licenses; quality assurance and review system; liability; institutional arrangements; implementation strategy; monitoring and evaluation; and legislative compliance. These statements address all the mainstreaming tasks under policy. The draft policy is currently under review by the MET for adoption.

7	Practice	7.1 Which courses to make OER? 7.2 Developed a systematic approach to OER content development? 7.3 Formed course development teams? 7.4 Identified useful OER for course development? 7.5 Developed/adapted course successfully? 7.6 Developed pilot OER? 7.7 Added metadata and built a catalogue?	The course development process was approached in three inter-related stages. First, four independent teams were formed with 4-6 teachers each tasked with completing the course development. The teams engaged with a COL expert through an online forum for 14 days to finalize the course blueprints and compile available OER, such as video clips and case studies, to be used in the courses. Second, a hands-on workshop on OER course development was conducted in November 2017, at the TIHE, facilitated by the COL expert. Four courses were developed during this workshop. The courses TIHE WS200 Working and Social Skills and TIHE TL100 Thinking and Learning Skills have been offered in the first semester of 2018 whereas TIOE ITT101 Information Technology and TIOE RP101 Restorative Practices will be offered in the second semester of 2018. Metadata and cataloging of the courses will be done when the OER repository has been established.
8	Quality assurance (QA)	8.1 Formed an OER QA Team? 8.2 Is this content suitable for our learners? 8.3 Is it pedagogically sound? 8.4 Is it open and accessible? 8.5 Do we have tech support?	The OER policy draft provides guidelines for establishing QA teams within the institution. This has been initiated at TIHE and TIOE during the course development process. The four courses were subjected to the institutional QA checks and balances prior to offering. COL's *External Review Toolkit for ODL and eLearning Courses* was used to quality assure the courses in terms of course planning, course information, orientation to learning, course content, multimedia, learning activities, assessment, user-friendly design, and evaluation and continuous improvement. The toolkit further covers QA aspects of OER including licensing and technology. Staff from IT services, educational technology unit and library were trained on supporting OER based online course delivery.
9	Mastery of learning outcomes	9.1 Are assessments correctly mapped against the learning outcomes?	In the capacity building workshop conducted under phase 1, a one-hour session on outcomes based education (OBE) and assessment of learning outcomes was used to sensitize the staff on the expectations of phase 2 and phase 3. This session briefly introduced how to define interrelated learning outcomes in sub-units, units, courses, and programs followed by assessment blueprints and outcome evaluation rubrics. Further, the concept of

	9.2 Learner exceeds the requirement, meets the requirement or needs improvement?	continuous quality improvement (CQI) based on achievement of learning outcomes was explained. The concepts of OBE and assessment of learning outcomes were integrated in to the course design during the course development workshop conducted under phase 2. Achievement of learning outcomes will be assessed during the "outcomes based evaluation and CQI" workshop scheduled for June 2018 under phase 3 of the project. There will be pre and post workshop sessions conducted online where the COL expert will work with the course teams at TIHE and TIOE to formulate the CQI strategy for the institutions.

Based on the project outputs summarized in Table 3, we believe that almost all mainstreaming tasks have been addressed during phase 1 and phase 2 of the project. Once phase 3 is complete, we believe that OER will be successfully mainstreamed at the TIHE and TIOE in a sustainable manner. When the two institutions achieve sustainability, COL will exit the partnership as shown in Figure 3.

Among the challenges faced during the course development process, limited computer skills and subject matter expertise were prominent. These challenges were addressed through increased guidance and contact time from the COL expert. In terms of Moodle, the COL appointed administrator worked closely with the course development teams to setup the platform to suit their teaching needs. However, there were initial delays due to the lack of experience by teaching staff in the use of the LMS. These delays were soon addressed by establishing procedures for communication, requests, and turnaround times.

Conclusion

In 2017, the Ljubljana Action Plan identifies five main challenges to mainstreaming OER. In response, the Commonwealth of Learning (COL) recommends several concrete actions to mainstream OER. To guide the implementation of these recommendations in a practical scenario, Abeywardena (2017) proposes the horizontal framework for OER mainstreaming and the OER mainstreaming checklist. This paper details the use of the horizontal framework for OER mainstreaming and the OER mainstreaming checklist within the Strategic OER Implementation Project in Tonga. By evaluating the targets of the project against the results and by addressing almost all the mainstreaming tasks outlined in the OER mainstreaming checklist, we consider the outcomes of Phase 1 and Phase 2 of this project to be successfully achieved. The novelty of this project is its approach to mainstreaming OER at an institution in a systemic manner. The contribution this paper makes is to provide a proven plan for sustainable OER mainstreaming in a development setting.

The discussion details the findings of phase 1 and phase 2 of the project. Overall the horizontal framework for OER mainstreaming and the OER mainstreaming checklist have been proven to deliver on their aims and can be used by other educational institutions in developing countries to mainstream OER. Phase 3 of the project will concentrate on evaluating the mastery of learning outcomes and continuous quality improvement. Phase 4 of the project will draw conclusions on the impact of OER mainstreaming on improved sustainable livelihoods in Tonga.

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Training of Adult Trainers: Implementation and Evaluation of a Higher Education Program in Greece

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Abstract

This article presents the implementation and the evaluation of the blended learning program *Training of Lifelong Learning Adult Trainers*, which was organized by the Center of Training and Lifelong Learning of the Aristotle University of Thessaloniki in Greece, during the last two years (2016-2017). The aim of the training program was to give the opportunity to adult trainers to certify their educational competence and update their knowledge in the field of adult education, enhancing their employability. After the completion of the program, the trainees assessed the implementation methodology, the educational content, the microteachings, the quality, and the organization of the program. The results of the evaluation showed that the program was of a high level, flawlessly organized, and with excellent educational material, while the blended learning model worked effectively, receiving positive reviews by the participants. It was concluded that blended learning is indeed adequate in adult educational programs increasing the participation and facilitating adult trainees to better integrate their learning experiences.

Keywords: blended learning, lifelong learning, training of adult trainers, higher education, employability

Introduction

The increasing number of institutions and organizations that offer adult and continuing education programs in Greece has led to a rise in the human resources involved in the design, organization, and implementation of these programs. Therefore, it is necessary that these human resources be well-trained. A relevant study carried out in 2002 showed that although there were enough adult trainers in Greece who had experience and knowledge of their cognitive field, they were behind the use of modern active teaching techniques, the design of teaching modules and educational programs, and the manipulation of the dynamics of the relationships formed within the trainees' group (Kokkos, 2007).

By the year 2019, certified educational adequacy will be a prerequisite for a trainer in order to participate in a public funded non-formal educational program. Thus, a trainee candidate who does not have the required legal experience in adult education will be referred to a training program of adult trainers, implemented by a public sector body.

In order to meet this need for training, many bodies, institutions, and universities in Greece have begun to set up training for adult trainers programs, aiming both at upgrading their qualifications and preparing for the certification exams for the adult educational adequacy (Kokkos & Karalis, 2011).

In this study we are examining the program *Training of Lifelong Learning Adult Trainers* organized by the Center of Training and Lifelong Learning (KEDIVIM) of the Aristotle University of Thessaloniki. Six cycles of studies have been implemented since October 2016 to December 2017 and each cycle lasted between seven to 11 weeks.

The Center of Training and Lifelong Learning (KEDIVIM) is a unit of the Aristotle University of Thessaloniki and develops interdisciplinary training, continuing education, and lifelong learning programs, which are offered either by face-to-face or by distance learning. The operation of such programs is now more urgent than ever, as they contribute to reducing social exclusion, upgrading the quality of education, and enhancing the employability of trainees. This program is directed to:

- prospective adult trainers of all cognitive subjects, who want to be trained, in order to certify their educational adequacy and teach their subject to adult learners;
- those registered in the National Organization for the Certification of Qualifications and Vocational Guidance as well as in other registers of adult trainers, who want to update their knowledge in the field of adult education; and
- existing and prospective staff members of lifelong learning structures, such as Institutes of Vocational Training, Second Chance Schools, Lifelong Learning Centers, etc., who want to upgrade their knowledge and gain additional degree.

Implementation Methodology

Blended Learning Model

As mentioned above, the Center of Training and Lifelong Learning at the Aristotle University of Thessaloniki implements training programs either via face-to-face teaching or e-learning teaching methods. The implementation of the program we are examining in this study was based on the blended learning model.

Blended learning has various definitions in the literature. The first concrete definition of the term appears in 2006 with *The Handbook of the Blended Learning* (Bonk & Graham, 2006). Graham defined "blended learning systems" as learning systems that "combine face-to-face instruction with computer mediated instruction." Other authors give wider definitions considering that blended learning means to personalize and individualize the teaching and learning activity, according to different learning needs of each learner (McSporran & King, 2005). However, the most definitions agree that the goal is to combine face-to-face education and online education in an efficient way, which best fits to individuals (Yigit, Koyun, Yuksel & Cankaya, 2014).

The term blended learning is based on constructivist theories about learning of Piaget, Dewey, Vygotsky, and Heinze, who theorized that participants have the opportunity to construct by themselves new knowledge and ideas that are based on their previous personal experience. The role of the trainer is to offer a great variety of exercises and learning experiences to learners in order to involve them and encourage them to use active methods, during which they should be able to independently achieve learning. Constructivist approach may be applied in the blended learning, as it offers participants various options in the architecture of knowledge: e-learning, sessions, adjustment to the trainees own learning style, workshops, simulations, written course aids, together with personal feedback from the trainer, who supervises and maximizes adult learners progress (Catalano, 2014).

The use of such a model of teaching and learning offers both advantages and challenges for participants. It may provide pedagogical benefits as increased learning effectiveness, satisfaction and efficiency. The University of Central Florida conducted a multi-year study examining the success rates of students attending face-to-face, blended learning, and online courses. The study found that the success rates for blended learning were higher than either fully face-to-face or fully online courses for both males and females. It has also been proven that blended learning increases access and flexibility in regards to time and space and makes participation possible for more people, for example, people living in rural areas far from institutions or employed people with limited free time. Additionally, using blended learning the operating cost is lower than face-to face teaching model. On the other hand, some challenges may become obstacles for adult participants, such as the need for computer skills and competence to use technology as a tool for communication and research (Graham, 2013; Porter, Graham, Spring & Welch, 2014).

Description of the Blended Learning Program *Training of Lifelong Learning Adult Trainers*

The methodology used in this program was based on the principles of blended learning, as mentioned above, and on contemporary adult learning techniques, promoting active and experiential learning through action and learner-trainer interaction.

By participating in the learning process, the adult trainee needs to acquire not only theoretical knowledge but also the practical knowledge of procedures, more specifically, how to do something. It is true that we learn something in relation to our present and past experience. The experience of a learner determines what he learns and the approach that he adopts to learning. Experiential learning theory defines learning as the process whereby knowledge is created through the transformation of experience. As adults have a rich foundation of experience and often these experiences are a rich resource for learning, greater emphasis can be placed on the techniques that tap their experience, such as group discussion, case studies, critical-incident process, simulation exercises, role playing, and skill practice exercises (Knowles, 1980; Pampouri & Sipitanou, 2016).

The structure of the training program that we are examining included 10 modules of education and learning in a blended learning environment. In particular, the thematic modules combined eight to 16 synchronous tele-education sessions and one to three face-to-face meetings for guidance and feedback, while the educational process was supported throughout the program by using a synchronous-asynchronous platform (Moodle) of the Aristotle University of Thessaloniki.

The trainees participated in synchronous teleconferences, videoconferences, exercises, and case studies for each of the modules and were ensured continued access to educational material and bibliography. Also, they used a forum in order to interact with their instructors and each other, as well as for guidance, support, and problem solving.

At the end of the program, the trainees were divided into groups of 10-12 in order to present their micro-teaching that they had prepared during the program. Upon completion of the program and the award of the certificate, the trainees evaluated the program by completing an electronic questionnaire.

Evaluation of Educational Programs

It is well known that, in today's knowledge society, that the continuous monitoring and improving of the quality of educational services offered by universities and institutions is crucial as the quality of instruction impacts overall economic development (Pampouri, Tsipa, Mavropoulos, & Tsipas, 2003). Educational evaluation can refer to the educational objectives, to the methods of teaching, to the curriculum, to the effectiveness of teaching, to the teaching staff, and also to a training program or even the educational system as a whole. More specifically, the evaluation of an educational program produces feedback to improve the learning process as well as the program (McGee & Reis, 2012; Taylor & Newton, 2012; Vergidis, 2001; Pampouri, 2014).

Research also outlines factors that make it difficult to evaluate a program. Due to the minimum physical contact time between trainees and trainers, informal communication is hampered and it is difficult to build a solid foundation of trust and communication. Also, there is no possibility to discuss the results of the evaluation and to clarify certain points. At the same time, trainees often find it difficult to express "sensitive" comments through forums or emails (Kälberer, Petendra, Böhmer, Schibelbein, & Beck-Meuth, 2016).

Scriven proposed for first time in 1967 today's classical classification of types of evaluation based on their purpose, introducing formative and summative evaluation (Karalis, 1999). In the case of the training program we are considering, the evaluation type used was the summative evaluation with the use of a questionnaire. *Summative evaluation* means the assessment conducted in order to get conclusions about the value of a program and which is usually combined with the continuation or expansion of the program (Knox, 2002; McNamara, Joyce, & O'Hara, 2010).

At the completion of the program, all trainees received by email a link to a questionnaire, which included closed-ended and open-ended questions. In particular, they were asked to fill in details of their profile, their educational level and the reasons for their participation. They were also asked to evaluate the quality of the program, the implementation methodology, the educational content, the micro-teaching process, and the whole organization of the program. We received 222 completed questionnaires.

Results and Discussion

Trainees' Profile

The overwhelming majority of the trainees attended the program for professional reasons. One of the main incentives for adults to participate in lifelong learning programs is for professional reasons. As shown in a survey of the National Statistical Service of Greece (NSSG) conducted in 2007 with a sample of 6,510 people aged 25-64, the largest percentage (78.4%) said that they attended a program for professional reasons, 16.7% for personal reasons, and a small percentage (5%) mentioned a combination of professional and personal reasons (Karalis, 2013). Karalis (2013, 2017) conducted a multi-year study in Greece, investigating the factors affecting adult participation in vocational training and general adult education programs. The study found that some of the main reasons for participation relate to job efficiency, maintaining a job position, or finding a better job.

Overall Program Quality Evaluation

Special attention was paid to the design of the program, which consisted of videoconferences, PowerPoint presentations, e-books, case studies, exercises, articles, and additional literature available for further study on the subject. With the support of the study guide and the timetable, the trainees were able to easily access all the educational material, as well as upload it to their computers for future use.

Since tuition could become a barrier to participation and prevent many prospective adult trainers from attending and completing the program (Koutouzis, 2013; Karalis, 2017), a low program cost was decided on. Indeed, 54% of the participants considered that the tuition fees were satisfactory, while 41% expressed they felt tuition was high and 5% felt they were very high, which shows that the tuition fees did not constitute a real barrier to participation.

Program Methodology

As discussed, combining face-to-face and distance learning resulted in synchronous tele-education sessions, asynchronous sessions through the e-learning platform of the university, as well as some face-to-face meetings that were scheduled in order to solve questions and provide better mentoring in the preparation of microteaching of trainees. The synchronous tele-education sessions were characterized as sufficient by an overwhelming majority of trainees (93%).

The asynchronous tele-education and videoconferences that were available for study in the e-learning platform, was reported as satisfactory by 91% of trainees. Through this platform, the trainees had access to educators' PowerPoint presentations, e-books, case studies, supplementary educational material, videoconferences adapted to the adult learning principles, and useful literature for further study.

The trainee's microteaching worked very positively, as that exercise enabled future adult trainers to translate into practice their theoretical knowledge acquired during the program (Pampouri & Sipitanou, 2016), to apply various participatory teaching methods, as well as to demonstrate the multiple and complex individual skills and abilities they have acquired and managed to use in their microteaching. Numerous research studies, moreover, have highlighted the importance and effectiveness of microteaching, noting the significant improvement in the teaching skills of trainers. Microteaching may offer opportunities for self-knowledge to future trainers and may induce a critical examination of their teaching behavior. Consequently, it helps them to shape their didactic identity, to reflect on their teaching, and to achieve effective teaching practices (Kapsalis & Vrettos, 2002; Giannakopoulou, 2008).

The learning modules content and presentations, both in face-to-face sessions as well as in synchronous and asynchronous sessions, were judged by 66% of the participants to be very clear and documented, 64% of them mentioned that they had direct relevance to each other, and 57% evaluated them as very well oriented to trainees' needs.

Evaluation of the Program Organization

Overall, the program was considered to be very well organized. In particular, 85% of the trainees evaluated the program's secretarial and administrative support as excellent. The infrastructure (the fundamental facilities of the program) was judged to be excellent by 48% and as very good by 46%. Fourty five percent of trainees thought the venues where the face-to-face sessions took place were very satisfactory for meeting the needs of the program, while 40% of them found the facilities good enough. The main shortcomings reported were related to sound problems in some synchronous sessions, inappropriate classroom for face-to-face meetings (as there was no possibility of seating rearrangement), and difficulty in consolidating the learning content due to the large amount of educational material compared to program's time duration.

Several proposals were made for the improvement of the program. Some trainees suggested that it would help to provide more guidance and help in the preparation of microteaching, perhaps by dedicating another session. This proposal was taken into account during the evaluation and redesign of the program and was incorporated in a workshop in the context of the face-to-face session, which took place in the middle of the program. During the workshop, the trainees had the opportunity to design a microteaching with the guidance of the trainers. It was also proposed to allow more time to study during the week, so at the redesign of the program the sessions were made two per week instead of three. Finally, tests were added between the modules in order to facilitate better content consolidation and improve performance for the final examinations of the program.

Conclusion

The evaluation of the program indicated that the training program *Training of Lifelong Learning Adult Trainers* at the Aristotle University of Thessaloniki was of high-level and value, well-organized, and with valuable educational material. The blended learning model worked efficiently and positively for trainees. Its flexibility gave participants the opportunity to attend the program even with their busy schedules. This success satisfied one of the main aims of the program, which was to enhance employability through participation in lifelong learning (Karalis, 2013; Karalis, 2017; McGee & Reis, 2012; Taylor & Newton, 2012).

The use of the blended learning model proved very effective (Graham, 2013; Porter, Graham, Spring, & Welch, 2014). It would be useful to carry out a comparative study between blended learning programs implemented by Greek universities and similar programs in other countries which follow identical or different education models, in order to highlight good practices that could also be used in Greece.

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