IRRODL

THE INTERNATIONAL
REVIEW OF RESEARCH IN
OPEN AND DISTANCE LEARNING

Vol 19 No 4

September 2018

International **R**eview of **R**esearch in **O**pen and **D**istributed **L**earning
Volume 19, Number 4

September – 2018

Influence of Learning Design of the Formation of Online Communities of Learning

Shazia K. Jan and Panos Vlachopoulos
Macquarie University, Australia

Abstract

This paper presents the findings of a study on a fully online Bachelor's level course in Health Sciences at a European University conducted to explore the influence of learning design on the formation and evolution of different types of communities of learning. The impetus for the study came from the well-established effectiveness of community-based learning, a need for understanding learning design and analytics within networked structures and, the lack of theoretical grounding for social network analysis (SNA) in previous literature. Our study uses the Integrated Methodological Framework (IMF) which employs SNA as the key methodology for exploring community-based learning in light of the Communities of Practice (CoP) and Community of Inquiry (CoI) frameworks. The course comprised of three differently designed successive discussion forums spanning three weeks each. Network diagrams and SNA measures clearly showed the impact of the different learning designs on student engagement in the discussion forums. Based on CoP and CoI structural components within the IMF, a comparative analysis of whole-network properties of the three networks indicated the formation of a CoP, initiated and mediated by the tutor in discussion 1, sustained by the students in discussion 2, and disintegrated due to lack of guidance and facilitation in discussion 3. Qualitative analysis on the content of discussion posts revealed the importance of group oriented messages in the formation of the CoP. The paper discusses findings in terms of implications for learning design and analytics in online learning and the role of the tutor in community formation.

Keywords: online learning, learning design, learning analytics, communities of practice, community of inquiry, social network analysis, online facilitation

Introduction

Learning within networked structures, such as communities, is increasingly being considered as the most effective way to learn in the 21st century (De Laat, 2012; Dawson & Siemens, 2014). Engaging learners meaningfully is one of the fundamental guiding principles in designing for networked learning (Boud & Prosser, 2002). A networked learning environment that directs learning processes towards deep learning can be designed but the actual learning or learning experience that occurs cannot be prescribed (Goodyear, Banks, Hodgson, & McConnell, 2004; Wenger, 1998). Learning designs indicate and execute the designer's pedagogical intentions but cannot control student perception and consequent actualization of the intended design. Neither do learning designs identify how students engage in the design during or after a learning activity (Lockyer, Heathcote, & Dawson, 2013), this being a function of learning analytics. Therefore, to inform teaching and learning practice within networked structures, the inseparable iterative relationship between learning design and analytics must be cultivated especially since the proliferation of anywhere, anytime, online learning and consequent access to "big data" from learning management systems (LMS). In a recent book, Carvalho, Goodyear, and De Laat (2017) identify the critical need for understanding approaches to analysis and design for networked learning. Social learning analytics, specifically, social network analysis (SNA), has been used considerably to investigate online networks and communities (Cela, Sicilia, & Sanchez, 2015); however, researchers have pointed to the lack of theoretical grounding for the SNA, which makes pedagogical interpretation and application of findings difficult (De Laat & Prinsen, 2014; Shea et al., 2013). This paper attempts to contribute to research on learning design and analytics in the context of higher education online learning (HEOL) by investigating the influence of learning design on the formation and evolution of communities of learning using the theoretically grounded Integrated Methodological Framework (IMF) (Jan & Vlachopoulos, 2018), which employs SNA as a central methodology. In a case study involving three differently designed discussion forums, the IMF is used to investigate the type of community formed in each discussion activity and the key factors that contribute to the formation of the community. The paper begins by a brief overview of the significance of, and design for, community-based learning. Following this, the case study is presented, findings are reported, and finally practical pedagogical implications for learning design and analytics in the context of HEOL are discussed.

Literature Review

Community-Based Learning

The terms *network* and *community* are frequently used interchangeably in literature on online learning despite the different educational affordances of the structures. Briefly, a network is defined as, "A set of connections among people, whether or not these connections are mediated by technological networks. They use their connections and relationships as a resource in order to quickly solve problems, share knowledge, and make further connections" (Wenger, Trayner, & De Laat, 2011, p. 9). On the other hand, "A community is a group of individuals identifiable by who they are in terms of how they relate to each other, their common activities and ways of thinking, and their beliefs and values" (Biza, Jaworski, & Hemmi, 2014, p. 162). While a network is simply a group of entities joined together by relationships, a community takes time to form. The effectiveness of community-based learning is a widely-held belief resting on decades of research. The pedagogical foundations for learning communities lie in Dewey's

(1980-1904) concept of student-driven learning via engagement, active learning and, collaboration (Fink & Inkelas, 2015). The precursor of the learning community dates to the 1920s when the "experimental college" program was introduced by Alexander Meiklejohn (Smith, 2001). The 1960s saw a rebirth of this idea which gained further momentum in the 1980s with the recognition that learning in a community leads to higher levels of learning and development (Zhao & Kuh, 2004). This momentum continued into the 1990s with several studies reporting links between participating in learning communities and favorable outcomes for college students (Matthews 1994; Pike, 1999; Tinto, 1998). Onwards, with the pervasiveness of online learning and the interactivity afforded by Web 2.0 technologies, learning in communities became the holy grail of online learning as stated by Palloff and Pratt (1999), "without the support and participation of a learning community, there is no online course" (p. 29). Kop and Hill (2008) state that "the starting point for learning occurs when knowledge is actuated through the process of a learner connecting to and feeding information into a learning community" (p. 1). With the development of frameworks, such as, Communities of Practice (CoP) (Lave & Wenger, 1991; Wenger, 1998) and Community of Inquiry (CoI) (Garrison & Anderson, 2003), the last two decades have seen an explosion of research on learning communities re-affirming that learning in communities is the way to learn. Given the effectiveness of community-based learning, can we assume that students, in a course of study, whose learning is embedded within online networked structures, naturally form a community of learning? If a community is not formed naturally, can a particular type of learning design influence the formation of a specific type of community?

Designing for Online Communities of Learning

The use of the term learning design is contested in literature and to date there is no one agreed upon definition of what constitutes learning design. For instance, Agostinho, Oliver, Harper, Hedberg, and Wills (2002) refer to learning design as "the sequence and types of activities and interactions that are selected to shape the student learning experience" (p. 3). Donald, Blake, Girault, Datt, and Ramsay (2009) define learning design as a product that "documents and describes a learning activity in such a way that other teachers can understand it and use it (in some way) in their own context" and as a "process by which teachers design for learning, when they devise a plan, design or structure for a learning activity" (p. 180). Conole (2012) refers to learning design as a "methodology for enabling teachers/designers to make more informed decisions in how they go about designing learning activities and interventions…" (p. 7). Regardless of whether learning design is considered as a sequence, a product, a process, or a methodology, in HEOL the basic components of learning design remain the same. The learning environment comprises of the LMS, tools and technologies, content or curriculum, individuals and their roles (lecturer, tutor, student, support staff, etc.), and some other resources. A good learning design framework is expected to bring together these components in a manner that leads to the desirable learning outcomes. In the Activity-Centered Analysis and Design (ACAD) framework, Carvalho and Goodyear (2014) discuss three structures of learning design, i.e. set design (space, place, artefacts, tools, etc.), social design (dyads, groups, roles, communities, etc.), and epistemic or intended design, which intermingle to create the actual activity or learning that emerges organically and cannot be manipulated by design. In a similar vein, referring to communities of learning, Wenger (1998) speaks of learning as something "that cannot be designed but can be designed for" (p. 229), i.e. one can create a design with the intention of forming a community; however, there is no guarantee that the community will form. Good learning designs are seldom static and can be altered, as needed, as a course of study progresses. However, once an activity, for example a discussion forum, has commenced, it must be seen to completion and the only changes that can be made to the design are through intervention (moderation) by a facilitator during the activity. Therefore, the role of moderation or facilitation forms a crucial component of online learning activities, and as such, has been the subject of substantial research over the past two decades. However, the impact, if any, of moderation on the formation of a specific type of community of learning remains unknown.

The Role of Facilitation in Community Formation

Numerous frameworks and models for online tutoring and e-moderation have been developed over the past couple of decades; however, most do not provide a clear a definition of e-moderation and online facilitation (Vlachopoulos & Cowan, 2010). The CoI framework (Garrison & Anderson, 2003), Salmon's (2000, 2003) 5-stage model of e-moderation and the ring-fence e-moderation framework (Vlachopoulos & Cowan, 2010) being the exception. The CoI framework comprises of three interconnected presences, social presence (SP), cognitive presence (CP), and teaching presence (TP). In a CoI, the role of the facilitator (lecturer or tutor) lies within TP. Teaching presence is not limited to facilitators and can be assumed by anyone, e.g., an actively engaged student.TP does not only encompass subject expertise but also includes design and facilitation of the learning environment such that a CoI would be created over the course of study (Anderson, Rourke, Garrison, & Archer, 2001). The essence of the role of the tutor in the CoI framework includes developing a sense of community amongst students by advancing social relationships (SP), among other things. (Garrison & Anderson, 2003). SP modelled by the tutor or lecturer encourages student engagement as students feel acknowledged and visible (Rourke, Anderson, Garrison, & Archer, 2001; Stacey, 2002, Shea & Bidjerano, 2010). However, SP and TP by themselves are not enough for deep and meaningful learning for which CP is critical. In a CoI, the facilitator should guide students to develop meaning, confirm understandings, integrate knowledge, and arrive at resolutions (Garrison & Cleveland-Innes, 2005). In a different vein, Salmon's (2000, 2003) 5-stage model of e-moderation describes a tutor as someone who progressively engages students in constructivist learning but who is not necessarily the subject expert. Like the CoI framework, Salmon's model is limited to online social learning; however, the model does not specifically concern community development (Moule, 2007). A community literally means, "a unified body of individuals" (Merriam-Webster, 2017) so when we think of a community of learning, it is natural to envisage a tightly-knit group of students. Based on this we can assume that a facilitator who intends to form a community of learning would aim to keep students tightly-knit towards the center of the community. The ring-fence e-moderation framework (Vlachopoulos & Cowan, 2010) comes closest to this idea postulating that e-moderation should be contained within "an enclosed learning arena" in which the learning is "student-centered and implicitly student-directed" (p. 31), and that distinctly encapsulates student and e-moderator activities only. Acknowledging that the tutor's activities within the ring-fence are influenced by predetermined outside and emergent inside factors, the framework clearly describes the role of the tutor as: identification of a significant posting; construction and posting in alignment with the tutor's style, purpose, and desired learning positions; and influencing, but not directing, student progress. There are several guides and books on best practices for online facilitation and moderation (Vlachopoulos, 2012); however, the role facilitation does and/or can play in the formation of a specific type of community of learning has yet to be investigated.

Research Questions

Considering the long-standing effectiveness of community-based learning and the gap in understanding design for community-based learning, especially the role of facilitation in community formation, we explore the influence of learning design on the formation and evolution of online communities of learning by specifically addressing the following questions: Given different learning designs of the same learning activity, can we identify the type of community formed within each design, if any, using SNA? If a specific type of community is formed, how does it evolve? And what are some of the key factors that contribute to the formation and evolution of the community? What practical pedagogical implications can we draw from our findings?

An Online Community of Learning – A Case Study

Context of the Study

The study was conducted on a fully online Bachelor's level course in the Health Sciences at a European University. The cohort comprised of a total of 20 students (13 female, 7 male) aged between 26 and 54 years. The students were qualified healthcare professionals who took the course to enhance their critical thinking skills and professional practice. The course comprised of three differently designed, successive discussion forums spanning 3 weeks each. Discussion 1 was guided and facilitated by the tutor who acted as the subject expert. In discussion 2, students were asked to discuss a practice online, for instance, something they did in the hospital, and exchange advice drawing on personal experiences. Discussion 3 was designed as a free-flowing discussion in which students could raise anything they wished in relation to the course or their practice. This discussion was not graded. The discussions were threaded with nested messages within each thread. Interaction data for each discussion activity was extracted from the LMS (Moodle) for analysis. All students had prior experience with online discussions as a way of learning and development as they had completed other online professional development courses at the same University. As such any maturation effect was not considered to be a methodological issue.

Analytical Framework for the Study

We use the Integrated Methodological Framework (IMF), shown in Figure 1, to conduct our investigation. The IMF uses SNA as the key methodology for identifying and exploring communities in higher education online learning (HEOL). The IMF embeds SNA in structural components of empirically tested and well-established CoP and CoI frameworks and includes selective qualitative analysis which supports the SNA. Definition of a CoP and CoI, explanation of the structural components of a CoP and CoI, and details on development and application of the IMF, can be found in Jan and Vlachopoulos (2018).

Identification of Communities in Higher Education Online Learning (HEOL)

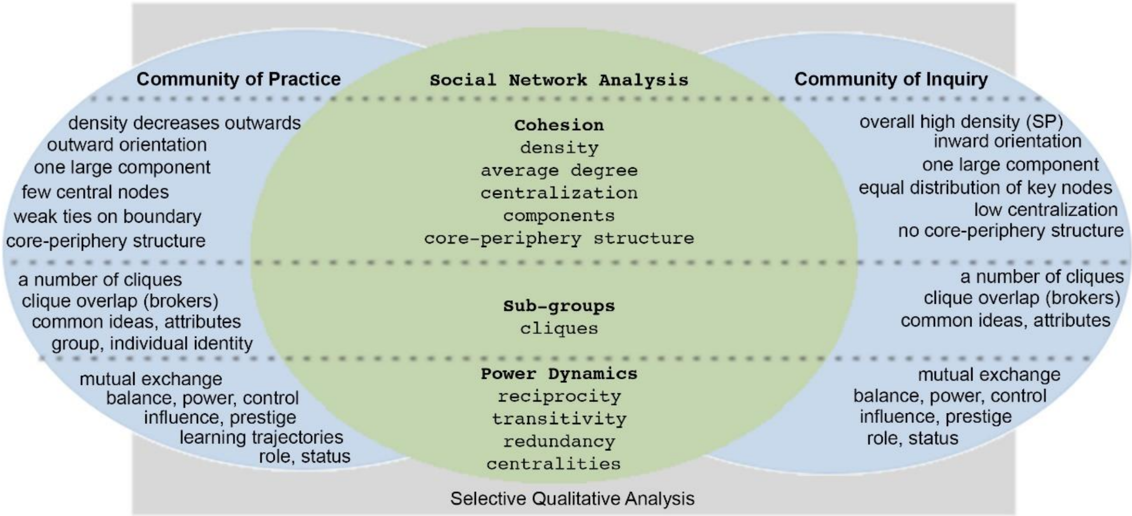


Figure 1. Integrated methodological framework (IMF).

Findings From SNA

Data was coded into matrices for SNA which was conducted in Ucinet 6.0 (Borgatti, Everette, & Freeman, 2002). The rows and columns of a matrix represented the nodes in the networks, i.e. the students and tutor. A value of 1 indicated an interaction (a direct response or reply to a message) between two nodes and 0 indicated no interaction. Multiple interactions between the same nodes were treated as one. The resulting networks were directed, indicating the initiator of each interaction, but not-weighted. The network diagrams shown in Figure 2 below were generated in Social Network Visualizer 2.3 (Socnetv, 2017).

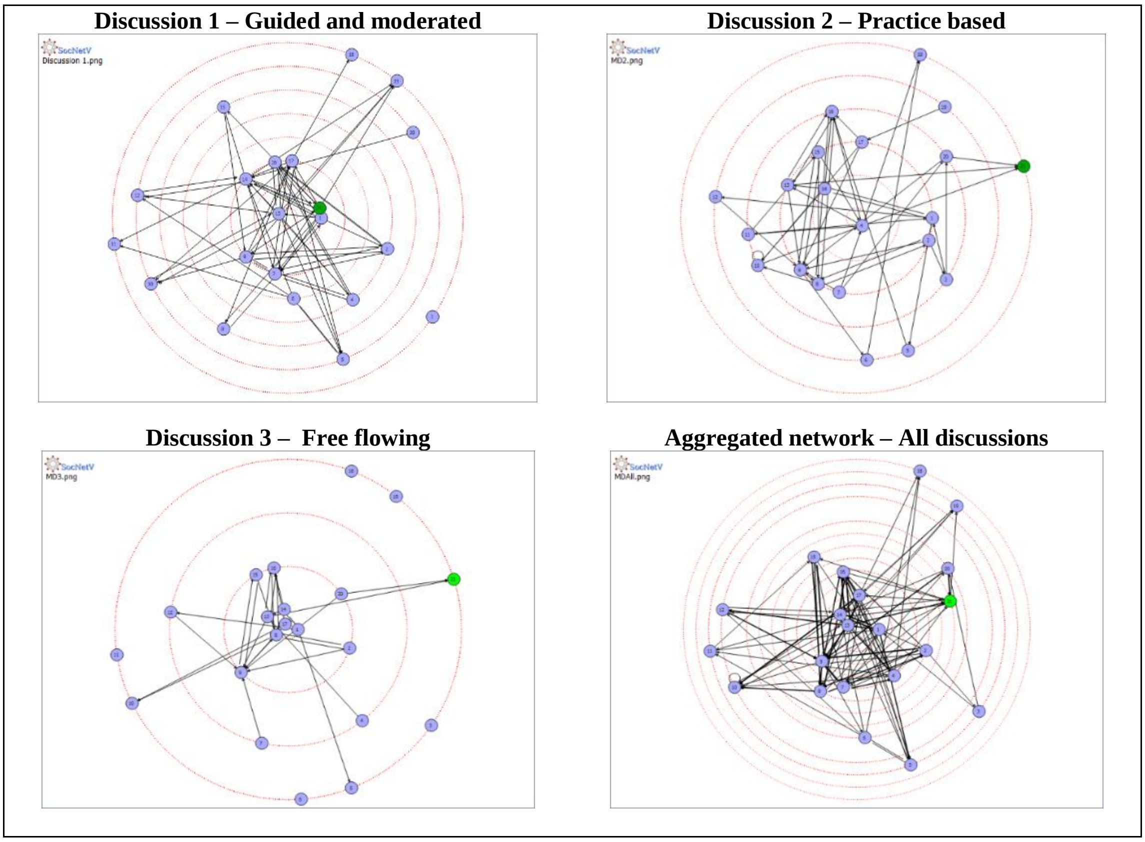


Figure 2. Discussion networks based on degree centralities.

The nodes in the network diagrams represent the 20 students and one tutor (shown in green) who was also the subject expert. The nodes are positioned within the networks based on the overall degree centrality of each node. The networks of discussion 1, 2, and 3 represent all interactions over the 3-week period of each discussion activity. The aggregated network shows all interactions over the total 9-week period.

Exploration of community formation and evolution using the IMF is a multi-stage process. First, we need to look at the structure of cross-sectional networks on a stand-alone basis. Cross-sectional networks are snapshots of interactions at a certain point in time, for instance, in Figure 2 the network diagrams of discussions 1, 2, and 3 are a cross-sectional representation of interactions at the end of each 3-week period. Second, to explore temporal dynamics of communities, we need to look at changes in the structure of the successive cross-sectional networks. Finally, we need to examine the aggregated network which captures cumulative interactions over the entire period under consideration. Although the aggregated network does not reveal community dynamics, the overall structure of the network indicates the global orientation of the community.

We begin our investigation into community formation and evolution by examining each network diagram from Figure 2 using constructs from the IMF. In discussion 1, the network comprises of one fully connected component. The density of the network decreases outwards from the center depicting weaker ties on the periphery and a clear core-periphery structure is visible. The tutor, who is the subject expert and moderator, appears highly central along with a few other students. In discussion 2, corresponding with the design of the discussion activity, i.e. practice-based and not moderated, the tutor moves out of the core to the periphery. While the network remains fully connected within one component, it is relatively less dense. However, we still see a core-periphery structure as the density decreases outwards from the center. In the free-flowing discussion 3, the network structure changes significantly as the number of interactions and density decline and the network becomes disconnected. The core-periphery structure remains somewhat with the same number of nodes in the core as discussion 2; however, a few isolates appear on the periphery along with the tutor. Based on the overall structure of the networks depicted in the network diagrams, we conclude that the learning design of discussion 1 and 2 lead to the formation of a CoP; however, as a consequence of the design of discussion 3, the CoP is not able to sustain itself fully in discussion 3 and begins to disintegrate. If we consider the aggregated network, again a CoP structure is observed owing to the fully connected large component, greater density towards the center, and a clear core-periphery structure in which the tutor is positioned towards the outer boundary of the core with a few students taking on central roles implicating development of subject expertise.

Having identified the networks as a CoP, further analysis is restricted to the CoP portion of the IMF. A key component of a CoP is the notion of legitimate peripheral participation (LPP) in which newcomers enter a community and progressively move to the core from the periphery replacing old-timers or experts as the newcomers learn and develop identities (Lave & Wenger, 1991). LPP signifies the learning process which culminates into the learning experience or identity formation in CoP terminology. In the context of network structure, LPP is denoted by a changing core-periphery structure in successive cross-sectional networks as students, tutors, and/or lecturers move in and out of the core. To validate our earlier conclusion and verify LPP among other things, we need to take our investigation to the next step in the IMF. In Table 1 below, whole-network SNA measures corresponding with the network diagrams in Figure 1 are given.

Table 1

Whole-Network SNA Measures for Successive and Aggregated Discussion Networks

SNA measures	Discussion 1	Discussion 2	Discussion 3	Aggregated
No. of ties	62	46	28	136
Average degree	3.0	2.2	1.3	6.5
Centralization	30.5%	28.2%	32.1%	23.6%
Components (n>1)	1	1	1	1
Nodes in largest component	20	21	16	21
Cliques (n=3)	18	7	3	33
Core nodes	1,7,9,13,14,16,17,21(T)	4,8,9,13,15,16	1,8,9,13,14,16	1,7,8,9,13,14,16,17,21(T)
Reciprocity	3.2%	12%	21.7%	28.9%
Transitivity	22.6%	9.2%	11.4%	28.6%

In addition to quantifying the structural properties evident in the network diagrams, the SNA measures further reveal the structural dynamics or rhythms of the community as it re-configures itself under the influence of different learning designs. Additionally, SNA measures such as reciprocity and transitivity, implicate overall power dynamics within the community. Reciprocity is the degree of mutual exchange between nodes. Transitivity is calculated based on the percentage of transitive triads within a network.

A transitive triad occurs if A is connected to B, B is connected to C, and A is also connected to C. A high transitivity indicates the presence of alternate paths for flow in a network. The higher the transitivity, the lower the power and control of central nodes. The CoP framework does not discuss issues of power and control that are critical determinants of the flow of information and resources in a community (Hughes, Jewson, & Unwin, 2007), an important consideration in the pedagogical context. For instance, a network with low transitivity and high reciprocity indicates that it is dominated by a few central nodes who are actively engaging with one another and control the flow of the network.

As shown in Table 1, with a total of 62 ties, discussion 1 consists of one large connected component consisting of 20 nodes, that is, one tutor and 19 of the 20 students. The network has a relatively high centralization (30.5%), the largest core (eight nodes), and number of overlapping cliques (n=3 is the number of nodes all of which are connected to one another). Clearly, the activity in the network is dominated by the tutor and a few select students who form tightly-knit subgroups or cliques. Interestingly, the reciprocity or mutual exchange is lowest in discussion 1 indicating that even though students are actively participating in the discussion, they are not responding to one another. On the other hand, the network has the highest transitivity at 22.6% making it less restrictive and controlled in comparison to the other networks. Generally, the transitivity is on the lower side, which implicates power and influence of the core nodes including the tutor – an outcome of the learning design. In discussion 2, the network is contained within one large component, as well with all 20 students active in the discussion. The degree of centralization drops to 28.2% as the tutor moves out to the periphery and the number of nodes in the core reduces to six. Even though the tutor is no longer active in the discussion, the CoP structure seen in discussion 1 remains intact. The core-periphery structure changes depicting LPP. Specifically, the tutor and student 1 and 7 move out of the core to the periphery, students 4, 8, and 15 join the core from the periphery while students 9 and 16 remain in the core. The number of cliques drops significantly indicating the loosening up of the structure as students reach out to other students as indicated by the high reciprocity. The low transitivity points to greater power and control of the students in the core. Both discussion 1 and 2 form a CoP with and without tutor or lecturer involvement, therefore it appears that the practice-based nature of the discussion achieves a similar outcome as the guided and facilitated discussion 1. In the free-flowing discussion 3, the number of ties and average degree drops further and the network centralization increases to 32.1%, the highest amongst the three networks. Again, we see evidence of LPP where the tutor remains at the periphery, student 1 re-joins the core, students 4 and 15 move out of the core to the periphery, student 14 joins the core from the periphery, and students 9 and 16 again maintain their positions in the core. The reciprocity is relatively high and the transitivity remains low indicating the control and influence of the students at the core. The overall structure of the network shows remnants of a CoP which has disintegrated presumably due to the lack of guidance and facilitation.

Finally, the aggregated network also depicts an overall CoP with a large spread out core (nine nodes) which explains the relatively low centralization (23.6%). The low but equal reciprocity (28.9%) and transitivity (28.6%) indicate the active participation, mutual exchange, control, and influence of the core nodes. Despite being on the periphery in discussions 2 and 3, the tutor appears in the core of the aggregated network, which indicates the integral role that guidance and facilitation played in the formation of a CoP. Furthermore, the tutor's position in the outer-boundary of the core nicely depicts the process of LPP whereby students push out the tutor by taking on central positions within the core. In summary, the learning design of discussion 1 and 2 leads to the formation of a CoP, which is not sustained by the design of discussion 3. The guidance and facilitation provided by the tutor in discussion 1 was instrumental in the initial formation of the CoP, which was driven and sustained successfully by the students in the practice-based discussion 2. The lack of direction and tutor involvement in discussion 3 led to student disengagement and disintegration of the CoP. We now turn our attention to the final component of the IMF, i.e. qualitative analysis to support the SNA.

Findings From Qualitative Analysis

Using the IMF, we have identified the type of community formed based on the structural properties and dynamics of the networks. However, for a complete exploration we need to examine the nature of the interactions that bring students together into a CoP (Jan & Vlachopoulos, 2017). For this, we conducted qualitative analysis of the content of messages posted in the discussion activities. We used the illocutionary unit (Howell-Richardson & Miller, 1996), which focuses on the linguistic properties of the messages and the individual to whom the message is directed, as the unit of analysis. All messages were coded in terms of the type of interactions using the coding scheme given in Table 2.

Table 2

Interaction Coding Scheme

Type of interaction	Code	Criteria
Group proactive	GP	Student or tutor looks for a response from someone in the group - anyone
Group reactive	GR	Student or tutor responds to one of the above, or some other message, playing reply back to group
Individual proactive	IP	Student or tutor looks for a response from a specific contributor, or even asks for it
Individual reactive	IR	Student of tutor responds to one of the above, or some other message, from and then to a specific contributor
Quasi interactive	QI	Threaded (follow-up) message where tutor or student acknowledges previous message but continues with a new idea/concept.
Monologue	M	A new thread. No evidence of interaction with any other participant

Note. For detailed indicators of criteria refer to Vlachopoulos 2012).

Two researchers independently performed the coding and achieved a Cohen's (1960) Kappa interrater reliability of 72%. Figure 3 shows the types of interactions within each discussion. Of a total of 292 types of interactions, 91 occurred in discussion 1, 106 in discussion 2, and 95 in discussion 3. Discussion 1 had the highest number of GP and an equally high number of IR interactions, which indicates that while participants addressed the entire group, they also reached out to others. However, the low reciprocity found indicates that they were not responding or reacting to each other. Discussion 2 had the highest number of GP interactions followed by the highest number of QI messages indicating that while individuals posted to the group, they were not specifically responding to messages directed to them.

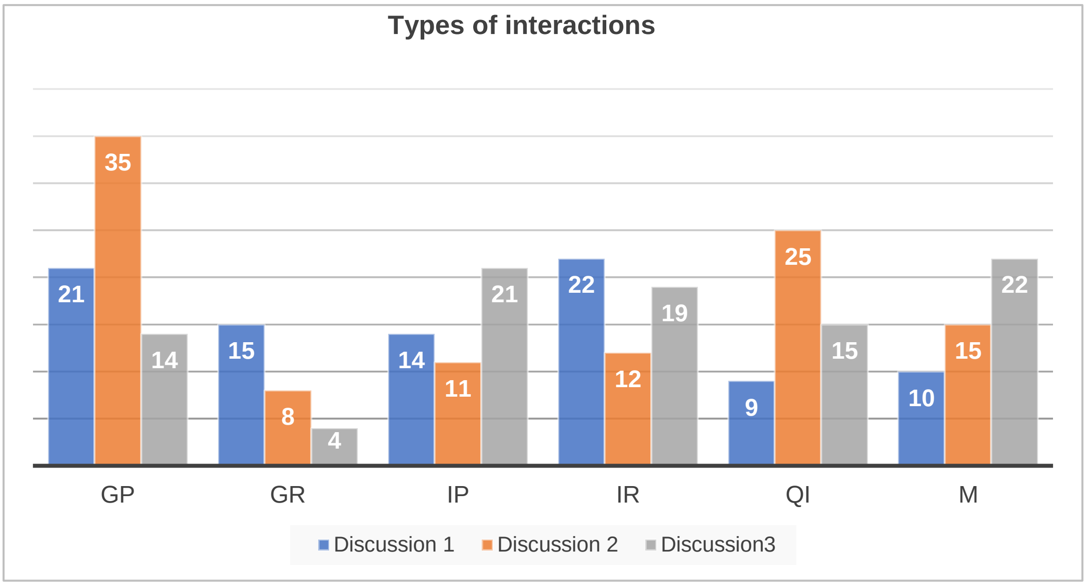


Figure 3. Types of interactions in discussions.

Again, this finding fits well with the low reciprocity found. Discussion 3 was dominated by M, IP, and IR interactions, which bodes well with findings from the SNA, i.e. there was a relatively high degree of mutual exchange (reciprocity), a few isolates, and a low level of group communication. The dominance of GP messages in discussions 1 and 2 lead us to conclude that messages directed to the entire group were a contributing factor in formation of the CoP.

Conclusion

In a CoP, individuals who share a *practice* come together as they *mutually exchange* ideas and negotiate meaning while creating a *shared repertoire* of conceptual and material artefacts (Wenger, 1998). As conceived by Wenger (1998) in its originality, a CoP is a natural occurrence and is formed whenever there is a practice, mutual engagement, and a shared repertoire. Learning, as signified by the process of LPP or identity formation, takes place within the CoP inevitably. In the context of online learning, if a CoP exists, we would expect similar patterns of engagement and learning to occur. However, in the online environment, a CoP may not form naturally and therefore needs to be artificially cultivated by design. As discussed earlier, a learning design does not have the capacity to orchestrate the learning experience or formation community but can create an environment conducive to its formation. Exploration of if and how this is achieved was the key objective of our research. In line with the research questions guiding our investigation, there are three key takeaways from our findings. Firstly, using CoP constructs from the IMF, we were successfully able to use SNA to structurally identify the type of community formed in each discussion activity by looking at the network diagrams and whole-network SNA measures. Secondly, we found that the guidance and facilitation in discussion 1 provided by the tutor was critical in setting the stage for the initial formation of the CoP. Replacing the tutors' guidance and facilitation with the practice-based design in discussion 2, maintained the structure of the community as the student-centered and student-directed discussion was able to sustain the CoP despite withdrawal of the tutor. In discussion 3, the absence of the tutor and the free-flowing, undirected design of the discussion, led to the disintegration of the CoP as student engagement lost its momentum and the nature of the interactions changed. As found by the qualitative analysis, another key influential factor in the formation of the CoP was the type of interaction or message within the discussions. Discussions 1 and 2 were dominated by group proactive messages that addressed the entire group while discussion 3 was dominated by monologues.

In terms of practical implications for learning design and analytics in the online learning context, firstly, our findings validate the application and effectiveness of the IMF in identifying a CoP without having to conduct extensive qualitative analysis as has been the case previously (Jan, Vlachopoulos, & Parsell, in press). Secondly, the learning designs of the successive discussions 1 and 2 act as exemplars of the sort of design that could potentially bring students and/or tutors together to form a CoP should that be the intention of the designer. Thirdly, with respect to the role of the tutor, facilitation can be planned during a course of study by generating cross-sectional network diagrams, which indicate the orientation of the network in terms of the type of community being formed. Again, if the learning design intends to create a specific type of community, appropriate facilitation or intervention can be planned to alter the underlying structure of the community, i.e. the network. Last, but certainly not the least, group proactive messages or posts seem to illicit greater engagement and response. Therefore, tutors should try to address the entire group in their posts, at least at the beginning of an activity, such as in a discussion forum.

In terms of limitations of the study, we would like to point out that the study merely examines the formation of a community of learning in the online learning context. It does not claim that learning within one particular type of community is better than another, or even that community-based learning is more effective than otherwise. Furthermore, the study does not consider the critical influence of individual attributes on individual engagement. For a more holistic exploration, further research should look at student performance and attributional data to explore the relationships between engagement within a community, individual attributes like goal orientation and self-efficacy, and performance.

References

Agostinho, S., Oliver, R., Harper, B., Hedberg, J., & Wills, S. (2002). A tool to evaluate the potential for an ICT-based learning design to foster "high-quality learning". In A. Williamson, A. Young, C. Gunn, & S. Clear (Eds.*), Winds of change in the sea of learning*. *Proceedings of the 19th Annual Conference of the Australasian Society for Computers in Learning in Tertiary Education* (pp. 8-11). Auckland, NZ: UNITEC Institute of Technology. Retrieved from http://ro.uow.edu.au/edupapers/125/

Anderson, T., Rourke, L., Garrison, D. R., & Archer, W. (2001). Assessing teaching presence in a computer conferencing context. *Journal of Asynchronous Learning Networks, 5*(2), 1–17. doi. 10.1.1.409.9114

Biza, I., Jaworski, B., & Hemmi, K. (2014). Communities in university mathematics. *Research in Mathematics Education, 16*(2), 161-176. doi.10.1080/14794802.2014.918351

Borgatti, S.P., Everett, M.G., & Freeman, L.C. (2002). *Ucinet 6 for Windows: Software for social network analysis*. Harvard, MA: Analytic Technologies. Retrieved from https://www.bibsonomy.org/bibtex/2760c85a6db2aa933963b1410aaee04c7/cabird

Boud, D., & Prosser, M. (2002). Appraising new technologies for learning: A framework for development. *Educational Media International, 39*(3), 237-245. doi.org/10.1080/09523980210166026

Carvalho, L. & Goodyear, P., eds. (2014). *The architecture of productive learning environments*. New York and London: Routledge. Retrieved from https://www.taylorfrancis.com/books/e/9781135070182

Carvalho, L., Goodyear, P., & De Laat, M. (2017). Place, space, and networked learning. In L. Carvalho, P. Goodyear, & M. De Laat (Eds.), *Place based spaces for networked learning* (pp. 1-10). New York and London: Routledge. Retrieved from https://www.routledge.com/Place-Based-Spaces-for-Networked-Learning/Carvalho-Goodyear-de-Laat/p/book/9781138850880

Cohen J. (1960). A coefficient of agreement for nominal scales. *Educational and Psychology Measurement*, *20*, 37–46. doi/abs/10.1177/001316446002000104

Cela, K. L., Sicilia, M. A., & Sanchez, S. (2015). Social network analysis in e-learning environments: A preliminary systematic review. *Educational Psychology Review, 27*, 219-246. doi.10.1007/s10648-014-9276-0

Conole, G. (2012). *Designing for learning in an open world*. Dordrecht: Springer.

Dawson, S., & Siemens, G. (2014). Analytics to literacies: The development of a learning analytics framework for multiliteracies assessment. *The International Review of Research in Open and Distributed Learning, 15*(4), 284-305. doi.10.19173/irrodl.v15i4.1878

De Laat, M. (2012). *Enabling professional development networks: How connected are you?* Heerlen: LOOK, Open Universiteit of the Netherlands. Retrieved from https://www.avs.nl/sites/default/files/documenten/artikelen/12014/De%20Laat%20-%20Enabling%20professional%20development%20networks.pdf

De Laat, M., & Prinsen, F. R. (2014). Social learning analytics: Navigating the changing settings of higher education. *Research & Practice in Assessment, 9,* 51 – 60. Retrieved from *w*ww.rpajournal.com/dev/wp-content/uploads/2014/10/A5.pdf

Donald, C., Blake, A., Girault, I., Datt, A., & Ramsay, E. (2009). Approaches to learning design: past the head and the hands to the HEART of the matter. *Distance Education, 30*(2), 179-199.

Fink, J. E., & Inkelas, K. K. (2015). A history of learning communities within American higher education In M. Benjamin (Ed.), *Learning communities from start to finish: New directions for student services* (pp. 5–15). Wiley Online Library. doi.10.1002/ss.20113

Garrison, D. R., & Anderson, T. (2003). *E-learning in the 21st century: A framework for research and practice*. New York: RoutledgeFalmer. doi.10.4324/9780203166093

Garrison, D. R., & Cleveland-Innes, M. (2005). Facilitation cognitive presence in online learning: Interaction is not enough. *The American Journal of Distance Education, 19*(3), 133-148. doi. 10.1207/s15389286ajde1903_2

Goodyear, P., Banks, S., Hodgson, V., & McConnell, D. (2004). Research on networked learning: An overview. In P. Goodyear, S. Banks, V. Hodgson, & D. McConnell, (Eds.), *Advances in research on networked learning* (pp. 1-9). Dordrecht, The Netherlands: Kluwer. doi.10.1007/1-4020-7909-5_1

Howell-Richardson, C., & Mellar, H. (1996). A methodology for the analysis of patterns of participation within computer mediated communication courses. *Instructional Science, 24,* 47–69. doi.10.1007/BF00156003

Hughes, J., Jewson, N., & Unwin, L. (2007). Introduction. In J. Hughes, N. Jewson, & L. Unwin (Eds.), *Communities of practice: Critical perspectives* (pp. 1-10). London: Routledge. Retrieved from https://www.amazon.com/Communities-Practice-Perspectives-Jason-Hughes/dp/0415364744

Jan, S. K., & Vlachopoulos, P. (2018). Social network analysis: A framework for identifying communities in higher education online learning. *Technology, Knowledge and Learning*. doi.10.1007/s10758-018-9375-y

Jan, S. K., Vlachopoulos, P., & Parsell, M. (in press). Social network analysis and learning communities in higher education online learning: A systematic literature review. *Online Learning.*

Kop, R., & Hill, A. (2008). Connectivism: Learning theory of the future or vestige of the past? *International Review of Research in Open and Distance Learning, 9*(3). doi.10.19173/irrodl.v9i3.523

Lave, J. & Wenger, E. (1991). *Situated learning: Legitimate peripheral participation*. Cambridge: Cambridge University Press. doi.10.1017/CBO9780511815355

Lockyer, L., Heathcote, E., & Dawson, S. (2013). Informing pedagogical action: Aligning learning analytics with learning design. *American Behavioral Scientist, 57*(*10*), 1439-1459. doi.10.1177/0002764213479367

Matthews, R. (1994). Enriching teaching and learning through learning communities. In T. O'Banion (Eds.), *Teaching and learning in the community college*. Washington, DC: The American Association of Community Colleges. Retrieved from https://www.amazon.com/Teaching-Learning-Community-College-OBanion/dp/0871172666

Merriam-Webster. (2017). Merriam-Webster dictionary. Retrieved from https://www.merriam-webster.com/dictionary/community

Moule, P. (2007). Challenging the five-stage model for e-learning: A new approach. *Research in Learning Technology, 15*(1), 2-36. doi.10.3402/rlt.v15i1.10911

Palloff, R., & Pratt, K. (1999). *Building learning communities in cyberspace*. San Francisco: Jossey-Bass. Retrieved from https://www.amazon.com/Building-Learning-Communities-Cyberspace-Jossey-Bass/dp/0787944602

Pike, G. R. (1999). The effects of residential learning communities and traditional residential living arrangements on educational gains during the first year of college. *Journal of College Student Development*, *40*(3), 269–284. Retrieved from https://www.researchgate.net/publication/232494922_The_Effects_of_Residential_Learning_Communities_and_Traditional_Residential_Living_Arrangements_on_Educational_Gains_During_the_First_Year_of_College

Rourke, L., Anderson, T., Garrison, D. R., & Archer, W. (2001). Methodological issues in the content analysis of computer conference transcripts. *International Journal of Artificial Intelligence in Education, 12,* 8-22. Retrieved from http://iaied.org/pub/951/file/951_paper.pdf

Salmon, G. (2000). *E-moderating: The key to teaching and learning online*. London: Kogan Page. doi.10.4324/9780203465424

Salmon, G. (2003). *E-moderating: The key to teaching and learning online* (2nd ed.). London: RoutledgeFalmer. Retrieved from http://oro.open.ac.uk/1559/

Shea, P., & Bidjerano, T. (2010). A re-examination of the community of inquiry framework: Social network and content analysis. *Internet and Higher Education, 13*, 10–21. doi.10.1016/j.iheduc.2009.11.002

Shea, P., Hayes, S., Smith, S. U., Vickers, J., Bidjerano, T, Gozza-Cohen, M., ..., Tseng, C. (2013). Online learner self-regulation: Learning presence viewed through quantitative content- and social network analysis. *International Review of Research in Open and Distributed Learning, 14*(3), 427-461. doi.10.19173/irrodl.v14i3.1466

Socnetv. (2017). Social network analysis and visualization software, v.2.3. Retrieved from http://socnetv.org/

Smith, B. L. (2001, Summer/Fall). The challenge of learning communities as a growing national movement. *Association of American Colleges & Universities, Peer Review, 4*(1). Retrieved from https://www.aacu.org/publications-research/periodicals/challenge-learning-communities-growing-national-movement

Stacey, E. (2002). Social presence online: Networking learners at a distance. *Education and Information Technologies, 7*(4), 287-294.

Tinto, V. (1998). Colleges as communities: Taking research on student persistence seriously. *Review of Higher Education, 21*(2), 167–177. Retrieved from https://muse.jhu.edu/article/30046

Vlachopoulos, P., & Cowan, J. (2010). Reconceptualising moderation in asynchronous online discussions using grounded theory. *Distance Education, 31*(1), 23-36.

Vlachopoulos, P. (2012). The importance of power dynamics in the development of asynchronous online learning communities. In M. Brown, M. Hartnett, & T. Stewart (Eds.), *Proceedings of ASCILITE - Australian Society for Computers in Learning in Tertiary Education Annual Conference 2012*. Australasian Society for Computers in Learning in Tertiary Education. Retrieved from https://www.learntechlib.org/p/42718/

Wenger, E. (1998). *Communities of practice: Learning, meaning, and identity* [Kindle Edition]. Cambridge University Press. doi.10.1017/CBO9780511803932

Wenger, E., Trayner, B., & De Laat, M. (2011) Promoting and assessing value creation in communities and networks: A conceptual framework. Open University of the Netherlands. Retrieved from http://wenger-trayner.com/documents/Wenger_Trayner_DeLaat_Value_creation.pdf

Zhao, C., & Kuh, G. D. (2004). Adding value: Learning communities and student engagement. *Research in Higher Education, 45*(2), 115 – 138. doi.10.1023/B:RIHE.0000015692.88534.de

International **R**eview of **R**esearch in **O**pen and **D**istributed **L**earning
Volume 19, Number 4

September – 2018

Effect of Communication Management on Distance Learners' Cognitive Engagement in Malaysian Institutions of Higher Learning

Bakare Kazeem Kayode
Al-Madinah International University (MEDIU)

Abstract

Rapid development of communication tools has brought about contentious issues in communication management in distance learning (DL) programs. The aim of this study is to investigate the relationships between communication management indicators, namely, communication practices, communication tools, and students' cognitive engagement in distance learning programs. A conceptual framework for communication management was developed from Moore's Transactional Distance Learning Theory (TDLT) and other existing literature. This study was conducted using quantitative research design. A questionnaire (a survey method) was used to elicit responses from 450 randomly selected in-service teachers from three Malaysian Public universities that offer blended mode distance-learning programs. Data analysis was conducted using Analysis of Moment Structures (AMOS) software to test the structural path of communication practices, communication tools, and students' cognitive engagement. Tests of hypotheses provided evidence of measures of fit statistics. The findings provide evidences that effective communication practices and communication tools have strong positive influence on distance students' cognitive engagement.

Keywords: communication management, cognitive engagement, communication practices, communication tools, distance learners

Introduction

Distance education or distance learning is a field of education that focuses on the use of technology in the delivery of curriculum to students who are not physically on site to receive their education (Taylor, 2006). Teaching and learning at a distance can be delivered via full electronic learning otherwise known as single delivery mode programs (synchronous or asynchronous) or blended delivery mode programs (Singh, 2003). Advancement in technology and the Internet has made the medium of teaching and learning more interactive and dynamic at a distance (Khan, 2005; Swerling & Thorson, 2014). Communication plays a very important role in the success of distance education programs. Guffey (2008) defines communication as a process within which the sender has an idea, encodes it as a message, and sends it over a channel (face-to-face, e-mail, telephone, or other methods of transmitting). The recipient then decodes this message (Guffey, 2008). This definition clearly shows the link between 'teaching-learning' and 'communication,' as teachers constantly impart new knowledge (or transmit information) and students receive this knowledge. The need to expand education via distance learning was given priority in the Tenth Malaysian Plan (2015-2025). It is stated in the plan that students will benefit from robust cyber infrastructure that can support the use of technologies like videoconferencing, live streaming and Massive Open. Higher learning institutions will also be required to ensure that 70% of their programmes use blended learning models.

The Malaysian Ministry of Higher Education (MOHE) encourages primary and secondary school teachers to upgrade their knowledge, skills, and qualifications (MoHE 2011-2015). To do this, Malaysian government made it compulsory for all teachers with a diploma degree who are still working (in-service teachers) in both primary and secondary school to complete a bachelor's degree through blended mode distance education programs offered by selected public universities (MoHE 2011-2015). This program, known as Program Pensiswazahan Guru (PPG), further guarantees the proposed shift of teacher education in Malaysia from quantitative expansion to qualitative improvement, and this shift will continue to respond successfully to the changes and challenges of the future (Noraini, 2010).

Ironically, the instructional support in distance education programs has not been put in proper perspectives (Mei, Su Ahmad and Rosnain 2017). This occurred because most institutions have not fully embraced distance education (Sa'adon, Dahlan, & Zainal, 2013). Such institutions offer distance learning as a crafted program. In these settings, the perception is that the instructor's role is mainly to grade or mark students' assignments, which are completed at an appointed time (Lentell, 2003). As the need for quality materials that can improve student cognitive engagement in distance education become imperative, distance-learning instructors must acquire requisite experience in Open Distance Learning (ODL) (Sa'adon, Dahlan, & Zainal, 2013; Rajasegeran, 2012) . The recruitment and selection of instructors with less experience in teaching distance-learning programs in most institutions is superfluous (Khan, 2005; Moore & Kearsely, 2005).

Maintaining quality pedagogy and efficient use of communication platforms in distance learning programs are the major challenges to many higher institutions (Allen & Seaman, 2013; Swerling & Thorson, 2014). Studies in Malaysia revealed that many distance education tutors did not support distance students with necessary pedagogical practices such as higher-order thinking and collaborative learning (Bahroom & Abdol Latif, 2012; Dzakiria, 2012; Kaur 2006). Problems related to switching from traditional face-to-face teaching styles to virtual classroom teaching that requires different communication practices such as course preparation and presentation peculiar to distance learning programs are significant challenges (Moore & Kearsely, 2012). The difficulties in adopting this new role lead to instructors' mishandling or poor management of online communication tools and ineffective delivery of course contents (Rienties, Giesbers, Lygo-Baker, Ma, & Rees, 2016).

Furthermore, according to Kaur (2006) such mishandling also leads to students' failure, lowers the morale of students to continue with the program, and occasionally leads to an intention to discontinue with the program. Angelaki (2013) argued that a lack of timely feedback on students' assignments and less active support from the tutor or instructors are reasons for early discontinuation of study. As such, investigating whether the instructors' handling or use of communication tools has connection with their pedagogical strength is highly germane in the present study.

Underutilization of communication tools like Learning Management Systems (LMS), e-mails, blogs, Facebook, and other distance learning communication platforms by instructors is very alarming in distance learning programs (Rienties et al., 2016). Many university lecturers face difficulties in using LMS to create instructional methods that truly engage students in learning (Steel, 2009). Very few distance education instructors in Malaysia truly practice some form of distance education activities timely response to forum questions, use of media for interaction etc. (Dzakiria, 2012). The inability of instructors to optimally use communication tools in teaching leads to low engagement of students' in learning activities (Kaur 2006). Surveys of student perceptions of instructors' use of LMS continue to indicate that students are concerned about the low levels of integration and quality of use of LMS in universities (Robbie, 2005). Therefore, it is necessary to investigate whether underutilization of communication media play any significant impact on distance students' cognitive engagement.

Program Pensiswazahan Guru (PPG) is designed for the in-service teachers in Malaysia. This program is conducted via distance learning in some selected Malaysia public universities. These teachers are somewhat unfamiliar with the blended distance-learning environment and the distance-learning administrators have not addressed most of their plight (MoHE 2011-2015). Due to the importance of in-service teachers, both to the Malaysian Ministry of Education and society, it is necessary to determine whether communication practices such as feedback, content, engagement, support in knowledge building, encouragement of higher-order thinking, and collaborative learning have any effect on students' engagement. Only handful of distance education instructors in Malaysia can demonstrate effective teaching to improve interaction and connectivity (Kaur 2006).

Theoretical Framework

The present study adopts Transactional Distance Learning Theory (TDLT). Transactional Distance Theory investigates the relationship between unique organization and unique teaching behaviors of instructors in distance education (Moore 2005). These teaching behaviors are classified into two clusters: dialogue and structure (Moore & Kearsley, 2005). Dialogue connotes the interplay of words and actions and can refer to any forms of interactions between instructor and students, for example, when the instructor gives an instruction, and the student responds to it (Moore & Kearsley, 2005). Structure, as explained by Moore (2005), consists of elements in course content. An array of research has been conducted on dialogue and structure. For instance, Murphy and (Cifuentes 2001 Saba, 2000, Lemone 2005). Cifuentes (2001) suggested that a balance between course structure and dialogue between instructor and students is vital for distance students' success.

Transactional distance in education usually occurs whenever students do not take interest in their learning or are not engaged in meaningful dialogue especially with their instructors (Saba, 2000). Transactional Distance Learning Theory proposes that for communication to reduce transactional distance in educational programs and increase engagement, three sets of dialogic interactions must be adequately maintained and managed (Moore & Kearsley, 2005). These are student-student interaction, student-content interaction, and student-teacher interaction (Moore & Kearsley, 2005). Hillman, Willis, and Gunawardena (1994) have extended the interaction to include a "student-interface" interaction. Researchers such as Chen (2001), Zhang (2003), and Lemone (2005) studied the influence of these four variables on Web-based learning. Their findings indicate the influence of dialogue and structure on students' interaction and engagement by reducing the feeling physical and psychological distance between student and instructors. They also affirm that cultural differences is a significant factor that influences transactional issues. A hypothesized model in Figure 1 summarizes the variables that guide the present study.

As suggested by Moore and Kearsley (2005), the communication practices construct is used to encapsulate the following three types of interactions: (a) student-student, (b) student-teacher and, (c) student-content. A communication tool on the other hand is composed of student-interface interaction as mentioned by authors such as Fallon, (2011), Anderson (2003), Creedon, (2007), and Dzakiria, (2012). Moore and Kearsley also suggest that "by manipulating the communication media, it is possible to increase dialogue between students and their teachers, and thus reduce transactional distance" (p. 25).

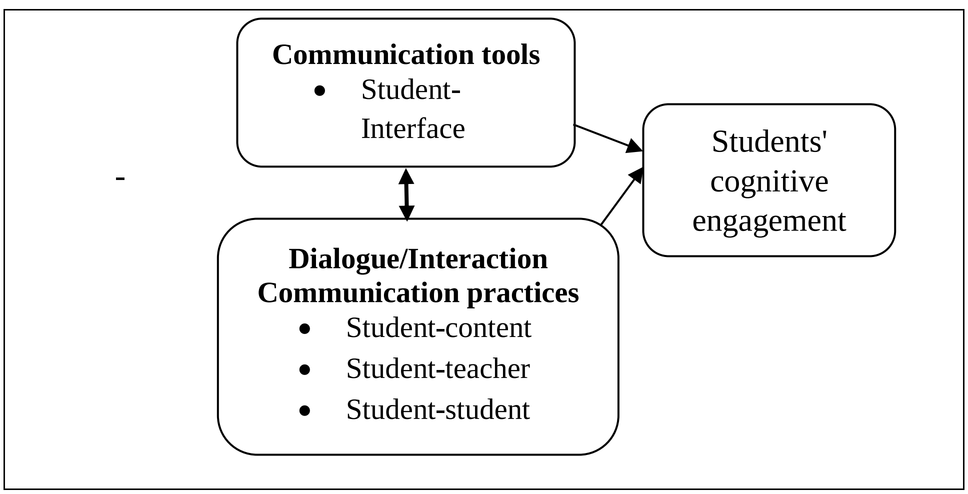


Figure 1. Hypothesized model for communication management in Distance Learning programs.

The principal point of Transactional Distance Theory as argued by its pioneer (Moore, 1989), is the centrality of the student to the educational process, of which interaction and communication play a vital role. Thus, to reduce transactional distance in teaching and learning programs, efforts must be made by instructors to manage course structure and interactions to improve students' understanding. In this study, elements of structure-student interaction, student-student interaction, student-content interaction, and student-teacher interaction are regarded as communication practices expected from instructors. Elements of dialogue-student-interface are classified as communication tools. This classification is premised on explanations of authors like Benson and Samarawickrema (2009) and Gorsky and Caspi (2005), who argued that distance-learning structure includes interactive activities, which are related to feedback programs, interactive course materials, and intrapersonal communication.

Previous Studies

Khan (2005) details how distance learning could be designed and managed. Khan developed an eight-clustered dimensional framework that can help to create a more meaningful learning environment in distance education. The clusters included in this framework are: institutional, management, technological, pedagogical, ethical, interface design, resources support, and evaluation (Khan, 2005). Since management of activities such as communication is the core issue of the present study, the researcher included a management dimension into the conceptual framework of the current study. Management of distance learning activities described by Khan refers to the maintenance of the learning environment and the distribution of information to improve learning. These two management components are integrated to form the communication management framework of the present study. Managing communication in distance learning is therefore divided into management and development of contents (i.e. communication practice) and managing delivery (i.e. managing communication tools).

Communication Practice and Communication Tools

Distance students may be constrained by time and space, but efficient online communication may enable students to form of social ties as if they were in a traditional classroom. Hrastinski (2008) privileged online discussion over face-to-face teaching. He asserted that when students agree with their colleagues in online discussion, they form social ties, and these are important for collaborative learning (Hrastinski, 2008). Nevertheless, Hrastinski did not elaborate on the conditions that can make student participation and engagement more profoundly established in distance learning programs. It should be noted that without communication, teaching and learning cannot take place. Learning will not be produced, if communication is not well managed. Hence, the objective of teaching and learning is either not achieved or underachieved. This suggests that certain activities, elements or components are necessary for communication in teaching distance learning courses to be effective in producing learning outcomes. These communication elements or components in the context of this study are referred to as communication practices.

McCrory, Putnam, and Jansen (2008) suggest that "there are ways to make sure that students engage meaningfully with subject matter" (p. 162) and ways for "teachers… [to] monitor and guide students' thinking…. for successful online learning environments" (p. 162). Communication practices which are required within the ODL teaching pedagogy include: challenging the student to think; communicating to the student the subject of the course; providing direction and additional resources; genuinely complimenting the student's posts; following up with the student; summarizing student's comments; directing students to another post, addressing more than one student comment at a time; sharing personal/professional experiences; responding more than once per week; using two or more communication strategies; and citing material other than course material (Belcher, Hall, Kelley, & Pressey, 2015). Distance learning instructors must practice these twelve positive characteristics to enhance critical thinking and Interaction within threaded discussions (Belcher et al., 2015).

In her study exploring the impact that communication and social presence has on adult students in distance learning, Angelaki (2013) discovered that more than 78% of the online students surveyed did not have the opportunity to communicate with their instructors. Dzakiria (2005) commented that there are limitations to the mode of teaching and learning in distance education programs in Malaysian institutions particularly on the issue of interactivity and the use of ICT in distance education, suggesting that interactivity will lead to further engagement and active participation. Communication practice enhances the communicative bridge between university management and students (Swerling & Thorson, 2014). Technological apparatus and administrative support for teaching and learning usually help both instructors and students to achieve their goals (Ahmad, Basha, Marzuki, Hisham, & Sahari, 2010). Moreover, with respect to the use of communication tools in distance learning, it is highly likely that technologies which are used as media of communication would facilitate or increase practices that enhance student interaction and engagement in learning (Rajasegeran, 2012). Technology improves practices such as timely feedback from lecturers and student responses to forums, as well as improves students' interactions (Angelaki, 2013). Dzakiria (2004) suggest that student-instructor interaction that relies on communication technology to present, clarify or elaborate information supports student learning, as well as supports the processes of providing feedback, evaluation, support, and encouragement. However, Dzakiria's discussion is geared towards the use of ICT only and preparing instructors and support like provision of modules does not seem to be a concern in this discussion. This is contrary to work by Moore and Kearsley (2005), wherein caution is made not be too enthusiastic about adopting new technology, but rather to give more attention to instructors who will be using the technology. Issues like participation, engagement in learning, and active interaction of distance students is indeed a problem in Malaysia that needs attention and action by all parties involved (Dzakiria, 2012). Based on these evidences, the current study hypothesizes that:

> Hypothesis 1: There is a positive correlation between communication practices and communication tools.

Communication Practice and Students' Cognitive Engagement

Effective management of course content by instructors can achieve a high level of cognitive engagement among students (Fallon, 2011; Angelaki, 2013). The previously discussed findings of both Kaur (2006) and Trevithick et al. (2004) adequately support arguments raised in this study. However, findings of both studies do not provide enough information regarding which teaching practices instructors need to integrate into their pedagogy. As such, there is a need to determine the impact of communication practices on students' engagement. In their research, Partlow and Gibbs (2003) identified different ways (called instructional practices) by which instructors can effectively deliver course material in distance learning courses. Included in the instructional practices suggested by Partlow and Gibbs are project-based learning tasks, cooperative group work, infrequent use of direct instruction, tasks that required higher-order thinking, interactivity, and student choice.

Partlow and Gibbs' (2003) research suggests a need to provide instructors with guidance regarding teaching practices that support effective delivery of course material to distance learning students, which is in line with the aim of this study. However, Bangert (2004) contends that this research is only an effort to inform faculty and institutions of the knowledge and expertise that are desperately needed by new course instructors. Bangert, on the other hand, proposes that institutions should focus more on quality validation of distance learning programs. The arguments of the present study are in consonance with Partlow and Gibbs' suggestions as well as with Bangert's arguments. Bangert's arguments seem to address the issue of quality and validation of instructional or communication practices (as used in this study), regardless of whether such practices result in students success

On the other hand, Partlow and Gibbs (2003) argue that evaluation of instructional practices may be counter-productive, because it may eventually jeopardize the success of the practices that are still gaining momentum. Contrary to Partlow and Gibbs' view, the argument presented in this study is that evaluation of communication practices between instructors and distance students is key in increasing student engagement and learning. Active participation and engagement in learning can only be achieved in the presence of instant messaging, teamwork, other opportunities for interaction with classmates, and course content. All these practices are expected to be designed, created or initiated by the instructors. In addition, more than 20 years ago, Chickering and Gamson (1987) identified seven guidelines for quality teaching of undergraduate in higher institution. Four of these seven guidelines dealt with interaction between the students, the instructor, and the content. As described by Lear, Ansorge, and Steckelberg (2010), instructors are individuals saddled with the responsibility of bringing a distinctive style of teaching which is developed throughout their teaching careers.

Consequently, communication practices involving clarity of languages, timely and prompt feedback, cooperation among students, pedagogical techniques, and motivation are highly encouraged for instructors (Angelaki, 2013). For students to be actively engaged in learning, instructors must seek to ensure that communication practices which facilitate dialogue (student-student, student-teacher, and student-content) such as instructional materials, course design, learning devices, clarity of language, and timely response to students' questions are well organized (Moore & Kearsley, 2012). In relation to this argument, this study also hypothesizes that:

> Hypothesis 2: Communication practices directly influence distance students' cognitive engagement.

Communication Tools and Students' Engagement

Teaching via technologies such as learning management systems (LMS), audiographic conferencing, one-way video, two-way video computer conferencing, e-mail and e-forum, and other communication media have been adopted by many higher institutions in Malaysia (Nawawi, Asmuni, & Romiszowski, 2009). However, the challenge is on how instructors use these technologies to improve communication between and among the distance students. Integration of ICTs in distance learning programs has lifted the distance education mode of delivery from a classical first and second generation (the use of correspondence mail) to a third-generation level of operation (Shirin, Sharifah, & Mohammed, 2014). Institutions of Higher Learning can leverage on novel digital learning infrastructure and have information and communication technologies at their hands to build global learning infrastructures (Sadat & Rahman, 2003).

Although technology has the potential to facilitate, enhance, and bring about effective learning, but the learning which results from the use of technology cannot be easily reproduced in other learning environments (Dzakiria, 2004). Most of the benefits of teaching and learning are intrinsic to interactivity, and it is pertinent to understand that the benefits of learning can only come via this interactive educational processes in combination with teaching tools, and not via the tools alone (Dzakiria & Kasim, 2002). In addition, findings regarding the effect of distance learning students' perceptions of the use of technology for communication and interaction are inconclusive (Dzakiria, 2012).

More so, instructors must be able to control and adequately interpret the information and course material provided to students. Moore and Kearsley (2012) contend that what many distance-learning programs are witnessing now is simply conventional classroom instruction within conservative structures, but with the blend of new communications technology. Therefore, investigating the positive effect of communication technology on engagement of distance students is necessary. This study therefore hypothesizes that:

Hypothesis 3: Communication tools directly influence students' engagement.

Method

This study adopts a quantitative research design. Questionnaires were used to elicit responses from students on engagement and communication management (communication practices and communication tools). Quantitative research is most appropriate to support hypotheses with statistical analysis when variables are known, and the researcher is interested in examining one variable in detail or describing the relationship between variables (Neuman, 2006). Three institutions of Higher Learning was involved in this research. The sample frame was the first, second, and third cohort of in-service teachers (undergraduate) who attended lessons at three-selected university campuses through a distance learning program. The population of this present study includes PPG students from three universities. These universities are:

1. International Islamic University (IIUM)
2. Universiti Pendidikan Sultan Idris (UPSI)
3. University Sains Islam Malaysia (USIM)

This study used a systematic random sampling technique. Population for this study is 4116. The population figure was divided by the estimated samples size number of 450 to get the sampling interval. Thus, 4116÷450=9, so every ninth respondent was selected. To do this, 4000 questionnaires were distributed to all students during a face-to-face learning session. One hundred and sixteen students were absent the day that the questionnaires were distributed. Therefore, only the 4000 PPG students were given the questionnaire. Prior to data collection, the students were briefed about the intent of the research. They were also informed that participation was voluntary and that there would be no repercussion for abstinence. Table 1 shows the distribution of the sample based on the three selected universities.

Table 1

Sample Distribution Based on the University

University	Distance students (In-service teachers) population (N)	Number of samples (n)
International Islamic University Malaysia (IIUM)	366	110
Universiti Pendidikan Sultan Idris (UPSI)	3,300	220
University Sains Islam Malaysia (USIM)	450	120
Total	4116	450 (10%)

**Note.* The information on this population was obtained from office of the distance learning coordinators of IIUM, USIM, and UPSI respectively.

Four hundred and fifty teachers, which is approximately 10% of total population, were systematically selected from the population of 4000 as shown in Table 1. The decision regarding the number of samples is based on the recommendation of Hair, Black, Babin, and Anderson (2010), who suggest that a sample size of >= 200 respondents is deemed appropriate for the structural equation model technique (SEM). Thus, researcher put up for the ratio of 10 respondents per parameter as recommended by Hair et al. (2010). In addition, to determine the sample size of 450 from a population of 4000, the researcher adopted the margin of error or accuracy technique suggested by Sekaran and Bougie (2010). The margin of error technique helped the study to determine the sample size within the probability of error tolerated. Before employing this technique, the researcher identified two basic components: the confidence interval and the margin of error. The confidence interval was set at 95% and the margin of error was set the lowest margin of error ± 5%.

The questionnaire items used in this study were taken from previous questionnaires created by Kaur (2006) and Lammers and Gillaspy (2013). The original questionnaire consisted of 63 items. All of the dimensions of the questionnaire items from Kaur (2006) and Lammers and Gillaspy (2013) were relabeled to reflect the dimensions of the constructs currently being studied. Certain phrases were modified and included. The instrument was then subjected to tests of face validity and construct validity. Two former PPG distance learning coordinators and three PhD students majoring in instructional technology, educational management, and language and literacy, conducted the first round of face validity. A series of comments were received on each of the items in the questionnaire. The researcher improved the instrument based on the suggestions provided.

Content validity is an extension of face validity, which relies on an assessment of whether the proposed measure incorporates all content of a construct (Martyn & Shuttleworth, 2009). For content validity, the instrument was sent to four experts: one professor, two associate professors (one of whom specialized in instructional technology), and one assistant professor (who specialized in measurement). This was followed by empirical evidence on the construct validity and reliability of the instrument. To test validity and reliability, a pilot test was carried out in two of the three institutions of Higher Learning selected for this study. The pilot test was conducted using distance-learning students from Universiti Pendidikan Sultan Idris (UPSI) and Institute of Education International Islamic University Malaysia (INSTED). Participants for this test included 120 PPG students: 80 participants from UPSI and 40 participants from INSTED. The students in the pilot test were not included in the 4000 participants sampled for the actual data. The study accomplished a three-factor solution accounting for 50.70% of the total variance explained. In other words, 50.70% of communication management model in the present study can be explained by 50.70% of the three factors. The Eigen values of three factors were in the range from 2.643 to 11.853. Based on the Composite Reliability test (CR) of each factor the factor communication practice with twenty items accounted for a very high reliability with CR of 0.95, communication tools with nine items, and student engagement with eight items accounting for CR of 0.89 respectively.

Data Analysis

The data collected from the population were subjected to data management and manipulation process. No missing data were replaced. In addition, 26 samples were discarded due to extreme values (outliers). The threshold point for the outlier is based on Mahalanobis distance (D2) with P< 0.001 (Kline, 2011).

Four hundred and five (405) completed sample data from PPG distance students form the final analysis of this study. The respondents background with respect to gender include 95 males (23.5%) and 310 females (76.5%). This result shows that the number of female in-service teachers is more than male in-service teachers. That is, early school workforce is still dominated by women. Societal perception, status, and payment might be the contributing factors.

Testing the Hypothesized Model

The model used within this study indicates two predictors for students' cognitive engagement as well as the relationship between the predictors. This model is based on the transactional distance learning theory (TDLT). Based on the results of the factor analyses, the researcher has formulated a full-fledged latent variable of the relationships between the communication management, (explained by communication practices and communication tools) and student cognitive engagement. The researcher adopts only the hypothesized model without any competing models.

In summary, the following hypotheses need to be addressed:

> H_1: Communication practices have a correlation relationship with communication tools
>
> H_2: Communication practices directly influence distance students' engagement
>
> H_3: Communication tools used in distance learning programs positively influence students' engagement.

With respect to general adequacy of the model, the results revealed an acceptable model fit. The relative Chi-square or Normed chi-square where the chi-square fit index divided by the degree of freedom (CMIN/*df*) was estimated to be 1.446 which falls below the threshold point of 3.000 (Kline, 2011), $\underline{p}$ = 0.012 ($\underline{p}$>0.05), Root mean square error of Approximation (RMSEA) = 0.033, Comparative fit index (CFI)=0.985, TLI=0.981, Root mean square residual RMR=0.016, Goodness-of-fit index (GFI) = 0.968 and Adjusted Goodness-of-fit index (AGFI) = 0.953. These results thereby satisfied the general hypothesis that the structural model fit the data. Table 2 presents the summary of fit indexes of the model. Due to the fit model, the individual parameters are further evaluated, and three specific hypotheses of the path relationships are then estimated (see Figure 2).

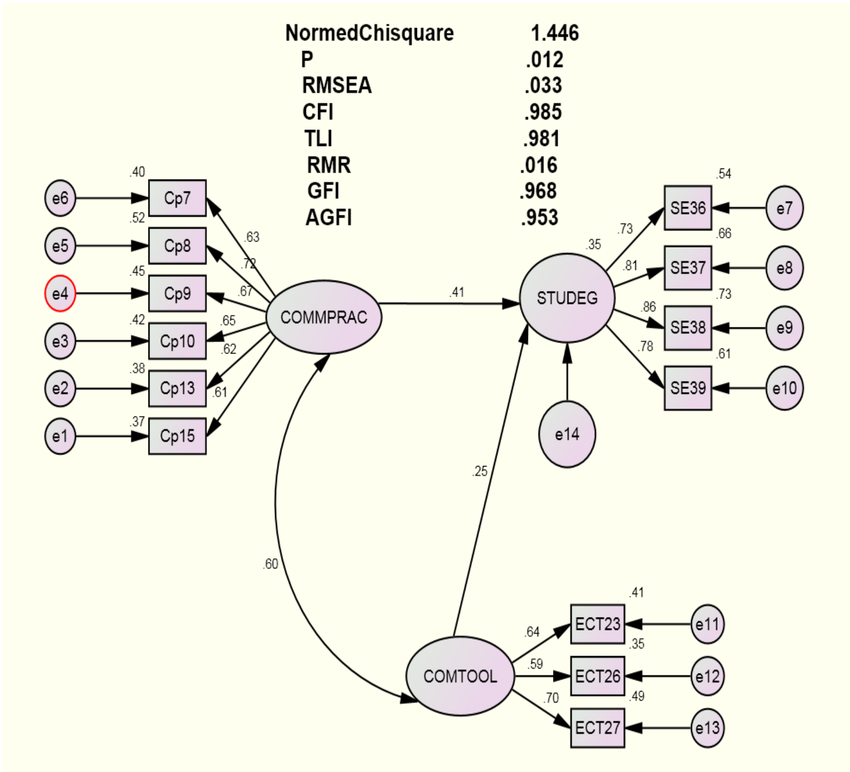


Figure 2. Hypothesized Model. COMMPRAC = communication practices, COMTOOL = communication tools, STUDEG = student cognitive engagement.

Table 2

Fit Indexes for the Hypothesized Model

Fit indexes	Obtained	Required value
CMIN/DF (if N > 200)	1.446	< 3.0
CFI	0.985	0 .90
RMSEA	0.033	0.05
GFI	0.968	0.95
AGFI	0.953	0 .95
RMR	0.016	0.05
TLI	0.981	0 .90

Table 3

Maximum Likelihood Parameter Estimates

Parameter	Standardized parameter	Critical ratio (C.R)		Standardized error (S.E)	Critical ratio (C.R)
Factor loading		**Measurement error variance**			
Cp15 Instructors usually present more thought-provoking issues during discussion	0.608	-	e1	0.026	12.538
Cp13 Reference of study materials (e.g. Web link, notes) are well organized by instructors	0.617	9.796	e2	0.026	12.466
Cp10 Issue in online discussion forum stimulates students thinking	0.650	10.240	e3	0.027	12.097
Cp9 Instructors/facilitators justify the relevancy of the content of online discussion	0.670	10.333	e4	0.027	11.883
Cp8 Interaction between instructors/facilitators and students in my class is well managed throughout the semester	0.724	10.920	e5	0.023	11.028
Cp7 Instructors/facilitators always make clear instruction on topic for discussion	0.634	9.870	e6	0.026	12.274
SE36 Discussion of course with peers challenges my thinking	0.735	-	e7	0.015	11.871
SE37 Inclusions of competition by instructors in discussion motivate me to prepare for response in other discussions.	0.813	15.841	e8	0.015	10.399
SE38 Discussion of content with instructors challenges my thinking.	0.855	15.971	e9	0.013	8.996
SE39 I like to learn new things, if the previous lesson are clearer to me	0.783	15.023	e10	0.015	11.151
ECT23 I like posting messages in the discussion board/chat-room/ because it is flexible to use	0.638	-	e11	0.041	10.392
ECT26 I received online discussion messages from myLMS on time from my instructors and peers.	0.595	8.469	e12	0.034	11.203
ECT27 Blog is an effective tool for student-instructor interaction	0.698	9.216	e13	0.035	8.960
Direct effects		**Disturbance variances**			
STE<--- COMP	0.426	5.174	e14	.136	7.676
STE<--- COMTOL	0.213	3.151			
Factor covariance and correlation					
COMP<-->COMTOOL	0.142	-	-	.022	6.471
COMP<-->COMTOOL	0.597				

**Note*. Maximum likelihood parameter estimates of standardized factor loadings, critical ratio, measurement error variances, and direct and covariance effect for structural model communication management.

Referring to Table 3, all the factor loadings were statistically significant at the 0.05 level (CR>1.96). The values were in the range of moderate loadings for item ECT26 *I received online discussion messages from myLMS on time from my instructors and peers* (standardized estimate was 0.595 and $R^2 = 0.354$), to high loadings for item SE38 *Discussion of content with instructors challenges my thinking* (Standardized estimates was 0.855 and $R^2 = 0.731$). All the variance of the errors were significant (CR>1.96). Table 4 displays the summary of the quantitative data analysis.

Table 4

Summary of Quantitative Data Analysis and Interpretation

Research hypothesis	Theory	Findings
Hypothesis 1: Communication practices positively correlate with communication tools	**Transactional distance learning**: Manipulating the communication media, it is possible to increase dialogue between students and their teachers (Khan, 2005; Moore & Kearsley 2005).	**Finding supports the hypothesis:** Communication practice has a significant relationship with communication tools. Standardized correlational effect of 0.597, Critical ratio CR>1.96
Hypothesis 2: Communication practices directly influence distance students' engagement	**Transactional distance learning**: Effective use of interaction between students-content, student-student, student-teachers (communication practices) will reduce the transactional distance and improve student autonomy (engagement; Moore, 1989)	**Finding supports the hypothesis:** Presence of communication and interaction elements among distance learning instructors significantly contributed to increase in cognitive engagement. Standardized regression weight of 0.409, CR>1.96
Hypothesis3: Communication tools used in distance learning positively influence students' engagement.	**Transactional distance learning**: Communication tools that promote student-interface interactions increase students' engagement in learning (Anderson 2003; Creedon, 2007; Dzakira, 2012).	**Finding supports the hypothesis:** Efficient use of communication tools such as private *e-mails, online discussion messages from myLMS, creation and use of Blog,* positively influences students' cognitive engagement. Standardized regression weight of 0.213 (CR>1.96)

Discussion

Communication Practice Positively Correlates With Communication Tools

The results in Table 3 reveal that communication practice has a significant relationship with communication tools with a standardized correlational effect of 0.597. Thus, it can be concluded that 59.7% of the number of times the respondents (the in-service teachers) experience communication practices (presentation of interesting e-forum discussions and well-organized reference of study materials) in distance learning programs, is attributable to efficient use of communication tools such as private e-mails, myLMS, and use of Blog and Facebook by the instructors. The remaining number of times (40.3%) in-service teachers experience good communication practices, is due to other reasons. Therefore, the more the instructors in distance learning use the features available in myLMS, blogs, and private e-mails in teaching, the greater the students experience efficient communication practices. This relationship has shown that as distance students (in-service teachers) experience the use of diverse features in communication medium such LMS, e-mail, and Facebook (communication tools), the more they interact with their, learning material, colleagues, and instructor. Wahlstedt and Honkaranta (2007) support this as they asserted that communication tools like LMS, e-mails, Facebook etcetera, have provided tremendous prospect for students' interaction as well as prompt feedback from tutors.

Communication Practice Positively Influenced Student Cognitive Engagement

Table 4 reveals that application of communication practices such as presentation of thought-provoking issues during discussion, justifying the relevancy of the content of online discussion, well-managed connectivity and rapport have an effect on student cognitive engagement in challenging discussion with peers, motivation to response in other discussions and willingness to learn new things. The strength of this causal relationship is relatively strong with standardized direct effect of 0.409 (CR>1.96). These results indicate that communication practices by DL instructors predicted students' effort to engage in learning, which in turn determined their learning outcomes at the end of PPG distance learning programs. In other words, students whose instructors provide communication practices measured by course content, learning material, and feedback had higher levels of cognitive engagement, and spent effort in learning, and therefore higher levels of performance in tests taken at the end of courses. In tandem with Burgess (2006), interaction and teamwork among students and cooperation between students and instructors are practices that are necessary for students' creative and critical thinking in a genuine context.

In addition, this study supports research by McGivney (2004) and Khan (2005) who suggest that managing learning resources such as course content and presentation, together with an interactive students' group, promotes higher thinking and self-directed distance learning students. On the other hand, our results contradicted studies by Coates (2006), Trowlers (2010), and Fredrick et al. (2004), within which learning environment and individual learning attitude are the determinants of how engaged students are. In our study, the students' cognitive engagement was explained by only 35% of its predictors, namely communication practices and communication tools. However, other factors such as learning environment structure and process and students' attitude towards learning may provide more influence on cognitive engagement among distance students. Further research on these factors is therefore needed.

Communication Tools Positively Influenced Students' Engagement

Table 4 shows that the communication tools significantly influenced students' engagement with a standardized direct effect of 0.213 (CR>1.96). This estimate indicates that the efficient use of communication tools such as *private e-mails, e-forum discussion and myLMS,* by distance learning instructors contributes to students' engagement in *challenging discussion with peers*, *response in other discussions*, *challenges thinking content*s. This indicates that students whose instructors optimally utilize the feature in communication tools like LMS were more interested in learning. A study conducted by Yu and Yu (2002) confirmed that e-mail is viable in promoting students' cognitive growth and engagement especially in distance learning. E-mail has characteristics that influence its suitability for learning purposes (Bouhnik & Deshen, 2014; Calvo, Arbiol, & Iglesias, 2014). The use of LMS and the use of other social interactive features such as e-mail and Facebook usually initiate class discussion among students and instructors (Almrashdeh et al., 2010). However, the direct relationship between communication tools and students' cognitive engagement appears not to be very high as compared to communication practices.

In summary, the hypothesized model has provided a reasonable explanation of the structural model of communication management (communication practices and communication tools) and students' cognitive engagement employed in the present study. The model was explained by two exogenous variables (communication practices and communication tools) and one endogenous variable (students' engagement). The overall observed variables that defined the respective factors are 13 indicators, 13 error variance and 1 residual.

Furthermore, findings from the hypothesized structural model have contributed to the implications for modeling of communication and interaction in distance learning by others (Anderson, 2003; Angelaki, 2013; Dzakiria, 2012; Moore, 1993) and cognitive engagement by Trowler (2010). The model has further expanded the theory of transactional distance learning by including communication tools (student-interface interaction) interaction in the context of communication management in distance learning.

Conclusion

Communication practices and communication tools are significantly related to students' engagement. However, the current state of use of communication tools in ODL programs in Malaysian public Higher Learning institutions surveyed is not efficient enough to allow for a great deal of content control and interaction between teacher and students. Communication practices are the strongest predictor that significantly contribute to student engagement in distance education settings. Nevertheless, insufficient and inefficient use of communication tools like LMS characterize the management of communication in the delivery course content to distance students. This indicates that distance-learning instructors are underutilizing the communication tools, which has led to low student engagement in learning and low management of communication in distance learning in general.

Implications of the Study

Theoretical Implication

This study has extended literature in Transactional Distance Theory, communication management, and student engagement. Previous findings of the Transactional Distance Learning Theory indicated that the basic interaction in distance learning revolved around three interactions: student-student, student-content, and students-teacher (Moore, 2005). However, the findings of the present study have shown that interaction in transactional distance theory must also include communication tools (students-interface) interaction.

Implications to Education

This study has pointed out the need for university management to investigate patterns of communication and interaction between students and instructors in distance learning programs. The need for an efficient use of communication media is imperative because it allows prompt and regular feedback (communication practices). There is also a need for thought-challenging discussions and willingness to learn new things (cognitive engagement). An ideal distance learning instructor should be able to organize, manipulate, and present lessons to produce creative and self-regulated students. Despite the existing learning materials and Learning Management System (LMS) in the three universities observed, self-dependent learning ability of the PPG students in the institutions needs to be further enhanced. Thus, administrators should increase training to improve the skills and competence of the instructors to make learning be closer, challenging, and interesting to students. This helps students become more involved in the learning process.

References

Ahmad, T. B. T., Basha, K. M., Marzuki, A. M., Hisham, N. A., & Sahari, M. (2010). Faculty's acceptance of computer-based technology: Cross-validation of an extended model. *Australasian Journal of Educational Technology*, *26*(2), 268-279. http://www.ascilite.org.au/ajet/ajet26/ahmad.html

Almarashdeh, I., Nur Fazidah, E., Noraidah, S., & Nor Azan, M. Z. (2013). Development of an interactive learning management system for Malaysian distance learning institutions Middle-East. *Journal of Scientific Research, 14*(11).

Allen, I. E., & Seaman, J. (2013). *Conflicted: Faculty and online education, 2012*. Babson Park, MA:

Babson Survey Research Group. Retrieved http://files.eric.ed.gov/fulltext/ED535214.pdf

Anderson, T. (2003a). Getting the mix right again: An updated and theoretical rationale for interaction. *International Review of Research in Open and Distance Learning*, *4*(2). Retrieved from http://www.irrodl.org/index.php/irrodl/article/view/149/230

Angelaki, C. (2013). Communication and social presence: The impact on adult students' emotions in distance learning. *Journal of the Theoretical Humanities*, *18*(1), 78-93.

Bangert, A. W. (2004). The seven principles of good practice: a framework for evaluating online teaching. *The Internet and Higher Education*, *7*(3), 217-232. Retrieved from http://dx.doi.org/10.1016/j.iheduc.2004.06.003

Bahroom, R., & Abdol Latif, L. (2012). *Open and distance learning as the key driver of lifelong learning*. Proceeding Malaysia Ministry of Higher Education Seminar on Life Long Learning Seminar: PWTT, Kuala Lumpur, 22-23 September 2012.

Belcher, A. R., Hall, B. M., Kelley, K., & Pressey, K. L. (2015). An analysis of faculty promotion of critical thinking and peer interaction within threaded discussions. *Online Learning, 19*(4).

Benson, R., & Samarawickrema, G. (2009). Addressing the context of e-learning: using transactional distance theory to inform design *Distance Education, 30*(1) 5–21. doi: ttp://dx.doi.org/10.1080/01587910902845972

Bouhnik, D., & Deshen, M. (2014). WhatsApp goes to school: Mobile instant messaging between teachers and students. *Journal of Information Technology Education: Research*, *13*, 217-231. Retrieved from http://www.jite.org/documents/Vol13/JITEv13ResearchP217-231Bouhnik0601.pdf

Burgess, J. (2006). Transactional distance theory and student satisfaction. (Doctorate dissertation, The University of West Florida). Retrieved from http://uwf.edu/vburgess/Final_Dissertation.pdf

Calvo, R., Arbiol, A., & Iglesias, A. (2014). Are all chats suitable for learning purposes? A study of the required characteristics. *Procedia Computer Science*, *27*, 251-260.

Chen, Y.-J. (2001). Dimensions of transactional distance in the World Wide Web learning environment: A factor analysis. *British Journal of Educational Technology*, *32*(4). 459-470. http://dx.doi.org/10.1111/1467-8535.00213

Chickering, A. W., & Gamson, Z. F. (1987). Seven principles of good practice in undergraduate education. *AAHE Bulletin, 39*(7), 3-7.

Coates, H. (2006). *Student engagement in campus-based and online education*. London: Routledge. Retrieved from http://www.cqu.eblib.com.ezproxy.cqu.edu.au/EBLWeb/patron/

Creedon, S. (2007). Preparing nurses on-line to work off-line: Experiences gained from teaching final year undergraduate nursing students in Ireland. *Online Journal of Nursing Informatics* (OJNI), *11*(1). Retrieved from http://ojni.org/11_1/creedon.htm

Dzakiria, H. (2004). Technology does not always teach distance students, but effective distance teachers do. *Journal of Open and Distance Learning, 1*(1), 1823-1144.

Dzakiria, H. (2012). Illuminating the importance of learning interaction to open distance learning (ODL) success: A qualitative perspectives of adult students in Perlis, Malaysia. *The Journal of Open Distance Learning, 16*(59), 111-125.

Dzakiria, H., & Kasim, A. (2002). ICT acceptance and enthusiasm: A case study of University Utara Malaysia Students, Malaysian. *Journal of Educational Technology*, *2*(2), 67-76.

Fallon, G. (2011). Making the connection: Moore's theory of transactional distance and its relevance to the use of a virtual classroom in postgraduate online teacher education. *Journal of Research on Technology in Education, 43*(3), 187-209.

Gorsky, P., & Caspi, A. (2005). A critical analysis of transactional distance theory. *The Quarterly Review of Distance Education, 6*(1), 1-11.

Guffey, M. E. (2008). *Business communication: Process & product*. Mason, OH: Southwestern, Cengage Learning.

Hair, J. F., Black, W. C., Babin, B. J., & Anderson, R. E. (2010). *Multivariate data analysis* (7th ed.). New York: Pearson Prentice Hall.

Hillman, D. C., Willis, D. J., & Gunawardena, C. N. (1994). Student interface interaction in distance education: An extension of contemporary models and strategies for practitioners. *The American Journal of Distance Education, 8*(2), 3-42.

Hrastinski, S. (2008). The potential of synchronous communication to enhance participation in online discussions: A case study of two e-learning courses. *Journal of Information & Management, 45*, 499–506.

Kaur, A. (2006). E-learning challenges as perceived by communities of practice: Open University

Malaysia's experiences. *Asian Association of Open University (AAOU) Journal, 2*(1), 51-65.

Khan, B. H. (2005). *Managing e-learning strategies: Design, delivery, implementation, and evaluation*. Information Science Publishing (an imprint of idea group), Covent Garden, London.

Kline, R. B. (2011). *Principles and practice of structural equation modeling* (3rd ed.). New York, NY: The Guildford Press.

Lammers, W. J., & Gillaspy J. A. Jr. (2013). Brief measure of student instructor rapport predicts student success in online courses. *International Journal for the Scholarship of Teaching and Learning*, *7*(2).

Lear, J. L., Ansorge, C., & Steckelberg, A. (2010). Interactivity / community process. *Model for the Online Education Environment*, *6*(1), 71-77.

Lemone, K. A. (2005). Analyzing Cultural Influences on E-Learning Transactional Issues. Proceeding of E-Learn: World Conference on E-Learning in Corporate, Government, Healthcare, and Higher Education (pp. 2637–2644). Vancouver, Canada.

Lentell, H. (2003). The importance of the tutor in open and distance learning. In A. Tait & R. Mills (Eds.), *Rethinking student support in distance education change and continuity in an international context*. London, UK: Routledge Falmer.

Malaysia Ministry of Higher Education.(2015). Blueprint 2015-2025 executive summary Kementerian Pendidikan. Putrajaya, Malaysia. Retrieved from www.moe.gov.my

Shuttleworth, M. (2009). Content validity. Retrieved from https://explorable.com/content-validity

McCrory, R., Putnam, R., & Jansen, A.(2008). Interaction in online courses for teacher education: Subject matter and pedagogy. *Journal of Technology and Teacher Education, 16*(2), 155-801.

McGivney, R. (2004). Technologies of online learning (E-learning). In T. Anderson & F. Elloumi (Eds.), *Theory and practice of online learning*. Athabasca, Canada: Athabasca University.

Mei, L., Su L.W., Ahmad, F. A., & Rosnaini, M. (2017). Teachers' perceptions of e-learning in Malaysian secondary schools. *Malaysian Online Journal of Educational Technology, 5*(2) 20-33.

Ministry of Higher Education.(2010). Report on the Implementation of the National Higher Education Strategic Plan: Planning and research division. Putrajaya, Malaysia. Retrieved from www.moe.gov.my

Ministry of High Education. (2015). Graduation determination review: Employment and status of employment. Putrajaya, Malaysia. Retrieved from www.moe.gov.my

Moore, M. G. (1989). Editorial: Three types of interaction. *The American Journal of Distance Education, 3*(2), 1–6.

Moore, M. G. (1993). Theory of transactional distance. In D. Keegan (Ed.), *Theoretical principles of distance education* (pp. 22-38). London, UK: Routledge.

Moore, M. G., & Kearsley, G. (2012). *Distance education: A systematic view of online learning* (3rd ed.). Belmont, VA: Wadsworth Cengage Learning.

Moore, M.G., & Kearsley, G. (2005). *Distance education: A systems view*. New York: Wadsworth.

Murphy, K. L., & Cifuentes, L. (2001). Using Web tools, collaborating, and learning online. *Distance Education: An International Journal, 22*(2), 285-305.

Neumann, M. S., & Yu. (2003). Differences between traditional and distance education academic performances: A meta-analytic approach. The *International Review of Research in Open and Distance Learning, 4*(2), 297-321.

Noraini, C. H. (2010). *Economic literacy among Malaysian students and student teachers: Education system in Malaysia*. Saarbrücken, Germany: LAP Lambert Academic Publishing.

Partlow, K. M., & Gibbs, W. J. (2003). Indicators of constructivist principles in Internet-based courses. *Journal of Computing in Higher Education, 14*(2), 68-97.

Rajasegeran, R. (2012). *Blended discrete trial clinical method to enhance performance in e-learning mathematics courses* (B7). Conference proceeding of Smart innovations in Education and lifelong learning. Muang Thong Thani, Nonthaburi, Thailand

Rienties, B., Giesbers, B., Lygo-Baker, S., Ma, H. W. S., & Rees, R. (2016). Why some teachers easily learn to use a new virtual learning environment: a technology acceptance perspective. *Interactive Learning Environments, 24*(3), 539-552.

Robbie, D. (2005). *Students use and experiences of Bb at Swinburne: A longitudinal study 2001-2005*. Paper presented at the Blackboard Asia Pacific Users Conference, Melbourne.

Saba, F. (2000). Research in distance education: A status report. *International Review of Research in Open and Distance Learning, 1*(1). Retrieved from http://www.irrodl.org/index.php/irrodl/issue/view/4/337

Sadat, A. & Rahman K. M. R. (2003 12-14 November). *Prospect of email communication as an educational tool for distance education in Bangladesh theme*. Paper presented at Provision for youth and young children Annual Conference, Thailand.

Sa'don, N. F. B., Dahlan, H. B. M., & Zainal, H. B. (2013, November). Derivation for design of virtual learning environment (VLE) framework for Malaysian schools. *Conference proceeding of*

International Conference on Research and Innovation in Information Systems (ICRIIS; pp. 570-575). IEEE.

Sekaran, U., & Bougie R. (2010). *Research methods for business* (5th ed.). Haddington, East Lothian: Scotprint.

Shirin, H.B., Sharifah Sariah Syed, H., & Mohammad, S. I. (2014). Interaction in e-learning environment: Does it fulfill with Islamic teaching? *Malaysian Online Journal of Educational Management 2*(4), 36-52.

Singh, H. (2003). Building effective blended learning programs. *Educational Technology*, *44*(1), 51-54.

Steel, C. (2009). Reconciling university teacher beliefs to create learning designs for LMS environments. *Australasian Journal of Educational Technology, 25*(3), 399-420.

Swerling, J., & Thorson, K. (2014). The role and status of communication practice in the USA and Europe. *Journal of Communication Management, 18*(1), 2-15.

Taylor, D. (2006). Issues , trends , and challenges in distance education: An international perspective, e-*Journal of Instructional Science and Technology, 4*(1), 41–25.

Trevithick, P., Richards, S., Ruch, G., Moss, B., Lines, L., & Manor, O. (2004). *Teaching and learning communication skills in social work education*. London, United Kingdom: Social Care Institute for Excellence (SCIE).

Trowler, V., & Trowler, P. (2010) *Student engagement evidence summary*. York: Higher Education Academy. Available at http://www.heacademy.ac.uk/assets/documents/studentengagement/StudentEngagementEvidenceSummary.pdf

Wahlstedt, A., & Honkaranta, A. (2007). Bridging the gap between advanced distributed teaching and the use of learning management systems in the university context. *Proceedings of the Seventh IEEE International Conference on Advanced Learning Technologies*. *Proceedings of a meeting held 18-20 July 2007,* Niigata, Japan.

Yu, F. Y., & Yu, H. J. (2002). Incorporating e-mail into the learning process: its impact on student academic achievement and attitudes. *Computers and Education Journal*, *38*(117). 117–126.

Zhang, A. (2003). *Transactional distance in web-based college learning environments: Toward measurement and theory construction* (Unpublished doctoral dissertation). Virginia Commonwealth University, Richmond.

International **R**eview of **R**esearch in **O**pen and **D**istributed **L**earning
Volume 19, Number 4

September – 2018

How do Virtual Teams Collaborate in Online Learning Tasks in a MOOC?

D.M.L. Verstegen[1], A. Dailey-Hebert[2], H.T.H. Fonteijn[3], G. Clarebout[4], and A. Spruijt[5]
[1] Maastricht University, School of Health Professions Education (SHE), [2] Park University, USA (Previously at Maastricht University, SBE), [3] Maastricht University, Department of Work and Social Psychology, [4] University of Leuven, Center for Instructional Psychology and Technology (Previously at Maastricht University, SHE), [5]Utrecht University, Faculty of Veterinary Medicine (Previously at Maastricht University, SHE)

Abstract

Modern learning theories stress the importance of student-centered and self-directed learning. Problem-Based Learning (PBL) supports this by focusing on small group learning centered around authentic problems. PBL, however, usually relies heavily on face-to-face team collaboration and tutor guidance. Yet, when applied in online/blended environments, such elements may not be feasible or even desirable. This study explores how virtual teams collaborate in online learning tasks in the context of a nine-week Massive Open Online Course (MOOC) where international, virtual teams worked on PBL-like tasks. Twenty-one self-formed teams were observed. An inductive thematic analysis resulted in five themes: 1) team formation and team composition, 2) team process (organization and leadership), 3) approach to task work (task division and interaction), 4) use of tools, and 5) external factors (MOOC design and interaction with others). Overall findings revealed that online, virtual teams can collaborate on learning tasks without extensive guidance, but this requires additional communication and technological skills and support. Explicit discussion about group organization and task work, a positive atmosphere, and acceptance of unequal contributions seem to be positive factors. Additional support is required to prepare participants for virtual team work, develop digital literacy, and stimulate more elaborate brainstorming and discussion.

Keywords: MOOC, problem-based learning, PBL, open educational resources, online learning, virtual teams, team collaboration, design-based research

Introduction

In the context of online learning, the role of the instructor or tutor has consequently been shown to influence student satisfaction, student learning, and persistence (Espasa & Meneses, 2010; Kauffman, 2015). Yet in recent years, and particularly with the influence of emergent technologies, more self-directed learning philosophies have emerged (Blaschke, 2012). Problem-Based Learning (PBL) aims at co-construction of knowledge by students (Barrows & Tamblyn, 1980; Dolmans, de Grave, Wolfhagen, & van der Vleuten, 2005), but has mainly been used in face-to-face settings and Higher Education curricula.

The first Massive Open Online Courses (MOOCs) specifically aimed at co-construction (Cormier & Siemens, 2010). However, since then, the majority of MOOCs have had a more traditional course-like set up with a fixed beginning and end point, providing a coherent set of resources and a sequence of activities organized by instructors (Hollands & Tirthali, 2014). Often, participants work individually, and interaction is limited to discussion fora and peer review of assignments. While MOOCs, in theory, offer a rich environment for self-directed, student-led learning it is not clear to what extent these promises are reached. MOOC research has mostly been quantitative, with limited attention for the experiences of learner populations and instructor-related topics (Veletsianos & Stepherdson, 2016).

MOOCs are open in the sense that anyone with adequate Internet access can participate in the course, typically without entry requirements and for free. They provide each individual learner with opportunities to engage with the content and the ability to personalize their learning environment (Evans, Baker, & Dee, 2016). However, there are also important challenges (Fournier & Kop, 2015). MOOCs are characterized by large dropout, typically more than 90% (Khalil, Hanan, & Ebner, 2014). Although this might be partly explained by the fact that participants do not always enter the course with the intention or need to complete it (Clark, 2016), MOOCs have also been criticized for lack of sound instructional design (Toven-Lindsey, Rhoads, & Berdan Lozano, 2015). The massive scale of MOOCs limits the applicability of proven instructional design principles, for instance because the amount of instructor support, feedback, and guidance is necessarily limited (De Freitas, Morgan, & Gibson, 2015). Alternative ideas stress learner participation and engagement and connectivism (Ahn, Butler, Alam, & Webster, 2013; Mackness, Waite, Roberts, & Lovegrove, 2013), but how to implement this in the design of a MOOC is less clear. MOOC practice shows a widespread use of traditional methodology based on teacher-directed video lessons (Fernández-Diaz, Rodriguez-Hoyos, & Calvo Salvador, 2017).

The researchers of this study pondered whether adult learners could work collaboratively online and without extensive guidance. This resulted in an exploratory observation study of virtual teams collaborating online on learning tasks in the context of a MOOC about Problem-Based Learning (PBL). PBL focuses on small-group learning centered around authentic problems (Barrows & Tamblyn, 1980). Traditionally, PBL groups meet face-to-face in the presence of tutor and follow a procedure which includes a collective brainstorm or pre-discussion, followed by individual self-study, and a collective reporting phase or post discussion regarding their findings (Moust, Bouhuijs, & Schmidt, 2014). Within our study, in the PBL MOOC, teams followed a similar procedure but online and without a tutor.

Both online and tutorless PBL have been used on a small scale, usually with advanced and/or postgraduate students. For example, Barber, King, and Buchanan (2015) used PBL in collaborative, online communities to enable students to discuss their own authentic problems. De Jong, Savin-Baden, Cunningham, and Verstegen, (2014) found that synchronous forms of online PBL using videoconferencing tools can be successful and similar to face-to-face PBL when students are motivated and prepared. However, van Tilburg (2014) found that this does not hold true for first year full-time students who are accustomed to face-to-face meetings and see no advantage in online PBL. PBL using asynchronous online tools, such as discussion boards or wikis appears to be less successful because this changes the procedure and form of discussion, often resulting in less interaction and superficial discussion (Verstegen et al., 2016a).

With respect to tutorless PBL, Hayashi, Tsunekawa, Inoue, and Fukuzawa (2013) found that students practicing PBL without a tutor were equivalent in final exam scores when compared to those who practiced PBL with a tutor. When exploring tutorless PBL in online environments, Fonteijn (2015) found that learners were able to thrive when afforded more autonomy and ICT support such as mapping software and communication tools. Ertmer and Koehler (2015), on the other hand, found that facilitated online discussions were superior to non-facilitated discussions. Woods, Duncan-Hewitt, Hall, Eyles, and Hrymark (1996) found that tutorless PBL groups experienced difficulty in workload distribution, building trust, and reliability.

The PBL MOOC

The MOOC *Problem-Based Learning: Principles and design. Students at the centre!* was designed to focus on interactive group work, while following PBL principles to enable constructive, contextual, collaborative, and self-directed learning (Dolmans et al., 2005). This MOOC about PBL was designed as a nine-week course with a study load of four to eight hours a week, and the defined target group consisted of people with a professional or personal interest in education in general, and PBL in particular. All assignments were group assignments, which were not graded but peer reviewed by members of other teams. Participants who finished the course received a Certificate of Participation (Verstegen et al., in press).

Within this PBL MOOC, participants completed their personal profile, then formed their own teams using the search facilities of the platform (individuals without a team were assigned to teams after the introduction week; Verstegen et al., in press, 2016b). Since participants were expected to vary widely in background and preferences, the MOOC design intentionally gave teams freedom in deciding how to interact and work together. Their first assignment was to complete a team charter discussing how they intended to collaborate during the MOOC. Subsequently, the teams worked on four authentic problem tasks. They were asked to brainstorm and generate learning questions or issues for further study within their team. Subsequently, they individually searched for and studied relevant sources, some provided in the MOOC and others found elsewhere. Next, teams were asked to collaboratively discuss what they had found in order to answer their own learning questions. The teams worked independently without a tutor. The course facilitators kept a general overview, answered questions on general discussion fora and provided general comments or tips based on their observations of all teams.

This MOOC was implemented in NovoEd (https://novoed.com), a platform that explicitly supports small group work. Each team was given private team space with chat facilities, file exchange, and facilities to schedule meetings (see Figure 1). After a smaller scale pilot test, the first fully open PBL

MOOC ran from October 5 to December 12 2015. More information about the instructional design and the delivery of the MOOC can be found in Verstegen et al., in press (2016b).

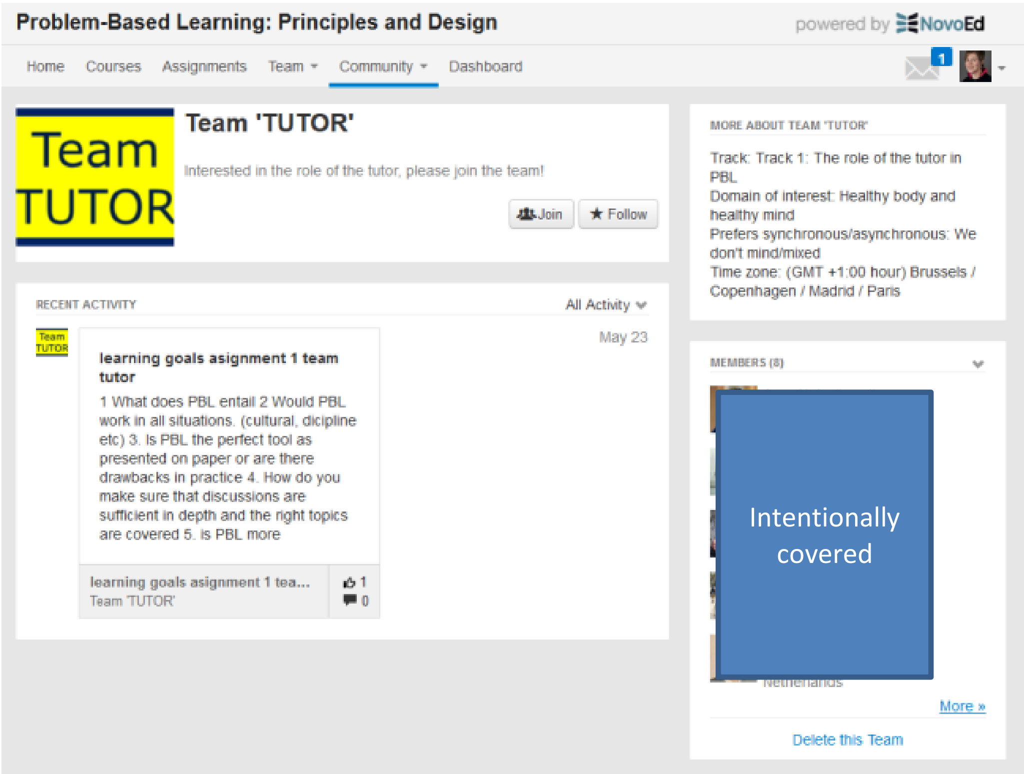


Figure 1. Team space with public profile page and private chat facilities, file exchange and facilities to schedule meetings.

Research Questions

The design of the previously described PBL MOOC followed a learning format that was in many ways similar to face-to-face PBL, but there were also large differences: there were no tutors, the teams worked online (virtual teams), the team members often did not know each other, teams were largely self-formed, and the participants varied widely in prior knowledge and experience. With this, our research questions for this study were:

- How do online, virtual teams collaborate on PBL tasks without the guidance of a tutor?
- How can we support online, virtual, tutorless teams in a MOOC?

Method

Participants

For this study, participants took part in the PBL MOOC described above from October 5 to December 12 2015. The MOOC started with 2989 participants. Just over a quarter (26%) filled in their profiles and became part of a team. Of these 109 teams, 49 (44%) finished the course and 264 participants received a certificate of participation. The majority of teams was formed by the participants themselves. After the first week, the facilitators formed 13 teams from the remaining participants, but since almost all of these teams were unsuccessful, they were excluded from this study. Questionnaire data show, that participants came from all over the world. Surprisingly, about two thirds of the participants that filled in their profile had never taken part in a MOOC before (Verstegen et al., 2016b).

For this study a subset of 21 teams was selected. The observers (the authors and three research assistants) asked permission to observe the teams' communication and collaboration in their NovoEd team space. Selection of teams was random except that teams that showed no recent activity were excluded. Up to week four, selected teams were replaced if they did not give consent, were no longer active, or if they communicated in a language the observers did not understand.

Procedure

Observers contacted the team leaders of the selected teams using a standard text message to explain the study. If the team leaders agreed the same message was posted in the team chat, stating explicitly that the observer would immediately stop observing the team if any member had objections. Observers did not participate in any way, but only followed the conversation in the team chat and any other documents or tools that they had access to (e.g. Googledocs files, uploaded documents, and links to other tools used by the team). Every week they collected the teams' assignments and completed an observation form. After the end of the MOOC the observers made short descriptions of the teams. The entire content of the team chat was copied into excel files.

Data

The data corpus for this study included:

- written team chats in NovoEd team space;
- files that teams uploaded;
- shared working documents linked to the team space;
- submitted assignments;
- weekly forms completed by the observers; and
- descriptions of the observed teams written by the observer.

Analysis

A priori the researchers of this study did not have defined expectations or ideas about how teams would or should collaborate in this PBL MOOC. Therefore, this study is descriptive and exploratory in nature. The aim was not to find out which teams were 'good virtual teams,' nor to find the best way to be a virtual team. Rather we aimed to discover how virtual teams can communicate and collaborate, and which factors might play a role in their interaction. Based in the constructivist paradigm (Bergman et al., 2012), thematic analysis was used in an inductive way to uncover latent themes (Braun & Clarke, 2006), guided by the research questions. Following Braun and Clarke's (2006) guidelines, the researchers familiarized themselves with the data by reading the descriptions of the observed teams, the weekly observation forms, and the team chats (copied from NovoEd to excel files). Initial codes were generated and potential themes collected.

The research team met twice to review and refine the themes, resulting in the final definition of themes and subthemes/aspects. In order to further refine the themes and find illustrative examples a subset of five team chats was selected for recoding. This selection was purposeful and sought to show a variety of ways that teams communicate and collaborate online. Chats with up to 500 contributions were entirely double coded. For longer chats, 250 contributions were double coded and the remaining contributions single coded. The two coders met to compare and discuss their coding: to reach an agreement about identified themes and subthemes.

Results

In this section we briefly describe the five resulting themes illustrated with quotes from the five teams that were included in the dataset for recoding.

Team Formation and Team Composition

Teams in this study were formed by the participants themselves, and team members usually shared a commonality such as country of origin, institution, or interest in the same domain. However, in many cases team members had never met before. Conversation about team composition took place mainly at the beginning when participants introduced themselves, though usually very briefly, with team members mentioning their background and PBL experience and sometimes their motivation to follow the course. Some introductions were a few sentences long, but many were as short as: "Hi everyone, I don't have any PBL experience either." After the first introductions participants rarely mentioned their background or place of work, except occasionally when they were looking for an example, e.g.: "We designed this course five years back in my country… in a medical school where I was working that time." For a more detailed analysis of team charters and first interactions, see Mayer (2016).

Most teams started out quite large, around 10-15 people. In some teams there was explicit discussion about team size, e.g.: "I have 6 more membership requests from other people. Personally I think the 12 team members we have now is the right amount of people to successfully finish the assignments. What do you guys think?" Hagedoorn (2017) analyzed MOOC dropout rates quantitatively and found that dropouts occurred mostly early in the course and could be predicted by early passive behavior such as not filling in the profile questions. Within our study, we observed that all teams shrunk in size and by the halfway point of the MOOC (approximately week four), there seemed to be a reasonably steady core of active participants of around four to six per team. Sometimes, participants explained why they were leaving: "Hi all, I have decided to stop with this MOOC …. I stop now, because I have too less time to do the assignments." Other team members seemed to appreciate such an explicit explanation and reacted with understanding: "…sorry to see you go. All the best in your new job." Other participants did not explicitly leave, but stopped contributing. This lack of involvement sometimes went unnoticed, but some team leaders actively addressed inactive members and eventually removed them from the team: "Hello, I write to you to seek clarifications regarding the status of your future participation and contributions to the activities on the group. Please let us know since it would help us streamline things better."

Large dropout caused problems if teams became too small, as we saw in some teams that stopped during the course. There was one exception: one team started with six members, and quickly shrunk to only two active members. However, they knew each other and also met face-to-face, which seemed to enable them to work together efficiently and finish the course regardless:

> Hello due to the burden of institutional work, we have had discussions face to face about the role of tutor during the post-discussion phase, based on the guiding questions and the Web resources and now we are analyzing the information to complete the assignment.

Some withdrawing team members asked permission to stay on as a passive team member, and this was generally accepted. In some teams, other team members actively tried to keep people in by proposing to be more flexible in deadlines and work division:

> I wonder why members are deciding to quit in hurry. please do not do it…To me some delay is no problem … everybody will contribute according to his or her convenience and other members will keep the wheel moving till end but each and every member will keep on doing self-study and observing the team activities at their convenience.

Team Process (Organization and Leadership)

How to organize the team was primarily discussed at the beginning of the MOOC, when the teams completed their team charter. Some teams maintained fixed roles with the same team leader throughout the course, while others explicitly chose to rotate roles. One team specifically appointed someone who had already experienced PBL as team leader for the first task. Spending more time on planning, discussing roles and role division, and discussing the steps to take and the tools to use seemed to have a positive effect on team collaboration. One participant suggested: "I also think the process manager should suggest some 'deadlines' for the assignment, so we can contribute to the assignment on moment that is convenient in our own schedule," while another stated:

> We are going to have 2 persons for each role and will changing the role once every two weeks. XX is taking the role of the summarizer, YY is taking the role of process manager. ZZ is taking the role as searcher… Role distribution is part of our PBL self- experiment, so we decided to switch roles on a regular basis so everybody can try out different duties. Since we are not always available, it is nice to have each role covered by 2 people.

After a few weeks the team charters were usually not up-to-date anymore, because not all team members were still active. However, there was little explicit discussion on role division or team leadership then. This seemed to be largely arranged implicitly in the discussion of how to work on specific tasks (see below). Though rare, explicit reflection on team processes did help teams to work together effectively and might also have helped other team members to remain engaged in the course:

> XX, YY, and ZZ, let us know what we can do to keep you on board and in which way we need to reorganize our way of working together. Perhaps we could update the charter or make a new document to reflect the schedule?

One team, kept updating the team charter and someone explicitly pointed out the role division of the coming week: "XX, you are team leader for this week's assignment. Do you have time to coordinate the group and this week's tasks or should I step in for you?" Frequently, there were team members apologizing when they had not been able to fully participate for personal or work-related reasons. Overall, team members responded positively to explanations for unequal contributions: "I hope you are ok. We all have troubles from time to time. This is life. The assignment is not with a fixed deadline and we are supposed to continue the discussion during the next week."

Team collaboration seemed to run smoother when teams showed adaptability and actively maintained a positive atmosphere: "... not all of us have English as a first language, so I think we will have to be aware of that." Negative remarks were very rare. Only one example was found:

> XX the error is that YY once again submitted his individualistic stuff without consulting or letting us know and I am unable to do anything about it. I guess that means that we have been hit badly this time. We had requested and informed him earlier to refrain from doing the same...

Team collaboration was stimulated by teams acknowledging others' contributions and being proud of the results with statements such as: "Good morning my lovely team. Finally I found the mind map which is brilliant! Thank you it is such a great addition to the assignment," and "It was a great experience working together with you. I'm proud of our team that we finished all the assignments!"

Approach to Task Work (Task Division and Interaction)

This theme is used to discuss how teams addressed concrete tasks in the PBL MOOC, for example, how they manage time or exchange information: "I just tried to set up a meeting poll with the dates proposed above by... Please double-check and let us know here in the chat (for upcoming meetings that we will have to schedule)," "I started the brainstorm in our document. I am looking forward to read your thoughts and questions on the problem." In some teams, proactive team members regularly pushed information, actively sought contributions, and supported others:

> Hello everyone! I was updating our [assignment]. We are missing input from [team member names]. Part A of the assignment is due in six hours, so I will wait four more hours before putting all of our questions together and clustering them. Thank you all!

Early task work interaction focused on content and role clarification, and on mobilizing team members, with comments such as: "I signed up to be a contextualizer, but I don't know what that is!" and "I still don´t understand which references I am supposed to summarize: the ones in the assignments or the ones I get from the searchers. What do you think?" After initial task planning, groups developed routines and shared more succinct planning messages at the start of a new assignment: "Duties for next week are 1: I am the process manager and reporter (summary hand in). 2: XX and YY are the searcher of this week. 3: Me and ZZ are summarizers." It helped when team members engaged in error correcting and back-up behavior:

> Hi everyone, I had a spontaneous day off yesterday and now I see I have missed a lot. I will have few hours today and half a day tomorrow, so if [team member names] need some help with summary just let me know. I will now read our problems and comments to get back to track :).

Most teams did not change set routines and there was limited reflection on past performance, with a few exceptions such as:

> Have you noticed in the videos showing PBL sessions in [anonymized university name], that they have a phase called "CLUSTERING" where they group the topics and questions into more scalable entities? I think it's time for us to do this too.

Only rarely did team members engage in explicit elaboration, reflection, or reaction to information from other team members, encouraging different perspectives or collectively drawing conclusions. Most teams seemed to simply divide the work and patch together what they had found. On the whole, in the team chats evidence of co-construction of knowledge is scarce with only a few exceptions: “Thanks to [team member names] for excellent contributions. I summarized all the texts in a concept map. I hope I have captured and integrated the essence of what you have researched.”

Inspection of the last assignments showed, however, that some teams did manage to engage in co-construction resulting for innovative and creative products, such as a video clip where team members discussed what they had learned from the course and how they intended to apply it, or a mock design for a training about PBL for colleagues in their own university Verstegen et al. (2016b).

Use of Tools

The “use of tools” theme was used to categorize comments about the platform’s facilities and functionalities and other tools external to the MOOC platform. The results show that many participants were not accustomed to using online learning environments. The observers noticed how the participants’ digital literacy impacted their teams, and witnessed a steep learning curve for some in using online tools. Most technological challenges occurred within the first two weeks and included: 1) trouble accessing files or documents, 2) issues with adding or saving their comments to shared files, or 3) challenges when trying to access or evaluate other teams’ work. For example:

> Thanks XX. I have uploaded doc now on google docs and google drive but I do not know how to bring it here because I failed to upload this doc from here. Thanks if you can help me. Then it will be available for change. Sorry for inconvenience.

While some teams discontinued the MOOC for various reasons (including technological challenges), other teams had a quick response time in providing peer support to resolve technological issues and demonstrated an ability to mentor and coach one another through technical challenges. Throughout the course participants engaged in problem solving, mentoring teammates to overcome technological challenges, and identified tools to benefit their team’s communication. However, the observers also saw a team member leaving a team because of inability to master the tools that their team had decided to use.

As participants learned about using the NovoEd platform, they also had to adapt to working in an online environment with geographically dispersed team members (often in various times zones around the world). Teams usually started off with the facilities provided in the platform: chat and file exchange, and the Google tool suite that they could easily link to. Some teams were more adventurous and experimented with alternatives, like padlet walls, mind or concept mapping tools, or tools to make visual representations in infographics: “I've also used Slack, a free, online intranet type tool but I've never set it up myself, do any of you have experience using it?” “I would like to try Lexicographer: identified and collaboratively defines words and phrases; shared definitions.” Occasionally, participants were inspired by what they had seen from other teams:

> Good morning! Would you be interested in submitting a mind map this time? I would like to try something different and I think it would be interesting to visualize our results (some of the other teams did great jobs being creative!).

Most teams that tried to organize synchronous discussion sessions, for example in Google Hangouts, gave up on the idea because busy schedules and time zone differences made it impossible to meet:

> I don't want to press ahead but I think a week goes by so quickly and it's not so easy for us to work together due to the different time zones. So I prepared an edupad (see the link) with the next steps. It's similar to a google docs: everyone can write and everyone is attributed automatically a different colour. But no problem if we choose another way to collaborate.

Thus, communication remained mainly asynchronous, although some teams tried to find other solutions: "We could copy the questions from the form in a doc and work on it simultaneously/together? As for real-time discussion, I have experience running a weekly twitter chat which facilitates easy discussion using a predetermined hash tag."

External Factors (MOOC Design and Interaction With Others)

Within this MOOC, interaction with facilitators and participants from other teams was possible on the discussion forum. The facilitators organized weekly Google Hangouts sessions. All assignments (except for the team charter) were public to all participants. Additionally, at the end of each PBL task participants were explicitly asked to peer review the work of three other teams. In their team chats some teams referred to points made in the general discussion forum or sessions by the facilitators: "FYI, here is an interesting list of research questions published by another team here: [link to discussion forum]," and "I noticed the teaching team addresses many practical issues in the weekly google hangout." There is also evidence of collaborating and exchanging information with other teams: "I would suggest maybe a collaboration with another team (<team name>) that are working on language classrooms too."

For some completing peer reviews served as a great example of what was possible. Some teams felt the need to improve their quality of work and also learned from other teams' assignments:

> Did you see all the other submissions? [link to assignments]. Some are works of art! I had not realized what it would be like for others to review us. I think that what's most important is what we learned and how we worked, but now that I did the peer reviews I have a better understanding of how we could further improve our assignments for others, should we want to.

A critical comment from one participant was that peer reviewing was time consuming and not always clarifying: "Although some mind maps were impressive, for me their answers became not really clear. One submission I had to review was over 25 pages. The review took me more than an hour."

Participants frequently provided links to resources within the MOOC that they found useful, especially the mini-lectures, and to external resources, such as websites and journal articles. And although the design of the MOOC was innovative and must have been new to most participants, there were only a few comments about this:

> As you will notice the course itself is scaffolding our learning: First what PBL is all about, then Problem design and now course design. The obvious additional parts of the design in addition to problem are Supportive Info, Procedural Info, and Part Task Practice as also taking a course dividing into blocks which run sequentially.

Discussion

This study has revealed that it is possible for online, virtual teams to collaborate on learning tasks without extensive guidance, but this requires additional communication and technological skills and support. In the MOOC *Problem-Based Learning: Principles and design. Students at the centre!* most teams worked fully online. Self-composed teams usually shared a common interest or lived in the same area, but often team members did not know each other. It is surprising that the teams did not spend much time on introductions or getting to know each other. Apparently, the MOOC evoked a task-focused approach, possibly because of the strict timeline required for the completion of assignments.

Within this study, we discovered that virtual teams can develop different ways to successfully communicate and collaborate. Some teams had a strong team leader and fairly fixed roles throughout the course, whereas others rotated roles. We saw the importance of having team members explicitly discuss team process and task division, and set clear expectations and timelines. This is in accordance with Wen, Yang, and Rosé (2015) who studied another NovEd course (with a different instructional design). In our study, teamwork was smoother in teams that remained positive, encouraged others, and set agreed upon patterns for communication. Collaborative creation of the team charters helped with this aspect.

The first weeks showed many changes with team members dropping out and new members dropping in. This is common according to Evans, Baker, and Dee (2016). Some teams chose to revise their team charter after a few weeks to account for a redistributed workload, while others did not. All teams lost members and the majority of teams ended up with an average size of four to six members. Gurtner, Tschan, Semmer, and Nägele (2007) suggest that team reflexivity is rare when teams are under time pressure (due to teams often wanting to perform rather than learn). However, in our study, some teams seemed to have the capacity to reflect upon on-going change. Successful teams showed team adaptability and were able to plan reactively, which helped them deal with unexpected events.

Like Littlejohn, Hood, Miligan, and Mustain (2016) we observed a large diversity in motivation and self-regulated learning skills of MOOC participants. We also found large differences in participants' online skills: for many it was their first MOOC (see Salazar-Márquez, 2017), while some others were actively looking for more advanced tools and new ways to collaborate. This may have been the reason that many teams only used the standard toolset: chat box, file exchange, and google docs. Most teams did not organize synchronous contact moments, presumably due to scheduling challenges. Haines (2014) argues that the development of virtual teams is different and requires explicit attention. De Freitas, Morgan, and Gibson (2015) stress the critical role technology plays in hosting a MOOC, and indeed the virtual teamwork in this study may have been influenced in positive and negative ways by the specific platform that was used. In the team chats we did not see a large amount of co-creation, but rather individual contributions compiled together in one document. A minority of groups engaged in a deeper level of discussion where input was combined and synthesized, with new insights developed collaboratively (as intended with the PBL process). This may be partly due to limited digital literacy, as co-creation requires intensive brainstorming and discussion. Basic asynchronous tools such as chat and file exchange do not optimally support intensive interaction.

In conclusion, characteristics of successful collaboration in virtual teams were: 1) consistent communication through multiple channels, 2) adjusted workload based on member needs, 3) ongoing explicit discussion of the workflow and/or a strong leader organizing the group process and task division, 4) acceptance of different abilities and skillsets of members, and 5) stimulation and assistance of team members when needed (i.e. due to technical challenges, language barriers, etc.). Moving forward it will be important to consider these factors in future MOOCs and therefore we offer the following recommendations.

Prepare the Participants for Virtual Teamwork

Given the wide variety of skills and expertise, it is important to prepare learners for virtual teamwork. Yet, it is also clear that there is not one universal or best solution to address this need. Therefore, we recommend giving several concrete examples of how virtual teams can successfully collaborate and communicate. We recommend that facilitators try to stimulate teams to spend more time on team formation and building trust, for example by discussing their knowledge and experience regarding PBL or digital tools, and how they might be able to complement and help each other. It will also be important to prepare teams for dropout and team changes, particularly during the creation of the team charter. Teams could be explicitly advised to update and revise their team charter after the first weeks.

Stimulate the Teams to Elaborate

We recommend highlighting the importance of co-creation, deeper discussions, and brainstorming while also suggesting tools that can support the required intensive interaction. Along this line, we recommend encouraging teams to engage in some amount of synchronous contact and to explicitly stimulate participants to ask explanatory and critical questions, visualize (e.g., in concept mapping), and synthesize the discussion. Since we observed the impact of peer evaluations to evoke interest and discussion, we suggest stimulating this more explicitly, for example by creating a “virtual gallery,” where all submissions can be reviewed and rated by other teams and MOOC participants.

Develop Digital Literacy

Given the significant divide between learners’ digital skills and their required use of technology to participate in the MOOC, it is important to recognize the steep learning curve for some. We recommend providing additional support to educate participants on technology available in the platform. Furthermore, it is important to acknowledge collaborative tools available outside the platform. We suggest describing more innovative tools and how they could be used during this MOOC, or involving participants in a running list to suggest and rate the effective communication tools they use.

Limitations and Further Research

This study was descriptive and exploratory in nature. We selected teams that were active throughout the course in order to explore how their collaboration evolved, but this has resulted in a selection bias towards successful teams. Future research should look into factors that hinder collaboration in virtual teams or reasons that virtual teams fail at their tasks. The teams that we observe may also have been in contact via other channels that we did not have access to, and so our observation data may be incomplete. Future research could also attempt to replicate this instructional design on another platform and/or with other tools and facilities, for example tools that explicitly stimulate interaction and discussion. Participatory research might enable researchers to fully observe and experience collaboration in virtual teams. Finally, future research could focus on implementing the recommendations above and could study the effects on virtual teams in a next run of the PBL MOOC.

Conclusion

In the MOOC *Problem-Based Learning: Principles and design. Students at the Centre!* self-formed teams worked online. This study has revealed that it is possible for virtual teams to collaborate on PBL learning tasks without a tutor, but this requires additional communication and technological skills and support. Explicit discussion about group organization and task work, a positive atmosphere, and acceptance of unequal contributions seem to be positive factors. Additional support is required to prepare participants for virtual team work, develop digital literacy, and stimulate more elaborate brainstorming and discussion.

References

Ahn, J., Butler, B. S., Alam, A., & Webster, S.A. (2013). Learner participation and engagement in open online courses: Insights from the Peer 2 Peer University. *MERLOT Journal of Online Learning and Teaching, 9*(2). Retrieved from http://jolt.merlot.org/vol9no2/ahn_0613.htm

Barber, W., King, S., & Buchanan, S. (2015). Problem based learning and authentic assessment in digital pedagogy: Embracing the role of collaborative communities. *Electronic Journal of e-Learning*, *13*(2), 59-67. Retreived from www.ejel.org

Barrows, H. S., & Tamblyn, R. M. (1980). *Problem-based learning: An approach to medical education*. New York, NY: Springer.

Bergman, E., De Feijter, J., Frambach, J., Godefrooij, M., Slootweg, I., Stalmeijer, R., & Van Der Zwet, J. (2012). AM last page: A guide to research paradigms relevant to medical education. *Academic Medicine: Journal of the Association of American Medical Colleges, 87*(4), 545. doi:10.1097/ACM.0b013e31824fbc8a

Blaschke, L. M. (2012). Heutagogy and lifelong learning: A review of heutagogical practice and self-determined learning. *The International Review of Research in Open and Distance Learning*, *13*(1), 56–71. Retrieved from http://www.irrodl.org/index.php/irrodl/article/view/1076/2087

Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology, 3*(2), 77-101.. doi: 10.1191/1478088706qp063oa

Clark, D. (2016). MOOCs: Course completion is wrong measure. Retrieved from http://donaldclarkplanb.blogspot.nl/2016/02/moocs-course-completion-is-wrong-measure.html

Cormier, D., & Siemens, G. (2010). Through the open door: Open courses as research, learning, and engagement. *EDUCAUSE Review, 45*(4), 30-39. Retrieved from http://www.educause.edu/ero/article/through-open-door-open-courses-research-learning-and-engagement

De Freitas, S. I., Morgan, J., & Gibson, D. (2015). Will MOOCs transform learning and teaching in higher education? Engagement and course retention in online learning provision. *British Journal of Educational Technology, 46*(3), 455–471. doi:10.1111/bjet.12268

Dolmans, D. H. J. M., de Grave, W., Wolfhagen, I. H. A. P., & van der Vleuten, C. P. M. (2005). Problem-based learning: Future challenges for educational practice and research. *Medical Education, 39*, 732-41. doi:10.1111/j.1365-2929.2005.02205.x

De Jong, N., Savin-Baden, M., Cunningham, A. M., & Verstegen, D. M. L. (2014). Blended learning in health education: Three case-studies. *Perspectives on Medical Education, 3*, 278-288. doi: 10.1007/s40037-014-0108-1

Espasa, A., & Meneses, J. (2010). Analyzing feedback processes in an online teaching and learning environment: An exploratory study. *Higher Education*, *59*(3), 277-292. doi: 10.1007/s10734-009-9247-4

Evans, B. J., Baker, R. B., & Dee, T. S. (2016). Persistence patterns in massive open online courses (MOOCs). *Journal of Higher Education, 87*, 206-242. doi.org/10.1080/00221546.2016.11777400

Ertmer, P. A., & Koehler, A. A. (2015). Facilitated versus non-facilitated online case discussions: Comparing differences in problem space coverage. *Journal of Computing in Higher Education, 27,* 69-93. Retrieved from https://www.learntechlib.org/p/161629/

Fernández-Diaz, E., Rodriguez-Hoyos, C., & Calvo Salvador, A. (2017). The pedagogic architecture of MOOC: A research project on educational courses in Spanish. *The International Review of Research in Open and Distributed Learning, 18*(6). Retrieved from http://www.irrodl.org/index.php/irrodl/article/view/2964/4374

Fonteijn, H. (2015). Making students responsible for their learning–Empowering learners to build shared mental models. In A. Dailey-Hebert & K. S. Dennis (Eds.), *Transformative perspectives and processes in higher education* (pp. 97-116). Springer International Publishing.

Fournier, H., & Kop, R. (2015). MOOC learning experience design: Issues and challenges. *International Journal on E-Learning*, *14*(3), 289-304. Waynesville, NC USA: Association for the Advancement of Computing in Education (AACE). Retrieved from https://www.learntechlib.org/primary/p/150661/

Gurtner, A., Tschan, F., Semmer, N, & Nägele, C. (2007). Getting groups to develop good strategies: Effects of reflexivity interventions on team process, team performance, and shared mental models. *Organizational Behavior and Human Decision Processes,* 102, 127–142.doi: 10.1016/j.obhdp.2006.05.002

Hagedoorn, T. R. (2017). *Massive open online courses profiling for dropout prediction*. (Unpublished bachelor thesis). Maastricht University, The Netherlands.

Haines, R. (2014). Group development in virtual teams. *Computers in Human Behavior, 39* (C), 213-222. doi.org/10.1016/j.chb.2014.07.019

Hayashi, S., Tsunekawa, K., Inoue, C., & Fukuzawa, Y. (2013). Comparison of tutored group with tutorless group in problem-based mixed learning sessions: A randomized cross-matched study. *BMC Medical Education*, *13*(1), 158. doi: org/10.1186/1472-6920-13-158

Hollands, F. M, & Tirthali, D. (2014). *MOOCs: Expectations and reality. Full report*. New York, NY: Columbia University, Teachers College, Center for Benefit-Cost Studies of Education.

Kauffman, H. (2015). A review of predictive factors of student success in and satisfaction with online learning. *Research in Learning Technology*, 23(1), 1-13. http://dx.doi.org/10.3402/rlt.v23.26507

Khalil, H., & Ebner, M. (2014). Moocs completion rates and possible methods to improve retention: A literature review. In *Proceedings of EdMedia, World Conference on Educational Media and Technology (Vol. 2014, pp. 1305-1313)*. Waynesville, NC: Association for the Advancement of Computing in Education (AACE).

Littlejohn, A., Hooda, N., Milligan, C., & Mustain, P. (2016). Learning in MOOCs: Motivations and self-regulated learning in MOOCs. *Internet and Higher Education*, 29, 40-48. doi.org/10.1016/j.iheduc.2015.12.003

Mackness, J., Waite, M., Roberts, G., & Lovegrove, E. (2013). Learning in small, task-oriented connectivist MOOC: Pedagogical issues and implications for higher education. *The International Review of Research in Open and Distance Learning, 14*(4). Retrieved from http://www.irrodl.org/index.php/irrodl/article/view/1548/2636

Mayer, L. (2016). *What can we learn from virtual team collaboration in a cMOOC? Introducing a framework of early team planning in virtual teams*. (Unpublished master thesis). Maastricht University, The Netherlands.

Moust, J., Bouhuijs, P., & Schmidt, H. 2014. *Introduction to problem-based learning: A guide for students*. Noordhoff Uitgevers B.V.: Groningen, the Netherlands.

Salazar-Márquez, R. (2017). Digital immigrants in distance education. *The International Review of Research in Open and Distributed Learning, 18*(6). Retrieved from http://www.irrodl.org/index.php/irrodl/article/view/2967/4361

Toven-Lindsey, B., Rhoads, R. A., & Berdan Lozano, J. (2015). Virtually unlimited classrooms: Pedagogical practices in massive open online courses. *Internet and Higher Education, 24*, 1-12. doi: 10.1016/j.iheduc.2014

Van Tilburg, J. (2014). *Digital problem-based learning goes beyond the university itself.* (Unpublished master thesis). Maastricht University, The Netherlands.

Veletsianos, G., & Shepherdson, P. (2016). A systematic analysis and synthesis of the empirical MOOC literature published in 2013-2015. *International Review of Research in Open and Distributed Learning, 17*(2), 198-221. doi: dx.doi.org/10.19173/irrodl.v17i2.2448.

Verstegen, D., Fonteijn, H., Dolmans, D., De Rijdt, C., De Grave, W., & Van Merriënboer, J. (in press). An exploration of Problem-Based Learning in a MOOC. In N. Dabbagh, M. Moallam, & W. Hung, *The Wiley handbook of problem-based learning*. New Jersey, USA: John Wiley & Sons.

Verstegen, D. M. L., de Jong, N., van Berlo, J., Camp, A., Könings, K. D., van Merriënboer, J. J. G., & Donkers, J. (2016a). How e-learning can support PBL groups: A systematic literature review. In S. Bridges, L. K. Chan, & C. Hmelo-Silver (Eds), *Educational technologies in medical and health sciences education* (pp. 9-35). Springer, Advances in Medical Education. Volume 5.

Verstegen, D., Spruijt, A., Dailey-Hebert. A., Clarebout, G., & Fonteijn, H. (2016b). *MOOCs and PBL: Project report*. Maastricht University, the Netherlands.

Wen, M., Yang, D., & Rosé, C.P. (2015) Virtual teams in massive open online courses. In C. Conati, N. Heffernan, A. Mitrovic, & M. Verdejo (Eds.), *Artificial intelligence in education 2015* (pp. 820-825). Lecture Notes in Computer Science, volume 9112. Springer, Cham.

Woods, D. R., Duncan-Hewitt, W. C., Hall, F. L., Eyles, C. H., & Hrymak, A. N. (1996). Tutored versus tutorless groups in problem-based learning. *American Journal of Pharmaceutical Education*, *60*(3), 231-238.

International **R**eview of **R**esearch in **O**pen and **D**istributed **L**earning
Volume 19, Number 4

September – 2018

Troubleshooters for Tasks of Introductory Programming MOOCs

Marina Lepp, Tauno Palts, Piret Luik, Kaspar Papli, Reelika Suviste, Merilin Säde, Kaspar Hollo, Vello Vaherpuu, and Eno Tõnisson
University of Tartu, Estonia

Abstract

Learning programming has become more and more popular and organizing introductory massive open online courses (MOOCs) on programming can be one way to bring this education to the masses. While programming MOOCs usually use automated assessment to give feedback on the submitted code, the lack of understanding of certain aspects of the tasks and feedback given by the automated assessment system can be one persistent problem for many participants. This paper introduces troubleshooters, which are help systems, structured like decision trees, for giving hints and examples of certain aspects of the course tasks. The goal of this paper is to give an overview of usability (benefits and dangers) of, and the participants' feedback on, using troubleshooters. Troubleshooters have been used from the year 2016 in two different programming MOOCs for adults in Estonia. These MOOCs are characterized by high completion rates (50–70%), which is unusual for MOOCs. Data is gathered from the learning analytics integrated into the troubleshooters' environment, letters from the participants, questionnaires, and tasks conducted through the courses. As it was not compulsory to use troubleshooters, the results indicate that only 19.8% of the users did not use troubleshooters at all and 10% of the participants did not find troubleshooters helpful at all. The main difference that appeared is that the number of questions asked from the organizers about the programming tasks during the courses via helpdesk declined about 29%.

Keywords: MOOC, open education, programming, troubleshooting system

Introduction

Teaching introductory programming courses has become an important subject matter in Estonia in connection with the need to raise awareness of, and interest in, information technology. Supporting the learning of the programming language Python, a massive open online course (MOOC) in Estonia called *About Programming* (in Estonian, *Programmeerimisest maalähedaselt*) was created in 2014. Research has shown that the average completion rate for MOOCs in the world is approximately 15% (Jordan, 2014; Siemens, 2013), but in our case the percentage of completions has been constantly over 50%. This paper addresses the idea of having a helpdesk supporting the participants in the course and reducing the number of questions from the participants by creating troubleshooters for the programming tasks.

Programming MOOCs rely mostly on automated assessments, which enable the participants to post the solutions for the tasks in a way that the system could automatically analyze the solutions and give automated feedback. Self-assessment should be used as an assessment for learning instead of an assessment of learning (Admiraal, Huisman, & Pilli, 2015). In programming, some mistakes in the code can be very difficult to resolve and therefore our MOOCs offered a helpdesk email address to answer the questions that appear during the course. The instructors and university students who lent their assistance, agreed to answer the helpdesk emails in less than 8 hours. While having people on watch all the time is not very cost effective, the helpdesk offers instant help that beginner learners need. The questions asked from the helpdesk give a lot of information about the problems occurring with the tasks during the course.

To reduce the number of questions asked from the helpdesk, troubleshooters were provided for every programming task, starting from 2016. The troubleshooters include collections of answers and clues to the questions, which can arise when solving the course tasks.

This paper gives an overview of the creation of the troubleshooters to support the course and presents the learners' opinions about the troubleshooters. The impact of troubleshooters is discussed in the context of the resources needed for creating troubleshooters and the results of course optimization, needed to keep it automated.

Theoretical Background

This section provides a theoretical background on supporting online programming courses with helpdesk and troubleshooters by categorizing programming mistakes that beginners make.

MOOCs

Massive Open Online Courses (MOOCs) are one of the recent models in open and distributed learning (Downes, 2017). The history of MOOCs can be divided into two phases: cMOOC (connectivist MOOCs) period and xMOOC (content-based MOOCs) period (Baturay, 2015). However, there is a move away from the cMOOC/xMOOC division towards recognition of the multiplicity of MOOC designs, purposes, topics, and teaching styles (Admiraal et al., 2015).

While the educational world is proliferated with MOOCs and they are hyped in the media, there are still some challenges for MOOCs to overcome (Veletsianos & Shepherdson, 2016). One of the most salient challenges is the dropout rate (Siemens, 2013), with widely cited figures of 10% completion rates (Ebben & Murphy, 2014). Researchers are trying to examine the reasons behind the low retention rates (Greene, Oswald, & Pomerantz, 2015; Hone & El Said, 2016). It has been found that a lack of incentive, insufficient prior knowledge about the topic, ambiguous assignments, and having no one to turn to for help can be possible reasons for non-completion (Hew & Cheung, 2014). MOOC content and interaction with the instructor were also shown to have a significant effect on retention (Hone & El Said, 2016).

Due to having thousands of participants per instructor, it is impossible for MOOC instructors to conduct assessments and provide individual feedback (Suen, 2014). Different models of interaction are used, such as automated feedback (Pieterse, 2013), peer support (Onah, Sinclair, & Boyatt, 2014), self-assessment (Papathoma, Blake, Clow, & Scanlon, 2015), helpdesk (Warren, Rixner, Greiner, & Wong, 2014), and scaffolding messages like troubleshooters (Vihavainen, Luukkainen, & Kurhila, 2012).

Helpdesks

As the number of questions on various topics of the course rises and it is difficult to find answers to the questions in a course with thousands of participants, we were faced with the challenge of how to retain the availability of sufficient support to positively finish the course. Using a helpdesk could be one option for answering the questions and monitoring the process. Previous MOOCs that used a helpdesk were rated extremely positive (Warren et al., 2014).

A helpdesk could use different kinds of data, video, and voice support (Motsuk, 1999), but our course offered a helpdesk email from the organizers of the MOOCs (faculty members and students) who had to answer any letters in less than 8 hours. The possibility to ask questions from the helpdesk could have been one of the key factors that helped more than 50% of the participants finish our courses (Lepp et al., 2017a).

As course participants send emails to the helpdesk address and receive answers from it, several helpdesk systems are available for managing such a system. A helpdesk system needs to be usable online, look nice and simple for users, be easy to use, include various functions, like a search engine, option to set labels to letters, and archive the letter data for later analysis. Developing such a system can be too complex task for a simple project (Washburn & El-Bayoumi, 2003). In our case an online helpdesk system, called Freshdesk (https://freshdesk.com/) was used.

Using a helpdesk has several advantages for organizers, too. One of the benefits is that engaging students in answering the helpdesk emails can have a positive influence on their studies (McRitchie, 2009) and reduce the cost of helpdesk (Sinnett & Barr, 2004). When counting the number of people getting help and being educated by MOOCs, the cost per participant can be rather low too. Frequently asked questions can be gathered to create helpful troubleshooters for each course task.

Troubleshooters

Troubleshooters are systems that are mostly used for IT services helping to solve problems manually by clicking answers to various questions to find a solution to the problem in a system with a decision tree structure. A similar kind of self-assessment (exercises with built-in scaffolding messages inside the programming environment) has been tried in case of programming MOOC and found to be fruitful (Vihavainen et al., 2012).

One way of identifying the problems that need to be included in troubleshooters would be mining the course data (and constructing, for example, Bayesian networks; Skaanning, Jensen, & Kjærulff, 2000). It can be difficult, as many filters should be applied to get reasonable results (Wustner, Joumblatt, Teixeira, & Chandrashekar, 2012). Sometimes the problems occurring can be rather difficult to track, as the real problems can be different from those originally discovered.

Creating troubleshooters can be difficult, but systematically organizing the problems that need to be solved can make it a lot easier. The presence of the course personnel in labs can be one possibility for answering the question about the next problem that can be encountered by a student (Vihavainen et al., 2012). In case of MOOCs, creating systematic decision trees for troubleshooters can be done by analyzing past help requests for the tasks and categorizing the questions in a way that supports the development of hints and examples to guide learners to answers to frequently asked questions.

Categorizing the Problems in Solving Programming Tasks

This paper addresses the system of help for typical problems of novice programmers. As many questions arise during the programming MOOCs, starting from questions about registration and ending with understanding specific nuances of certain aspects, this article is limited to the frequently asked questions that have been asked by the participants in an introductory programming MOOC. It can be much more difficult to help with the problems in more complex courses, including aspects such as inheritance, objects, class, encapsulation, methods, message passing, polymorphism, and abstraction (Sanders & Thomas, 2007).

Many questions can be about error messages. The Center for Computing Education and Diversity at the University of California has identified 17 categories of errors that can occur in Python programming (Marceau, Fisler, & Krishnamurthi, 2011), but when looking at one task, few of them usually occur and users are often accustomed to that when trying to resolve a mistake in the code. Error messages are only a part of the problems that can occur and code can often be wrong even when executed with no errors. This could be the case, for example, when trying to understand the changes that need to be made in the code to produce different outputs for certain inputs.

Garner, Haden, and Robins (2005) have organized introductory programming courses and investigated the mistakes novice programmers make during the practice sessions. They noticed that the more assistance weaker participants receive the better is their achievement in the course. Garner and colleagues described 27 problems that can appear in the practice sessions of a programming course for beginners. As our courses were online courses, we had to use helpdesk letters instead of direct feedback from practice sessions.

The problems occurring can be different in various situations. In pair-programming, the pairs would later be able to solve more low-level syntax problems individually than in solo-programming (Hanks, 2008). As in our courses the assignments are individual, we needed a system to help more with the low-level syntax problems.

As the problems appear during the process of solving certain tasks, our idea was to cultivate from that and to look at the problems coming out from the MOOC tasks via the helpdesk. Although in our case many of the problems (like errors and input-output faults) are solvable with the help of the automatic assessment tool, that assessment tool can create extra problems and questions that need to be solved.

Research Problem

The purpose of this study was to develop and evaluate troubleshooters for the programming tasks to provide additional support to MOOC participants and reduce the number of learner emails with questions to organizers while maintaining a high completion rate. Figure 1 presents the research problem.

The research questions were:

1. Can troubleshooters facilitate the work of MOOC organizers?
2. How do participants perceive troubleshooters as an additional support tool?

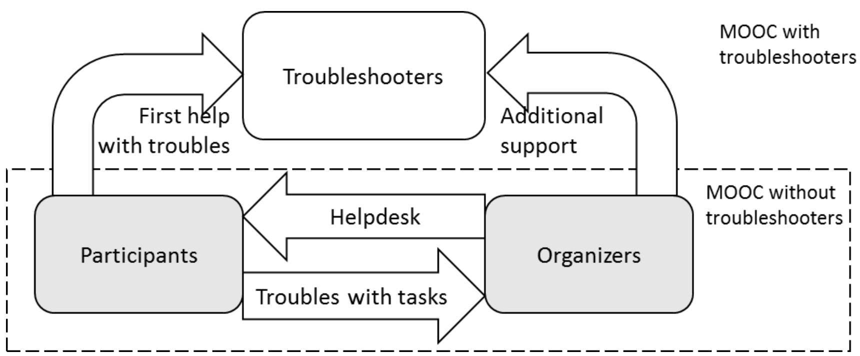


Figure 1. The research problem.

Murelahendaja Environment for Troubleshooters

Based on previous studies (Garner et al., 2005; Vihavainen et al., 2012), our troubleshooter creation process, which was rather difficult and time consuming, includes:

1. Analyzing the questions asked via the helpdesk about the weekly programming tasks;
2. Categorizing the questions asked by creating a table of types of typical questions;
3. Creating a tree-structured hint system with examples called troubleshooters to help with questions that have been asked.

Analysis of Questions and Categorization of Occurring Problems

This paper deals with an introductory programming MOOC *About Programming* in Estonia for adults that has been organized several times since December 2014. The Institute of Computer Science also organizes a MOOC named *Introduction to Programming*, which will only be touched upon briefly in this article.

A helpdesk was organized in our MOOCs to help participants with their problems and to get an overview of the questions asked about the tasks. After collecting the questions that were asked from the helpdesk in 2015, a table of data was compiled to categorize the problems that occurred in certain aspects of the tasks. This paper focuses on troubleshooters created for the course in 2016 to help with these problems with the programming tasks.

As our idea was to create helpful hints for the tasks of each week, it meant that each task needed to be looked at separately. The course *About Programming* had eight different parts in 4 weeks (2 parts per week): introduction (algorithm and program, part I), variables and data types (II), conditionals (III), strings (IV), loops (V), regular expressions (VI), functions (VII), and conclusion (part VIII). Tasks were provided only for parts II to VII. The organizers received a total of 1,250 letters with questions from 1,534 participants in the MOOC of 2015. Some letters were related to organizational issues. The statistics for parts II to VII show that most of the questions were asked about the task of part VII (see Figure 2).

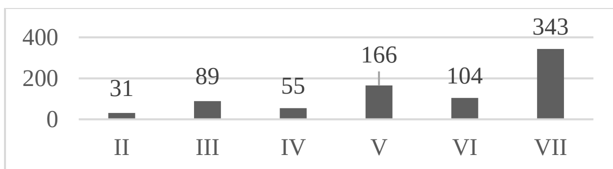


Figure 2. Number of questions asked per task from the helpdesk.

A description and a manual were created to help allocate the problems asked from the helpdesk into the categories. Letters were broken down into separate questions, each representing one problem. Questions from one letter could belong to a number of different categories. Three experts were used to evaluate 10% of the total number of problems asked from the helpdesk randomly to see if the descriptions of the categories were understood similarly. The overlap in the categorization of the problems was 80%. Most of the differences were caused by the fact that some of the questions asked from the helpdesk can lead to several problems and the letters from the participants were not that clear.

The questions were categorized based on existing classifications (Garner et al., 2005) and judgements of the course organizers. In total, 30 categories of occurring problems were discovered for the MOOC of 2015. Ten categories were related to organizational problems with registration to the course and the software used during the course. Twenty categories were related to programming tasks with the following keywords: input, datatype, variable, syntax and whitespaces, output, round, loops and conditionals, choosing symbols, using default functions, wrong order of input, calculations, iteration, finding the sum, sum vs counter, wrong regular expression, missing regular expression, module import, argument of the function, calling a function, and creating a file.

Initially, the questions were analyzed and categorized by weekly tasks. As different tasks can have similar problems, some of the categories were included in several tasks. Five to nine categories were identified per task. The categories were rather specific to the tasks to give the best help for the questions asked. The categories provided the basis for creating a troubleshooter for the particular task. Our weekly tasks and topics are mostly typical for introductory programming courses, which means that the occurring problems are also rather typical, but can also depend on the text of the particular weekly task (for example, finding the sum).

An example of the problems occurring in weekly task VII can be seen in Table 1. For this task, the aspects listed in the table need extra help from the organizers so that the troubleshooter could give hints and examples to help with those problems. As the topic of the seventh part is functions, mostly questions about using functions were asked (calling a function and argument of the function), but other categories are closely related to that topic and the task too. Several registered problems were also related to the contents of previous parts of the course (for example, variable).

Table 1

Categories of Occurring Problems for Task VII

Keywords of the category	**Number of times occurred**
Variable	74
Calling a function	64
Round	51
Argument of the function	38
Datatype	31
Input	31
Syntax and whitespaces	23
Calculations	19

Troubleshooters

After the categorization of the problems with programming tasks was complete, the environment called *Murelahendaja* was created to offer decision-tree-structured hints and examples called troubleshooters (see Figure 3). Along the way of creating the troubleshooters, the environment was further developed. The functionalities of looking at the tree of troubleshooter and getting a statistical overview of the usage of troubleshooters were added during the development process.

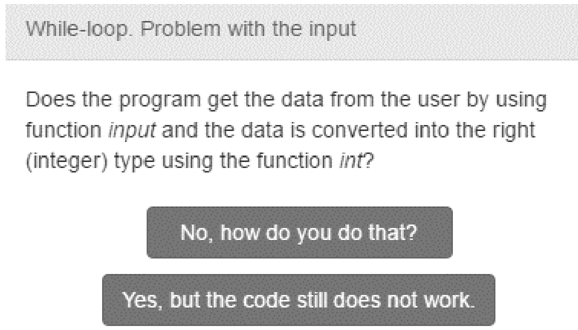


Figure 3. An example of a troubleshooter question.

The *Murelahendaja* environment has two separate views: i) one for registered users to create troubleshooters and view the statistics of usage, and ii) second for course participants (guests) to use troubleshooters.

Registered users can create troubleshooters by adding linked pages with questions about the problems of the tasks and helpful hints with code examples to help solve the problem. Pages are linked together in a decision tree structure and an overview of the linked pages can be seen on one screen (see Figure 4).

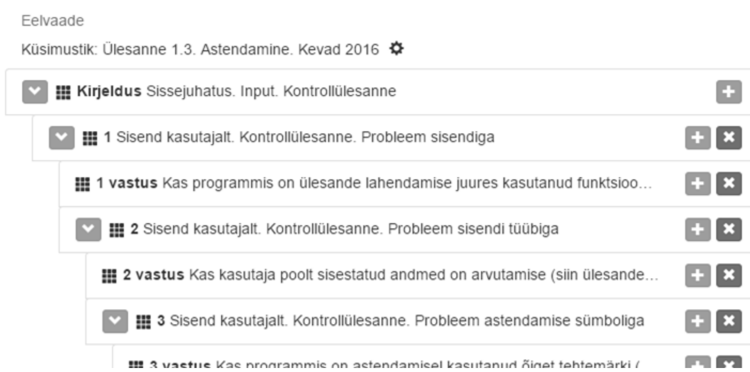


Figure 4. Overview of created troubleshooter pages.

Registered users can see descriptive statistics about the use of each page of the troubleshooters (see Figure 5). Statistics show on a tree graph how many times a troubleshooter has been viewed (letter “v”) and how many times people have indicated that the hints and code examples were helpful by clicking “It worked!” (letter “s”). Figure 5 shows that the first step of the troubleshooter always includes an introduction to the troubleshooter. The second step asks from the user if the respective function is used by the user in the solution. There are two branches after that question – button “No, how do you do that?” leads to the page explaining the usage of the function in the program and button "Yes" leads to asking the next question about the next trouble.

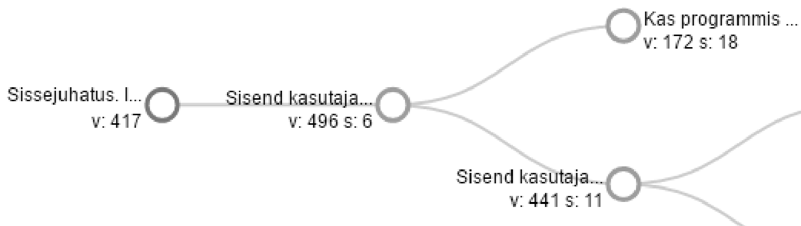


Figure 5. Tree graph with the statistics of a troubleshooter.

Guests, who are in our case the participants of the course, can see the troubleshooter as a series of questions asked one-by-one to lead to the problematic part of the task. Each question has a button to display hints and example code to solve the problem, which means that most of the questions have two buttons with the following texts to choose from (see Figure 3):

1. Button with the text "No, how do you do that?" – leads to the page with hints and examples to find an answer to the question (see Figure 6). That page has one button to go back to the question page and another button with the text "It worked!" which indicates that the clues and examples helped to solve the problem.

2. Button "Yes, but the code still does not work." – leads to the next question.

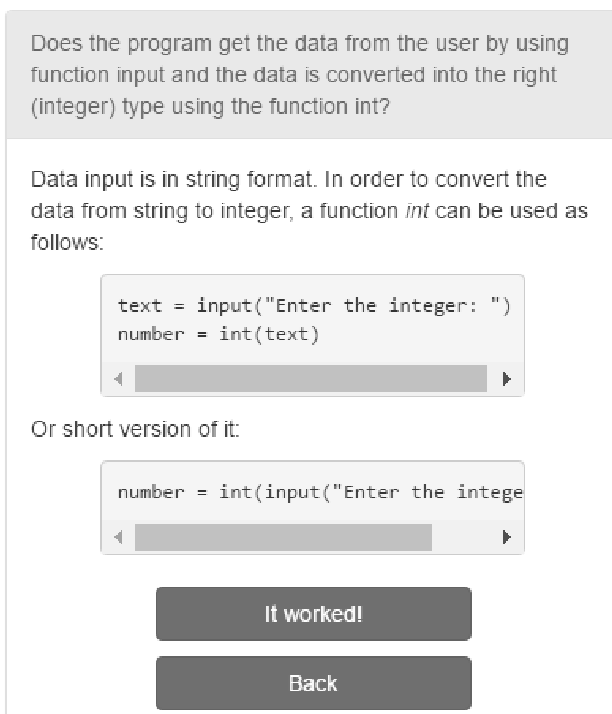


Figure 6. Hints and example codes for solving the problem.

Troubleshooters created in the *Murelahendaja* environment can be used in various situations in different courses (not necessarily in programming courses). For example, programming MOOCs use troubleshooters also for problems with registering to the course (see Figure 7).

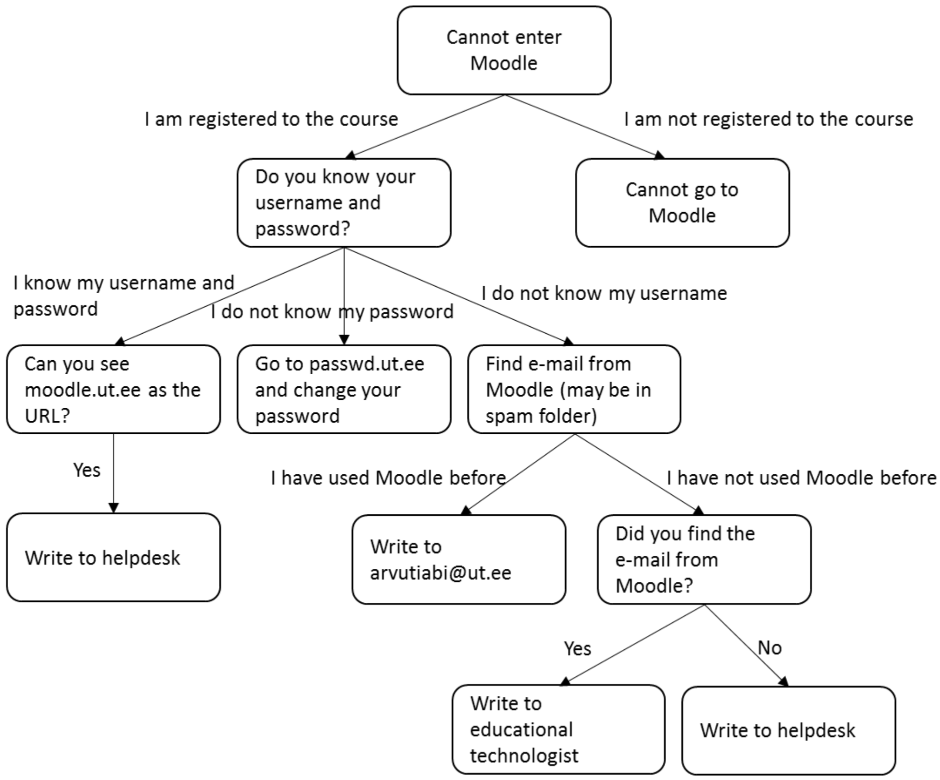


Figure 7. Example of troubleshooter.

Every programming task was supported with a troubleshooter and a troubleshooter was created for each weekly task of the course. During the process of creation and usage of troubleshooters, the environment was tested and supplemented so that it would contain all the questions asked from the helpdesk in a sensible way. Troubleshooters never give a direct answer to the questions, but help with hints and examples.

As it can be difficult to navigate in a large system of hints, the troubleshooters for tasks were kept as linear as possible (Figure 8). Troubleshooters for the course *About Programming* contain 5-9 questions with 5-9 examples. Creating troubleshooters requires rather specific knowledge and experience, to identify the type of task and questions that could be helpful, and for this reason most of the troubleshooters were created by one or two persons. That guarantees that the style of troubleshooters is uniform throughout the course. The creation process takes a lot of time and energy, which means that the troubleshooters were not drastically changed for the next courses.

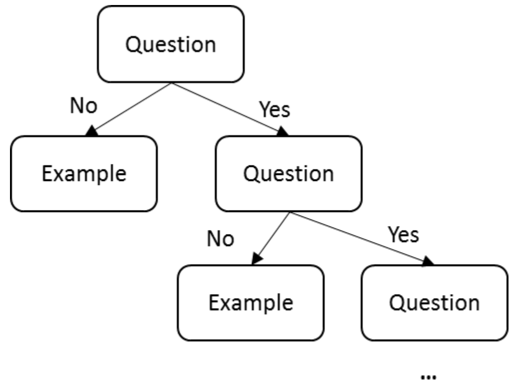


Figure 8. Structure of troubleshooter for programming task.

The technologies used for creating the web application *Murelahendaja* included CSS, HTML, JavaScript, AngularJS, D3.js, and MongoDB. The requirements for *Murelahendaja* included a web application that works in all popular web browsers and has an interface in Estonian language. The system had to be able to handle at least 1,000 guests at a time and have a response time of 0.5 seconds with the maximum response time of 2 seconds. It had to be available at least 99% of the time; critical errors had to be fixed in an hour. The *Murelahendaja* environment and user registration form can be found at progtugi.cs.ut.ee.

Potential Advantages of Troubleshooters for Online Courses

The troubleshooters may have the potential to be an additional supportive self-assessment tool in MOOCs. First, participants can use troubleshooters when they are stuck before writing to helpdesk (see Figure 9), thereby reducing the number of letters to organizers. Second, troubleshooters as part of MOOC content can have a positive effect on MOOC completion rate. In addition, troubleshooters with hints and examples can provide additional learning material and stimulate further thinking as participants study them. Furthermore, troubleshooters can be used not only in MOOCs but in traditional courses as well.

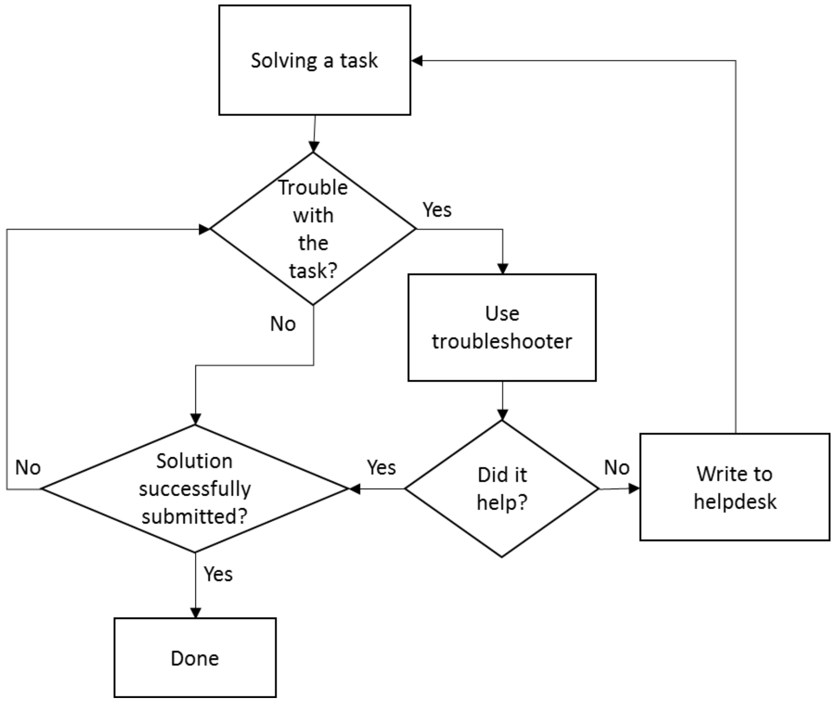


Figure 9. The role of troubleshooter in solution process.

Evaluation of Troubleshooters

The *Murelahendaja* environment for troubleshooters was evaluated to examine the effectiveness of troubleshooters in a programming course.

Research Methods

Participants and context. In autumn 2015, programming MOOC *About Programming* was held for the third time with 1,534 participants, and 1,010 (66%) of them successfully finished the course. In spring 2016, programming MOOC *About Programming* was held for the fourth time with 1,430 participants, and 885 (62%) of them successfully finished the course. The course in 2015 used a helpdesk, but no troubleshooters, which were added in 2016 (Lepp et al., 2017a). We are improving our courses gradually with new technical tools. For example, Muuli et al. (2017) describe a novel form of automated feedback. The troubleshooters were created on the basis of this MOOC and the number of questions to helpdesk was used for answering the first research question.

We collected feedback data about troubleshooters from 792 participants (89.5% of completing learners), who completed the course in the spring of 2016. From the participants 342 (43.2%) were male and 450

(56.8%) female, and 790 (99.7%) were from Estonia. The average age of the participants was 35.8 years (SD=10.9) ranging from 12 to 81.

Instruments and procedure. Data is gathered from the learning analytics integrated into the troubleshooters' environment, letters from the participants, questionnaires, and Moodle's learning analytics.

In the beginning of the courses, questionnaires were sent to get some background information about the participants and their attitude toward certain aspects, including mathematics and programming. At the end of the course, another survey was conducted to ask opinions about the course, for example, the usage and helpfulness of troubleshooters, the evaluation on the difficulty of last exercises, and the last weekly quiz. Both questionnaires were online questionnaires. The answering on these questionnaires was voluntary and passing the MOOC did not depend on that.

The Moodle learning analytics of each participant, indicating the attempts to submit tasks and the points for tasks, was matched to the answers from the questionnaire and to the background data from the pre-questionnaire.

Data analysis. Statistical analyses were carried out as follows. First, the learning analytics integrated into the troubleshooters' environment was studied. Next, descriptive statistics on the participants' opinion on using troubleshooters was investigated. Then Spearman correlation coefficients were calculated to investigate the relationship between participants' evaluations on various statements and their evaluations on the usage of troubleshooters. The helpfulness of troubleshooters for learners was also investigated using the Spearman correlation coefficient. The analyses were carried out using the statistical package SPSS version 23.0.

Results

When looking at the statistics, the total number of people clicking the button "It worked!" was 2,180 (see Figure 10). This chart shows that troubleshooters provided the most help for weekly tasks III and V. Data from the helpdesk questions from the previous course showed that the same weekly tasks prompted many questions, too. The biggest difference is that weekly task VII did not get that much help from troubleshooters as expected, but the reason could be that people had received help for many aspects from the previous troubleshooters or just did not click "It worked!" as the course was ending.

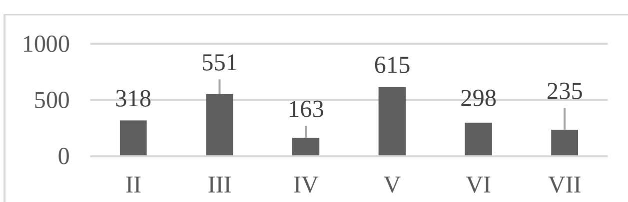


Figure 10. Number of people getting an answer from troubleshooter per weekly task.

As troubleshooters were used in the fourth instance of the course *About Programming*, the number of letters received by the helpdesk can be compared with the previous time the course was conducted. Previous time (without troubleshooters), the helpdesk received 1,250 letters from 1,534 participants, but after adding troubleshooters to the course, 750 letters were received from the 1,430 participants. There were no other major changes in the course, which means that the percentage of questions per participator declined 29%.

The MOOC *About Programming* concluded with a feedback form, which included questions about troubleshooters. The total number of people answered the final questionnaire was 792 and 635 of them had used troubleshooters. As troubleshooters were not compulsory, the results indicate that 16.6% of the participants did not look at troubleshooters at all (see Figure 11).

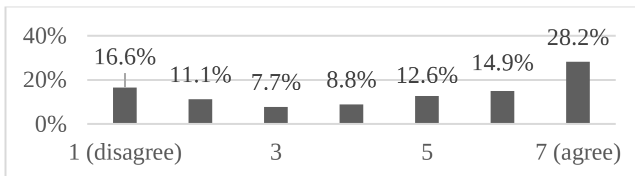


Figure 11. Looked at troubleshooters.

When the users (n=635) were asked about the helpfulness of troubleshooters, 40.8% of the participants claimed troubleshooters to be very helpful (see Figure 12) and 3.5% of the participants did not find troubleshooters helpful at all.

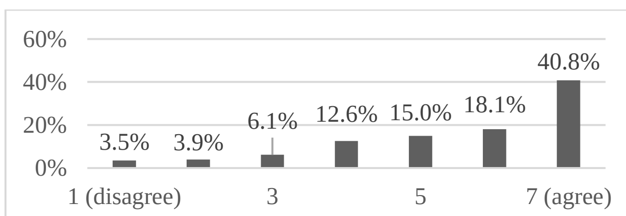


Figure 12. Got help from troubleshooters.

One of the questions included ordering the various parts of the course (videos, reading materials, extra materials, stories, tasks, forum, test, troubleshooters, and other materials) by their position in the solving process when they were used. According to the final questionnaire, 19.8% of the participants did not use troubleshooters at all and 7% looked at troubleshooter as the last thing in the process of solving the tasks (see Figure 13). For the rest of the users, troubleshooters were located at various places in the order of resources. For example, some participants used troubleshooters even before solving the weekly tasks, which means that troubleshooters have changed the way course participants learn.

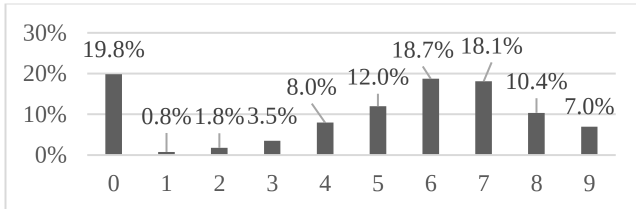


Figure 13. Place of troubleshooters in the order of solving.

Using troubleshooters correlated with various aspects of the course (see Table 2; Lepp et al., 2017b). In the beginning of the course, the participants had to answer on the Likert scale of 7, how much they felt that mathematics and programming were for them. The results show that the more participants feel like mathematics is for them, the less they use troubleshooters. With programming, it is the other way around. Furthermore, the participants, who found the weekly tasks and tests harder, used more troubleshooters. The users, who made more attempts to submit weekly tasks and tests and were deducted points for that, used troubleshooters more. This could indicate that the people falling behind do use the opportunity to use troubleshooters more.

Table 2

Spearman Correlation Coefficients Between Participants Evaluations on Various Statements and Their Evaluations on the Usage of Troubleshooters

Statement	**Evaluations**
Evaluation that mathematics is something for me	-0.128
Evaluation on programming pleasantness	0.261
Evaluation on the difficulty of last exercises	0.348
Evaluation on the difficulty of the last week's quiz	0.174
Number of attempts to submit solutions of exercises	0.300
Number of attempts to submit weekly quiz (at least 90% right solutions)	0.146
Sum of points of weekly quizzes	-0.223

**Note*. All coefficients are statistically significant on .01 level.

Discussion and Conclusions

Creating troubleshooters for course tasks has been useful, as the number of questions asked from the helpdesk declined 29%. In total, 86.5% of the users of troubleshooters have given at least 4 points from 7, showing agreement with the statement that troubleshooters were helpful. It is obvious that not all participants need troubleshooters, but troubleshooters as one possibility to replace a helpdesk could influence the attitude towards the MOOC (Warren et al., 2014) and could be one reason why in our MOOC the dropout rate was lower than in most MOOCs (Jordan, 2014; Siemens, 2013). As a result of the success of troubleshooters, they were also implemented in a MOOC, called *Introduction to Programming*, and will be used in the future.

This paper does not describe didactically how much troubleshooters can actually help in certain situations. The course *About Programming* uses only shorter basic tasks to evaluate certain aspects of the topics and the tasks have mostly one solution; however, the construction of troubleshooters can become very long and difficult in bigger tasks and algorithms. Tasks like finding suitable algorithmic solutions can form several branches, which make the troubleshooter's decision tree difficult to navigate. How much one can help with hints, when there are several different solutions, has not been looked at in this case. Pieterse (2013) stated that providing high quality automatic assessment can be very challenging and demands increased effort from the instructor. We think that the same applies to troubleshooters; however, crafting troubleshooters can be rewarding to the instructors as there is much to learn about learners' mistakes and problems (Vihavainen et al., 2012).

While the number of questions asked from the helpdesk has declined, many of the questions asked from the helpdesk duplicate the questions solved by troubleshooters. It still remains unknown why that occurs. There is a future course coming up without the helpdesk, which may lead to more answers.

Finally, troubleshooters change the way people study as, for example, many learners look at troubleshooters even before they encounter any problems, solve the tasks, or even before reading the theoretical materials about the topic. As has been suggested in a previous study (Anderson, Huttenlocher, Kleinberg, & Leskovec, 2014), learners differ in the ways they engage with online courses. Some participants acquire the required knowledge without needing troubleshooters, while other participants (called "solvers" by Anderson's et al., 2014) focus on solving exercises, using troubleshooters if they encounter problems. The survey revealed that 19.8% of the participants did not use troubleshooters at all and the results indicate that the participants, who received more points and felt that the weekly tasks were easier, were not very active in using troubleshooters, which could imply that troubleshooters are more helpful to people in need for extra assistance. In our case this tool was created for learning as was suggested by Admiraal et al. (2015) and therefore could be helpful for learners.

A danger is that troubleshooters can become an essential part of the study process, which can lead to learned helplessness, where some of the students are addicted to troubleshooters without even experiencing any problems. Will the students learn to swim when they have been thrown a swim ring?

As troubleshooters help to understand the content of the task, they can reduce the students' ability to read and understand the text of the task by themselves. Understanding the problem without external assistance, being able to solve a problem without hints, and debugging it by finding the solutions yourself are important parts of programming too. Similar concerns were also highlighted in a previous study (Vihavainen et al., 2012).

Creating troubleshooters requires special kind of experience and is not that easy. In MOOCs, each new task has to i) use mostly the knowledge taught before, ii) have an automated assessment feedback, and iii) have a troubleshooter with hints for the questions that may occur. All this limits the creation and changing of tasks because too many changes would have to be made. Development of the *Murelahendaja* environment continues in further courses.

Acknowledgments

We would like to thank all of the participants and organizers of the MOOC for their co-operation. Also, the support of the University of Tartu for the development of the MOOC, data collection, and writing of the paper has been considerable.

References

Admiraal, W., Huisman, B., & Pilli, O. (2015). Assessment in massive open online courses. *Electronic Journal of e-Learning*, *13*(4), 207-216.

Anderson, A., Huttenlocher, D., Kleinberg, J., & Leskovec. J. (2014). Engaging with massive online courses. In *Proceedings of the 23rd International Conference on World Wide Web* (WWW '14), 687-698. ACM, New York, NY, USA. doi:10.1145/2566486.2568042

Baturay, M. H. (2015). An overview of the world of MOOCs. *Procedia - Social and Behavioral Sciences*, *174*, 427-433. doi:10.1016/j.sbspro.2015.01.685

Downes, S. (2017). New models of open and distributed learning. In M. Jemni, Kinshuk, & M. Khribi (Eds.), *Lecture notes in educational technology*. *Open education: from OERs to MOOCs* (pp. 1-22). Berlin, Germany: Springer-Verlag. doi:10.1007/978-3-662-52925-6_1

Ebben, M., & Murphy, J. S. (2014). Unpacking MOOC scholarly discourse: A review of nascent MOOC scholarship. *Learning, Media and Technology*, *39*(3), 328-345. doi:10.1080/17439884.2013.878352

Garner, S., Haden, P., & Robins, A. (2005). My program is correct but it doesn't run: A preliminary investigation of novice programmers' problems. In *Proceedings of the 7th Australasian Conference on Computing Education*, 173-180. Retrieved from http://crpit.scem.westernsydney.edu.au/confpapers/CRPITV42Garner.pdf

Greene, J. A., Oswald, C. A., & Pomerantz, J. (2015). Predictors of retention and achievement in a massive open online course. *American Educational Research Journal*, *52*(5), 925-955. doi:10.3102/0002831215584621

Hanks, B. (2008). Problems encountered by novice pair programmers. *Journal on Educational Resources in Computing, 7*(4). doi:1316450.1316452

Hew, K. F., & Cheung, W. S. (2014). Students' and instructors' use of massive open online courses (MOOCs): Motivations and challenges. *Educational Research Review*, *12*, 45–58.

Hone, K. S., & El Said, G. R. (2016). Exploring the factors affecting MOOC retention: A survey study. *Computers & Education*, *98*, 157-168. doi:10.1016/j.compedu.2016.03.016

Jordan, K. (2014). Initial trends in enrolment and completion of massive open online courses. *The International Review of Research in Open and Distributed Learning*, *15*(1). doi:10.19173/irrodl.v15i1.1651

Lepp, M., Luik, P., Palts, T., Papli, K., Suviste, R., Säde, M., & Tõnisson, E. (2017a). MOOC in programming: A success story. In *Proceedings of the International Conference on e-Learning* (ICEL), 138-147. Academic Publishing International, USA.

Lepp, M., Luik, P., Palts, T., Papli, K., Suviste, R., Säde, M., Hollo, K., Vaherpuu, V., & Tõnisson, E. (2017b). Self- and automated assessment in programming MOOCs. In D. Joosten-ten Brinke, & M. Laanpere (Eds.), *Communications in computer and information science: Vol. 653. Technology enhanced assessment* (pp. 72-85). Cham, Switzerland: Springer International Publishing AG. doi:10.1007/978-3-319-57744-9_7

Marceau, G., Fisler, K., & Krishnamurthi, S. (2011). Measuring the effectiveness of error messages designed for novice programmers. In *Proceedings of the 42nd ACM Technical Symposium on Computer Science Education* (SIGCSE '11), 499-504. ACM, New York, NY, USA. doi:10.1145/1953163.1953308

McRitchie, K. J. (2009). Technology consultants: A successful generation of student staff. In *Proceedings of the 37th Annual ACM SIGUCCS Fall Conference: Communication and Collaboration* (SIGUCCS '09), 287-292. ACM, New York, NY, USA. doi:10.1145/1629501.1629555

Motsuk, K. (1999). The student helpdesk: student information technology support at Georgetown University. In *Proceedings of the 27th Annual ACM SIGUCCS Conference on User Services: Mile High Expectations* (SIGUCCS '99), 172-175. ACM, New York, NY, USA. doi:10.1145/337043.337135

Muuli, E., Papli, K., Tõnisson, E., Lepp, M., Palts, T., Suviste, R., Säde, M., & Luik, P. (2017). Automatic assessment of programming assignments using image recognition. In É. Lavoué, H. Drachsler, K. Verbert, J. Broisin, & M. Pérez-Sanagustín (Eds.), *Lecture notes in computer science: Vol. 10474. Data driven approaches in digital education* (pp. 153-163). Cham, Switzerland: Springer International Publishing AG. doi:10.1007/978-3-319-66610-5_12

Onah, D. F. O., Sinclair, J. E., & Boyatt, R. (2014). Exploring the use of MOOC discussion forums. In *Proceedings of London International Conference on Education*, 1-4. doi:10.13140/RG.2.1.3319.5042

Papathoma, T., Blake, C., Clow, D., & Scanlon, E. (2015). Investigating learners' views of assessment types in massive open online courses (MOOCs). In G. Conole, T. Klobučar, C. Rensing, J. Konert, & E. Lavoué (Eds.), *Lecture notes in computer science: Vol. 9307. Design for teaching and learning in a networked world* (pp. 617-621). Cham, Switzerland: Springer International Publishing AG. doi:10.1007/978-3-319-24258-3_72

Pieterse, V. (2013). Automated assessment of programming assignments. In *Proceedings of the 3rd Computer Science Education Research Conference on Computer Science Education Research* (CSERC '13), 45-56. Open Universiteit, Heerlen, The Netherlands. Retrieved from http://dl.acm.org/citation.cfm?id=2541917.2541921

Sanders, K., & Thomas, L. (2007). Checklists for grading object-oriented CS1 programs: Concepts and misconceptions. *SIGCSE Bull*, *39*(3), 166-170. doi:10.1145/1269900.1268834

Siemens, G. (2013). Massive open online courses: Innovation in education. *Open educational Resources: Innovation, Research and Practice*, *5*. Retrieved from https://oerknowledgecloud.org/sites/oerknowledgecloud.org/files/pub_PS_OER-IRP_web.pdf#page=31

Sinnett, C. J., & Barr, T. (2004). OSU helpdesk: A cost-effective helpdesk solution for everyone. In *Proceedings of the 32nd annual ACM SIGUCCS conference on User services* (SIGUCCS '04), 209-216. ACM, New York, NY, USA. doi:10.1145/1027802.1027851

Skaanning C., Jensen F.V., & Kjærulff U. (2000). Printer troubleshooting using bayesian networks. In R. Logananthara, G. Palm, & M. Ali (Eds.), *Lecture notes in computer science: Vol. 1821*. *Intelligent problem solving*. *Methodologies and approaches* (pp. 367-380). Berlin, Germany: Springer-Verlag. doi:10.1007/3-540-45049-1_45

Suen, H. K. (2014). Peer assessment for massive open online courses (MOOCs). *The International Review of Research in Open and Distance Learning, 15*(3), 313-327. doi:10.19173/irrodl.v15i3.1680

Veletsianos, G., & Shepherdson, P. (2016). A systematic analysis and synthesis of the empirical mooc literature published in 2013–2015. *International Review of Research in Open and Distributed Learning*, *17*(2). doi:10.19173/irrodl.v17i2.2448

Vihavainen, A., Luukkainen, M., & Kurhila, J. (2012). Multi-faceted support for MOOC in programming. In *Proceedings of the 13th Annual Conference on Information Technology Education*, 171-176. ACM. doi:10.1145/2380552.2380603

Warren, J., Rixner, S., Greiner, J., & Wong, S. (2014). Facilitating human interaction in an online programming course. In: *Proceedings of the 45th ACM Technical Symposium on Computer Science Education* (SIGCSE '14), 665-670. ACM, New York, NY, USA. doi:10.1145/2538862.2538893

Washburn, K., & El-Bayoumi, J. (2003). UNB's single site service source. In *Proceedings of the 31st Annual ACM SIGUCCS Fall Conference* (SIGUCCS '03), 237-239. doi:http://dx.doi.org/10.1145/947469.947532

Wustner, S., Joumblatt, D., Teixeira, R., & Chandrashekar, J. (2012). Automated home network troubleshooting with device collaboration. In *Proceedings of the 2012 ACM Conference on CoNEXT Student Workshop* (CoNEXT Student '12), 61-62. ACM, New York, NY, USA. doi:10.1145/2413247.2413284

International **R**eview of **R**esearch in **O**pen and **D**istributed **L**earning
Volume 19, Number 4

September – 2018

MOOC Makers: Professors' Experiences With Developing and Delivering MOOCs

Stephanie J. Blackmon, Ph.D.
William & Mary School of Education

Abstract

Massive open online courses (MOOCs) have been described as purposeful educational resources for teaching, open educational initiatives, competency-based learning, and the like. They have also been described as an agent of higher education's deterioration. Although MOOCs are often discussed in terms of their current and future usefulness, or lack thereof, in higher education contexts, very little data exists on professors' experiences creating and teaching these courses. Therefore, I conducted a qualitative study, more specifically a phenomenography, to examine professors' experiences with developing and teaching a MOOC. Data include their thoughts on why they decided to teach a MOOC and the benefits and challenges associated with making and teaching a MOOC.

Keywords: teaching, MOOC, online teaching, online learning, OER, distance education

Introduction

Massive open online courses (MOOCs) have been both extolled and condemned in higher education. Consider the disparate MOOC parties as food "camps." One camp says that MOOCs have some nutritional value, that there is the potential for sustenance through the materials and the methods of MOOCs. For the other camp, MOOCs are the cotton candy of higher education—a swirl of sugary goodness that may attract some with its puffy sweetness, but that dissolves on contact and has no real nutritional value. Cormier and Siemens (2010) emphasized the positive aspects of open courses, stating, "Online open courses allow for innovation in how educators prepare to teach, how learners negotiate knowledge from the information they are encountering, and how courses can have an impact on the broader field of study" (p. 32). Lesko and Hollingsworth (2013), however, indicated that the openness of open courses proves problematic for some, as there may be concerns about content ownership. Several companies, higher education institutions, and professors, seemingly undaunted, persist with the creation and delivery of MOOCs.

Purpose

The purpose of the current study is to provide empirical data on instructors' experiences with creating and teaching MOOCs. Each participant was involved in developing the MOOC that s/he taught. The research question is the following: What are the various lived experiences of professors who teach massive open online or open access courses? Current literature provides more and more information about MOOC learners. For example, researchers have published data related to learners' completion of MOOCs (Pursel, Zhang, Jablokow & Velegol, 2016), and another recent study indicated that 60% of "paying users" earn certificates for MOOCs and that a number of MOOC participants are teachers (Chuang & Ho, 2016). Researchers have also noted the time it takes for a portion of the 4.5 million (so far) MOOC users to earn a certificate (Chuang & Ho, 2016; Straumsheim, 2017). However, although there are several blog posts and personal reflections available on instructors' experiences with MOOCs, there is very little empirical data related to the experiences of the instructors who create MOOCs. Liyanagunawardena, Adams, and Miller (2013) stated that the lack of data on those who instruct or deliver MOOCs represents a missing component in the literature on massive open online courses, and that is still the case today. While some faculty members are intrigued, and even excited, about the idea of MOOCs, others are fearful about the continued use of massive open online courses (Kolowich, 2013). Empirical research on faculty members' experiences teaching MOOCs is quite limited. Therefore, the current qualitative study, a phenomenography, focuses on the variations of faculty members' experiences with creating and teaching MOOCs.

Background Literature

Although there is still quite a lot to learn about the creation and delivery of massive open online courses, there have been numerous conversations about MOOCs since the creation of Stanford's Artificial Intelligence (AI) open course.

Several works, for example, have examined MOOC pedagogy. In Clara and Barbera's (2013) work, they discussed what they termed the "problematic pedagogy" of MOOCs through cultural psychology (p. 129). They also continued a conversation about xMOOCs, which do not seem to emphasize pedagogy, and cMOOCs, which do seem to emphasize pedagogy (Clara & Barbera, 2013; also see Siemens, 2012). However, some current offerings of xMOOCs seem to take on a few characteristics typically associated with cMOOCs (see Blackmon & Major, 2017). Like Clara and Barbera (2013), Rhoads (2015) also addressed the pedagogical distinction of cMOOCs and xMOOCs in his book on MOOCs in higher education. Clara and Barbera indicated that cultural psychology can be instrumental in developing pedagogy for MOOCs.

MOOC learners are, understandably, a very important topic of MOOC literature. Kop, Fournier, and Mak (2011) discussed pedagogy and MOOCs, but they specifically investigated support for MOOC participants. Rodriguez (2012) also talked about, to some extent, the experiences of MOOC learners. Graham (2012) discussed learners and MOOCs, but from quite a different angle. He expressed the idea that MOOCs, even though they are touted by some of the nation's leading institutions, could potentially harm students who are already experiencing challenges in the traditional classroom. Veletsianos, Collier, and Schneider (2015) examined more in-depth interactions of learners in MOOCs: their use of social networks outside of the course, their processes for note taking, and their consumption of the MOOC content. Zhenghao et al. (2015), in their study of Coursera students, found that learners enrolled in MOOCs for reasons related to education and careers.

Some texts address the experiences of MOOC participants while also discussing the experiences of MOOC instructors. One such example is Blancato and Iwertz's (2016) study on a rhetorical composition MOOC. Like previous studies on MOOC participants' experiences, the text explored learners' perspectives on various aspects of the MOOC; however, Blancato and Iwertz also noted that this particular MOOC experience allowed students to teach each other as well as faculty. The learning experience was one that explored both the student and faculty roles in MOOCs and how those roles can be distributed across a course to allow participants and teachers to simultaneously occupy both of the aforementioned roles.

MOOC instructors have also written reflective works to chronicle their experiences teaching these types of courses. For example, Comer (2014) noted being encouraged to keep a journal during the process of creating and teaching a MOOC, so the text addresses everything from making videos to managing students' concerns on the course discussion board. Journals and blog posts can provide helpful information on some of the instructional benefits and challenges related to MOOCs.

There are empirical studies available on instructional aspects of MOOCs as well. For example, in addition to investigating students' motivations for taking MOOCs, Hew and Cheung (2014) also looked at professors' motivations for delivering MOOCs in their review of MOOC research. Margaryan, Bianco, and Littlejohn (2014) chose to examine a different instructional aspect of MOOCs and focused on the quality of instruction in several MOOCs they selected randomly. However, as MOOC enrollment continues to grow and change, researchers should also continue to investigate the evolving experiences of learners as well as those of instructors. There are many professors involved in the creation of MOOCs, and learning more about their experiences with the creation and delivery of these courses could inform the current and future conversations in higher education regarding MOOCs. As noted in some of the aforementioned works, MOOCs carry both benefits and drawbacks, and hearing from faculty members who created and taught these courses will provide much needed qualitative data on many of the celebrated and concerning aspects of massive open online courses.

Theoretical Framework

The framework for the current study is social constructivism. In a work by Woo and Reeves (2007), they used social constructivism when interpreting interactions in "web-based learning" (p. 16). For the current study, social constructivism plays a large role, too, in that the MOOC environment has multiple layers and multiple contexts. Faculty members who create and deliver MOOCs have the added context of the "massive" part of the MOOC experience. Assignments and ideas that may have worked well for a face-to-face or online class of 25 will have to be adjusted for a MOOC of 2500. Even learners who are accustomed to introductory courses with 200 or so students will have to adjust to a classroom with thousands of students, potentially. The technology itself is one context, and the scale of the course is another, very different, context. In their study of online community, Shackelford and Maxwell (2012) used social constructivism to frame their work. They noted that in social constructivism, "The role of the educator is to establish an environment in which active participating between and among learners and the instructor can occur" (Shackelford & Maxwell, 2012, p. 229). In a massive open online class, the scale of the course is an integral part of the environment, and by extension, affects the co-construction of knowledge and the context for student-student and student-professor interactions. The current study seeks to examine the variations of professors' experiences with teaching MOOCs, and since those experiences are arguably socially constructed, social constructivism is the theoretical framework for this study.

Methods

I chose to conduct a qualitative study because I was interested in participants' stories. In a number of instances, MOOC research relies on quantitative data because of the sheer number of people. However, devoting time and empirical work to the stories of participants, their voices through their own words, is the business of qualitative research (Creswell & Poth, 2018) and a valuable, worthwhile endeavor. More specifically, my study is a phenomenography (Marton, 1981), a variation of a phenomenological study (Savin-Baden & Major, 2013), and the research question for this study is as follows: What are the various lived experiences of professors who teach massive open online or open access courses? According to Savin-Baden and Major (2013), phenomenography highlights the variations of participants' lived experiences and is often used in educational research on teaching and learning. Although my study presents various cases in the form of each participant's experience, the current study is not a case study because it is not bounded and does not present a unique case (Merriam, 1998; Creswell & Poth, 2018). The combination of creating and teaching a MOOC is no longer a unique endeavor, but it is an understudied one, at least from the perspective of instructors' qualitative experiences. I chose phenomenography because I wanted to highlight the variations of the lived experiences of those who create MOOCs and go on to teach the MOOCs they create. The research question was broadly framed in order to capture as much information about the MOOC teaching experience as possible, but from a very specific group of participants: those who created the MOOCs they taught. Because my study is an education study of faculty members' myriad experiences with developing and teaching MOOCs/open access courses, phenomenography is an appropriate methodological approach.

Other researchers have also employed phenomenography to explore issues related to teaching and learning in higher education. For example, Goh's (2013) phenomenographic study examined pre-service teachers' "conceptions of competency" (p. 1). Goh chose phenomenography "because of its potential to capture variation of understanding, or way of constituting, conceptions of competency" (p. 3). She interviewed 18 "beginning teachers" with the goal of "report[ing] the variation that emerged from [their] understanding of the phenomenon," which was competency (p. 3).

Parmaxi, Kyriacou, and Stylianou (2013) conducted a phenomenography on the attitudes teachers and learners had toward computer-assisted language learning. They conducted semi-structured interviews with 15 undergraduate students and 12 language teachers.

Participants

After receiving IRB approval, over 20 potential participants were contacted for this study, and 8 professors agreed to participate in the study. Phenomenography is a variation of phenomenology (Savin-Baden & Major, 2013), so my number of participants falls within the acceptable range for phenomenological works, which can be from 5 to 35, and in some cases larger or smaller depending on the goals of the phenomenological work (Creswell & Poth, 2018). The participants were either assistant or associate professors at colleges and universities across the United States. Tenure-track or tenured assistant, associate, or full professors who had created a MOOC and taught the MOOC they created were specifically targeted for this study, as the experiences of adjunct or clinical professors may be markedly different from the experiences of professors who have some experience with the tenure process and its impact on teaching opportunities. For example, several professors may teach MOOCs "out-of-load," or as an addition to their requisite departmental courses. The conversation about "in-load" or "out-of-load" courses affects tenure and post tenure review. Therefore, the current study will leave room for those types of conversations among a participant pool of faculty members who have some experience with tenure or post tenure review. The experiences that adjuncts and clinical professors have with MOOCs are equally valuable, but would involve a separate set of circumstances that would work well for a separate study. The following chart shows the list of participants, the colleges or schools where their courses were or would have been taught ("would have been taught" because some participants taught their courses through third-party providers), and the number of students in the MOOC:

Table 1

List of Study Participants and Course Information

Participants	College where course was/would be offered	Number of MOOC students enrolled
Participant 1	College of Business	1,500-2,000 (first offering); 500 (second offering)
Participant 2	College of Arts and Sciences	about 8,000
Participant 3	College of Arts and Sciences	3,000

Participant 4	College of Arts and Sciences	2,500-3,000
Participant 5	College of Engineering	55,000
Participant 6	College of Engineering	1,700
Participant 7	College of Arts and Sciences	35,000
Participant 8	College of Engineering	40,000-50,000

Data Collection

Interview data were collected using a combination of face-to-face and virtual approaches. Face-to-face interviews were logged with a hand-held tape recorder, and virtual interviews were recorded via Adobe Connect. All interviews were transcribed verbatim and did not include identifying information about participants (names, institutions, courses, gender, or MOOC platform) in order to maintain strict confidentiality. The data were deleted from the handheld recording device and Adobe Connect upon completion of the study.

Data Analysis and Trustworthiness

Data were coded and analyzed according to Marton (1986), which included reading the transcripts, highlighting quotes that responded to the research question, closely examining the meaning of the quotes for "significant differences" that could lead to what Marton referred to as "pools of meaning" across data, connecting similar quotes, and forming themes based on the quotes (p. 43). I read each transcript and highlighted the quotes that answered the research question. Next, I carefully explored the meanings of the quotes and noted the "significant differences." These differences led to "pools of meaning," and those pools of meaning across quotes became the themes for the study—noted in the Findings section of this paper.

Creswell and Poth (2018) recommended several "validation strategies" (p. 259) and suggested that researchers use at least two of the strategies listed. The current study included member checking and explication of "researcher bias" (Creswell & Poth, 2018, p. 261) as trustworthiness measures. The discussion of researcher bias is addressed in the following Researcher Positionality Statement.

Researcher Positionality

The impetus for the current research comes from my own experiences teaching MOOCs. For example, in negotiating the responses and valuable contributions of the little over 100 participants connected to my graduate-level, non-credit-bearing course, I wondered how other faculty members, with far more students, handled their MOOC-teaching experiences. I wanted to make sure that my experiences with MOOCs were not conflated with study participants' experiences, so I focused on an open-ended approach to my interactions with participants. I also ended the interviews by asking participants what other information they would like others to know about teaching a MOOC, to ensure that my perspectives and direction did not inhibit or minimize participants' contributions. In a larger context, I noticed that a lot of the literature related to teaching MOOCs resided in areas of scholarship on reflections or on blog posts, and extant literature (see, for example, Liyanagunawardena et al., 2013) confirmed that observation. Those contributions are useful, but I saw an opportunity to provide empirical data on instructors' experiences with MOOCs, helping to address a gap in the literature. My approach to the work as an opportunity to share instructors' perspectives helped me to focus on participants' contributions.

Results

Participants expressed a number of viewpoints on their experiences with developing and delivering MOOCs, and as noted in Marton (1986), participants' quotes were used to develop themes. The four major themes for the current study include the following:

1. Reasons for teaching a MOOC.
2. Benefits of teaching a MOOC.
3. Challenges of teaching a MOOC.
4. Implications for other types of courses.

Reasons for Teaching a MOOC

The "Reasons for Teaching a MOOC" theme is based on what participants noted as the initial impetus for developing and teaching a MOOC. Participants indicated three reasons for moving forward with MOOCs: altruism, research exposure, and the opportunity to experiment with new technology.

Several participants noted that they wanted to teach a MOOC for altruistic reasons, such as providing content to people in areas who did not have access to such content. For example, Participant 2 stated:

> But more than that was the idea of it being an opportunity to reach out to a lot of people who don't necessarily have access [to the specific content for the course]. …In fact, I should say it has turned out to be completely like that. I mean, I hear from people all over the world, pretty constantly, who are gratified that they have access to this, so it was for both ego reasons and social reasons, social justice reasons, I guess you could say, that I was attracted to the idea.

Along with altruistic reasons, however, participants also explained that MOOCs provided an opportunity for them to extend their research to larger audiences. Participant 5 mentioned research exposure connected to offering a MOOC and noting connections to:

> promoting my specific research field and the view that my community has of how to do [work in the participant's area]—in terms of promoting my research group and my field of study and my

> university. So--the opportunity to offer it to tens of thousands of students was very compelling as well, and I think the rewards from that have been significant.

The opportunity to experiment with new technology motivated some participants to develop and teach a MOOC. Participant 3 said:

> I was, I guess I was primarily interested in the new format. I've been teaching for a long time…so I see the kids as bored with PowerPoint for lectures as I am, so I was interested in broadening my toolkit, trying something different. I was interested in technology and education…So, I'm interested in new formats, new approaches to higher education instruction.

It is important to note that each participant mentioned that their institutions or third party providers initially approached them about developing and teaching a MOOC. The fact that institutions and organizations approached them was consistent among all participants, but the reasons for their being approached varied. While being asked to have a course available for anyone in the world, and by extension represent the institution to those constituents, is an honor, there may be underlying implications associated with agreeing (or not agreeing) to teach a MOOC when asked—a topic that will be addressed in the Implications section of this paper.

Professional Benefits of Teaching a MOOC

Participants highlighted benefits MOOCs held for them and for their students. Many people from local communities and around the world accessed the participants' MOOCs, and as a result, participants reported opportunities to show leadership in their fields and more exposure for their areas of research as professional benefits for teaching MOOCs.

Participant 2 stated:

> I got a call from, I think it was actually the vice president of [my institution] wanting to just find out more about what I was up to and all of that. I've been through something in a kind of early stage that my university is interested in, so I'm a resource there, too.

Developing and teaching the MOOC gave Participant 2 an opportunity to provide leadership on his/her campus related to this developing instructional form. Participant 2 also received public recognition, outside of the institution, related to the MOOC. Participant 4 mentioned a type of public recognition as well, stating:

> I was, frankly, amazed at how many people signed up for the course and where all they were coming from. I was floored by it. And so, not that long ago I gave a talk overseas about the class, and people over there had already taken it. I don't know how many people in that conference who knew who I was through this class…

The MOOC provided widespread recognition for Participant 4, which, in turn, provided widespread attention for the participant's institution, and potentially, area of research.

Participants did not necessarily agree to teach a MOOC with these benefits in mind, as evidenced by Participant 4's surprise that so many people were familiar with the MOOC at a conference, but there were professional benefits to some of the professors (and again, the universities, by extension) who decided to develop and teach a MOOC. As with any endeavor, just as there are benefits, there are also challenges.

Challenges of Teaching a MOOC

The major challenges with teaching a MOOC mirrored some of the same challenges discussed in research about online courses in general: technology and time. Although several of the participants were excited about a new form of teaching, the recording, uploading, and editing associated with the videos for their courses took a lot of time, and in some cases, almost required that they acquire new skills in video production. Many participants saw teaching a MOOC as a learning experience, but even when the challenges with technology could be subsumed under the category of "learning experience," the time constraints in particular were quite pronounced.

Some of the professors taught MOOCs "out-of-load," which means that they had other required courses they were teaching, and the MOOC did not count as one of those courses.

Time and technology. Participant 1 expressed some of those challenges, saying, "Well, early on the challenge was that there just wasn't a whole lot of support. In other words, I didn't have a camera crew standing ready to record me, so it was very, very time consuming." Participant 1 also indicated that making the course content more manageable, especially when creating shorter videos, was a significant time commitment as well.

Participant 8 shared:

> In some sense the biggest challenge was the immense amount of time it takes to get the materials in good enough shape and your lectures sufficiently well-organized that they will be effective at scale. When you have that many students relying on your materials, they have to pretty much be perfect, and that demands a level of polish that's not always necessary--in classroom only sessions, you can sometimes get away with an occasional mistake here or there or homework assignment that doesn't quite work out the way the instructions say that it will--with a MOOC…it's a really bad day when that happens. So, probably the biggest challenge, what I remember most, is just the amount of time. It was like having two jobs.

Much like the other participants, Participant 8 highlighted time as a significant challenge related to MOOC development. However, Participant 8 also noted editorial issues as well. Although Participant 8 did not indicate finding the technology and time connected with working with technology particularly time consuming, the participant did point out how important it was to have the course material "pretty much… perfect." All of the participants in the study are experts in their fields, but in an environment that makes use of other materials for instruction, materials that will be viewed by students and colleagues around the world, there is a legitimate concern about having those materials look polished. Participant 5 stated:

> What was a concern, you know the style of teaching online is very different than what you do in the classroom for many reasons, and so I can talk about those in depth but the conclusion is that

> you pretty much have to develop all of this material from scratch, and you're teaching in such a different way that you're not getting feedback along the way--you have to do so much reparation to make sure you're gonna be really good on camera. It's like starting over as a teacher, and that was very time consuming and difficult. I'd say that was the hardest thing.

Again, it is not that the participants did not understand the technology—several of them did; the challenge is that technology allows their teaching to happen in a very different way with a

MOOC, and concerns that may not have been present in face-to-face or more traditional online environments are now present in a massive open online course.

As indicated by participants' comments, time and technology are somewhat intertwined when considering the challenges related to developing and teaching a MOOC. Their professional identities are no longer only tied to their expertise in their fields; their identities may also be tied to the quality of a video or other media, which may not be an area of expertise for them.

Implications for Other Types of Courses

Participants discussed how MOOCs changed (or would change) the way they taught other courses, particularly face-to-face classes. For example, Participant 7 stated:

> I think rather that I have, for me, personally come to the conclusion that everything I say in a class should be available for a learner in an online version as well. ... I feel that the way I used to teach—I would do slides and put those slides up—that I won't do in the future, but rather I will prepare a course almost MOOC style by recording videos beforehand with me sort of teaching into the camera and then use that as a basis for people to fall back on later in the course.

Teaching a MOOC caused several participants to rethink ways of teaching in their face-to-face courses.

Discussion

Some of the participants' experiences are consistent with existing accounts of teaching MOOCs. For example, several participants mentioned teaching a MOOC for altruistic reasons, a finding that is consistent with the literature. In terms of differences, although flexibility is often viewed as a boon for online courses, in the case of MOOCs, flexibility was challenging for some participants. Participant 2 mentioned not knowing when the course actually stopped. These issues are consistent with Comer's (2014) reflective account of teaching a MOOC. There was a constant feeling that the professor needed to respond because people were accessing the course at various times, and Participant 2 in the current study had a similar experience. Because some MOOCs can remain open, people can participate and post to forums at their leisure. For the professor of the course, there may be a feeling that s/he must check in with the course to respond to people who find and engage with the MOOC after the "official" offering is done. This finding is particularly interesting in light of recent data indicating that when MOOCs are run multiple times, the enrollment has often been 25% smaller than the original course offering (Chuang & Ho, 2016). Depending on the original enrollment numbers, however, 25% could still be a significant amount of students. Just as

Participant 2 expressed reservations about the ambiguity around some MOOC offerings, other instructors could have similar concerns. For example, there may be financial or time-related implications associated with offering another iteration of a MOOC. Also, there are challenges related to the social construction of the course experience because of participation inconsistencies. Even though MOOCs can be accessed at any time, many of them are still developed according to traditional academic timelines, so MOOC instructors are sometimes in a liminal position, not quite in a traditional academic timeframe, but not quite out of one either.

Evidence-based information from faculty members who create and teach MOOCs will add to the conversation about online learning and higher education. Courses in general can be created by one person or group and delivered by another person or group, and as the area of MOOCs in higher education is still relatively new, understanding the experiences of those who create and teach MOOCs will help establish a foundation for future conversations about others who create and teach MOOCs, those who only create MOOCs, those who only teach MOOCs, and the like. As the data show, instructors commit a great deal of time to offering MOOCs, and although it is largely a personal choice to do so, as these courses contribute to institutional image and enrollment, understanding what it takes to create a MOOC is an important endeavor. Instructors' insights could also inform policies and practices related to massive open online courses. Some of the data on MOOCs is student driven and quantitative simply because of the "massive" number of students in these courses. The data on students in these courses is extremely important; however, content on faculty members' experiences with MOOCs is also valuable. A qualitative study on faculty members and MOOCs is informative for higher education administrators, other faculty members, and third-party MOOC providers.

Although extant literature broaches the subject of instructors' motivations for offering MOOCs (i.e., Hew & Cheung, 2014), the current study also indicated some of the challenges and concerns professors have related to MOOCs. The time and effort it takes to develop and teach a MOOC cannot be overstated, and as Blancato and Iwertz (2016) noted, students often have particular expectations for their MOOC experience, sometimes based on stories about interaction or the lack thereof in these courses. Furthermore, these experiences, too, are socially constructed by faculty and MOOC participants, and are also guided by various perceptions of what it means to be involved in these courses. Time and effort are often empirically discussed as critical components of the MOOC experience for participants, but the current study empirically confirmed that time and effort are concerns for MOOC faculty as well. Several participants noted that the time commitment for MOOCs is quite high, and although many professors gladly chose to teach MOOCs and would consider teaching a MOOC again, there are challenges related to the time it takes to create and deliver these courses. For the current participants in particular, who were tenure-track or tenured professors, MOOCs have serious implications for teaching, research, and service. These challenges related to time could be present for other tenure track or tenured professors, as well as other categories of instructors like adjuncts. Opportunities for developing and delivering MOOCs should be open to instructors from various backgrounds at various points in their careers, so understanding more about instructors' experiences with MOOCs, such as the data the current study provided, will add to a necessary conversation that is directly connected to the future of MOOCs in higher education.

Implications and Conclusion

Future researchers could investigate different types of instructors' experiences with MOOCs, as the current study addressed the experiences of tenure track or tenured professors. The findings for the current study have implications for higher education institutions, third-party MOOC providers, researchers, faculty, and MOOC participants. Institutions who offer MOOCs or those who have professors, instructors, etc. offering MOOCs, could make a greater effort to track whether or not the contact that participants have with institutions via the MOOCs results in any additional interest in other programs offered by the institution. For institutions that partner with third party providers, there may also be opportunities to connect with those providers to gather data related to the impact MOOCs have on admissions or interest in those institutions. Institutional researchers could connect with MOOCs associated with their institutions to learn more about any potential benefits MOOCs have for those colleges or universities. MOOC faculty and participants can use the data from the current study to explore more intentional ways of socially constructing the MOOC experience. Recognizing the benefits and challenges of MOOCs before beginning the process can help both faculty and participants create a richer, more interactive experience. As more people decide to receive MOOC certificates, like the 60% of users mentioned in Chuang and Ho's (2016) text, understanding the relationship between MOOCs and institutional enrollment could become the next phase of MOOC research, particularly if some institutions consider accepting the credential as a part of prospective students' application packets.

Although some faculty members may be excited about and prepared for teaching MOOCs, others may feel pressured to create massive open online courses. Any efforts to continue MOOCs should include conversations about the many benefits associated with MOOCs and the many challenges connected to these courses as well so that administrators, participants, and instructors understand the various components MOOC creation and delivery include. Knowing more about faculty members' experiences with MOOCs through qualitative, quantitative, and mixed methods studies could help improve the process of creating, teaching, and administering these courses.

References

Blackmon, S. J., & Major, C. H. (2017). Wherefore art thou MOOC?: Defining massive open online courses. *Online Learning-AERA Special Issue, 21*(4), 195-221. Retrieved from https://olj.onlinelearningconsortium.org/index.php/olj/article/view/1272/346

Blancato, M., & Iwertz, C. (2016). 'Are the instructors going to teach us anything?': Conceptualizing student and teacher roles in the 'Rhetorical Composing' MOOC. *Computers and Composition*, *42*, 47-58. Retrieved from https://www-sciencedirect-com.proxy.wm.edu/science/article/pii/S8755461515300153

Chuang, I., & Ho, A. D. (2016). *HarvardX and MITX: Four years of open online courses, Fall 2012-Summer 2016*. Retrieved from SSRN website: https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2889436

Clara, M., & Barbera, E. (2013). Learning online: Massive open online courses (MOOCs), connectivism, and cultural psychology. *Distance Education, 34*(1), 129-136. Retrieved from http://web.b.ebscohost.com.proxy.wm.edu/ehost/pdfviewer/pdfviewer?vid=1&sid=416769fa-6f43-4c70-99a7-6b0db93f8944%40sessionmgr102

Comer, D. K. (2014). Learning how to teach differently: Extracts from a MOOC instructor's journal. In S. D. Krause & C. Lowe (Eds.) *Invasion of the MOOCs: The promise and perils of massive open online courses* (pp. 130-149). Anderson, SC: Parlor Press. Retrieved from http://www.parlorpress.com/pdf/invasion_of_the_moocs.pdf

Cormier, D., & Siemens, G. (2010). The open course through the open door: Open courses as research, learning, and engagement. *Educause Review*, 31-39. Retrieved from https://www.islandscholar.ca/islandora/object/ir%3A3675/datastream/PDF/view

Creswell, J. W., & Poth, C. N. (2018). *Qualitative inquiry & research design: Choosing among five approaches* (4th ed.). Los Angeles, CA: Sage Publications.

Goh, P. (2013). Conceptions of competency: A phenomenographic investigation of beginning teachers in Malaysia. *The Qualitative Report*, *18*(40), 1-16. Retrieved from https://nsuworks.nova.edu/cgi/viewcontent.cgi?referer=https://scholar-google-com.proxy.wm.edu/scholar?hl=en&as_sdt=0%2C47&q=Conceptions+of+competency%3A+A+phenomenographic+investigation+of++beginning+teachers+in+Malaysia&btnG=&httpsredir=1&article=1519&context=tqr/

Graham, G. (2012, Oct. 1). After the buzz: How the embrace of MOOCs could hurt middle America. *Chronicle of Higher Education*. Retrieved from http://www.chronicle.com

Hew, K., & Cheung, W. (2014). Students' and instructors' use of massive open online courses (MOOCs): Motivations and challenges. *Educational Research Review*, *12*, 45-58. Retrieved from https://www-sciencedirect-com.proxy.wm.edu/science/article/pii/S1747938X14000128

Kolowich, S. (2013, May 2). Why professors at San Jose State won't use a Harvard professor's MOOC. *Chronicle of Higher Education*. Retrieved from http://www.chronicle.com

Kop, R., Fournier,H., & Mak, J. (2011). A pedagogy of abundance or a pedagogy to support human beings: Participant support on massive open online courses. *The International Review of Research in Open and Distance Learning*, *12*(7), 74-93. Retrieved from http://www.irrodl.org/index.php/irrodl/article/viewFile/1041/2042

Lesko, C., & Hollingsworth, Y. (2013). Challenges and value-adds: Proposed use of virtual world environments to provide interactive workspace for MOOC course deliveries. In T. Bastiaens & G. Marks (Eds.), *Proceedings of e-learn 2013--world conference on e-learning in corporate, government, healthcare, and higher education* (pp. 834-843).

Las Vegas, NV, USA: Association for the Advancement of Computing in Education (AACE). Retrieved from https://www-learntechlib-org.proxy.wm.edu/p/114947/

Liyanagunawardena, T.R., Adams, A.A., & Williams, S.A. (2013). MOOCs: A systematic study of the published literature 2008-2012. *The International Review of Research in Open and Distance Learning, 14*(3). Retrieved from http://www.irrodl.org/index.php/irrodl/article/view/1455/2531

Margaryan, A., Bianco, M., & Littlejohn, A. (2014). Instructional quality of massive open online courses (MOOCs). *Computers & Education*, *80*, 77-83. Retrieved from https://www-sciencedirect-com.proxy.wm.edu/science/article/pii/S036013151400178X

Marton, F. (1981). Phenomenography—Describing conceptions of the world around us. *Instructional Science*, *10*(2), 177-200. Retrieved from https://www-jstor-org.proxy.wm.edu/stable/pdf/23368358.pdf

Marton, F. (1986). Phenomenography: A research approach to investigating different understandings of reality. *Journal of Thought*, *21*(3), 28-49. Retrieved from https://www-jstor-org.proxy.wm.edu/stable/pdf/42589189.pdf

Merriam, S. (1998). *Qualitative research and case study applications in education*. Jossey-Bass: San Francisco, CA.

Parmaxi, A., Kyriacou, S., & Stylianou, K. (2013). Using phenomenography to compare the variation of language teachers and learners' attitudes towards computer assisted language learning. *Global Perspectives of Computer-Assisted Language Learning*, WorldCALL. Retrieved from https://www.researchgate.net/publication/236678708_Using_phenomenography_to_capture_the_variation_of_language_teachers_and_learners%27_attitudes_towards_Computer_Assisted_Language_Learning

Pursel, B., Zhang, L., Jablokow, K., & Velegol, D. (2016). Understanding MOOC students: Motivations and behaviors indicative of MOOC completion. *Journal of Computer Assisted Learning*, *32*(3), 202-217. Retrieved from https://onlinelibrary-wiley-com.proxy.wm.edu/doi/pdf/10.1111/jcal.12131

Rhoads, R. A. (2015). *MOOCs: High technology & higher learning*. Baltimore, Maryland: Johns Hopkins University Press.

Rodriguez, O. (2012). MOOCs and the AI-Stanford like courses: Two successful and distinct course formats for massive open online courses. *European Journal of Open, Distance and E-Learning, 2,* 1-13. Retrieved from http://www.eurodl.org/materials/contrib/2012/Rodriguez.pdf

Savin-Baden, M., & Major, C. (2013). *Qualitative research: The essential guide to theory and practice*. London: Routledge.

Shackelford, J., & Maxwell, M. (2012). Sense of community in graduate online education: Contribution of learner to learner interaction. *The International Review of Research in Open and Distance Learning*, *13*(4), 228-249. Retrieved from http://www.irrodl.org/index.php/irrodl/Â%C2%ADarticle/view/1339/2317

Siemens, G. (2012). *MOOCs are really a platform*. ELearning Space. Retrieved from http://www.elearnspace.org/blog/2012/07/25/moocs-are-really-a-platform/

Straumsheim, C. (2017, January 13). Harvard U, MIT release updated MOOC report. Retrieved from https://www.insidehighered.com/quicktakes/2017/01/13/harvard-u-mit-release-updated-mooc-report?utm_content=buffer19fe0&utm_medium=social&utm_source=twitter&utm_campaign=IHEbuffer

Veletsianos, G., Collier, A., & Schneider, E. (2015). Digging deeper into learners' experiences in MOOCs: Participation in social networks outside of MOOCs, notetaking and contexts surrounding content consumption. *British Journal of Educational Technology*, *46*(3), 570-587. Retrieved from https://onlinelibrary-wiley-com.proxy.wm.edu/doi/pdf/10.1111/bjet.12297

Woo, Y., & Reeves, T. (2007). Meaningful interaction in web-based learning: A social constructivist interpretation. *Internet and Higher Education*, *10*, 15-25. Retrieved from https://www-sciencedirect-com.proxy.wm.edu/science/article/pii/S1096751606000753

Zhenghao, C., Alcorn, B., Christensen, G., Eriksson, N., Koller, D., & Emanuel, E. (2015). Who's benefitting from MOOCs, and why. *Harvard Business Review*. Retrieved from https://hbr.org/2015/09/whos-benefiting-from-moocs-and-why

International **R**eview of **R**esearch in **O**pen and **D**istributed **L**earning
Volume 19, Number 4

September – 2018

Pushing Toward a More Personalized MOOC: Exploring Instructor Selected Activities, Resources, and Technologies for MOOC Design and Implementation

Curtis J. Bonk[1], Meina Zhu[1], Minkyoung Kim[2], Shuya Xu[1], Najia Sabir[1], and Annisa R. Sari[1,3]
[1]Indiana University, USA, [2]University of West Florida, USA, [3]Yogyakarta State University, Indonesia

Abstract

This study explores the activities, tools, and resources that instructors of massive open online courses (MOOCs) use to improve the personalization of their MOOCs. Following email interviews with 25 MOOC and open education leaders regarding MOOC personalization, a questionnaire was developed. This questionnaire was then completed by 152 MOOC instructors from around the world. While more than 8 in 10 respondents claimed heavy involvement in designing their MOOCs, only one-third placed extensive effort on meeting unique learner needs during course design, and even fewer respondents were concerned with personalization during course delivery. An array of instructional practices, technology tools, and content resources were leveraged by instructors to personalize MOOC-based learning environments. Aligning with previous research, the chief resources and tools employed in their MOOCs were discussion forums, video lectures, supplemental readings, and practice quizzes. In addition, self-monitoring and peer-based methods of learner feedback were more common than instructor monitoring and feedback. Some respondents mentioned the use of flexible deadlines, proposed alternatives to course assignments, and introduced multimedia elements, mobile applications, and guest speakers among the ways in which they attempted to personalize their massive courses. A majority of the respondents reported modest or high interest in learning new techniques to personalize their next MOOC offering.

Keyword: massive open online courses (MOOCs), personalization, instructional design, MOOC instructors

Introduction

Massive open online courses (MOOCs) and their many derivatives allow for thousands of learners to simultaneously engage in a learning experience (Bonk, Lee, Reeves, & Reynolds, 2018; Pappano, 2012; Siemens, 2012b). While a relatively recent phenomenon, MOOCs have the potential for large scale usage and impact by helping learners in developing parts of the world obtain access to education (Bowman, 2012; Jagannathan, 2015). While promising in terms of access, many studies point to retention issues in MOOCs (e.g., Hew & Chueng, 2014; MOOC @ Edinburgh 2013 – Report #1, 2013; Yuan, Powell, & Olivier, 2014). Despite MOOCs being promoted and leveraged by universities and international organizations for several years, there are scant empirical studies evaluating how MOOCs and similar types of open educational courses address diverse learner needs through the personalization of the course content and experiences. After evaluating comprehensive reviews of the MOOC research literature (Zhu, Sari, & Lee, 2018; Deng & Benckendorff, 2017; Liyanagunawardena, Adams, & Williams, 2013; Saadatdoost, Sim, Jafarkarimi, & Mei Hee, 2015; Veletsianos & Shepherdson, 2016; Zhu, Sari, & Lee, 2018), it is evident that few MOOC studies use instructor perspectives to better understand instructional design and delivery practices. It is our belief that collecting instructor perspectives may lead to enhanced instructor training, guidelines, and personalization practices.

The purpose of this study was to better understand how MOOC instructors adapt their courses to enhance or personalize MOOC design and delivery. Personalization, however, is a complex construct (Bethke, 2016) and hard to succinctly define or agree upon. In a meta-review of the literature on personalization, Fan and Poole (2006) caution that:

> At the conceptual level, personalization means different things to different people in different fields. For architects, personalization means creating functional, pleasant personal spaces; for social scientists it is a way of enhancing social relationships and building social networks; for some computer scientists, personalization is a toolbox of technologies to enhance the Web experience through graphic user interface design. Different conceptualizations in turn dictate different research methodologies and implementations. Cognitive scientists resort to explicit mental modeling to differentiate users, whereas e-commerce marketers rely on user profiles and purchase records to segment customers. (p. 181)

Seeking to provide a common theoretical framework from which to study personalization and aid in the design of more personalized systems, Fan and Poole (2006) also provide different definitions and examples of personalization for architecture and environmental science, information science, cognitive scientists, computer scientists, social scientists, and marketing/e-commerce. Given the complexities of personalization and the associated difficulties defining it, their ideas and examples can be quite useful for those attempting to design MOOCs that offer individualized attention and personalization.

While personalization is a difficult concept to pin down, the goal of this study was to determine the types of activities, resources, and technology tools that can enhance the quality, and ultimately the retention rates, of MOOCS. Unlike most MOOC research (Zhu et al., 2018), the MOOC instructor perspective is the primarily focus of this study.

According to Kop (2011), instructors are one of five key elements to a successful MOOC; the other four are learners, topic, material, and context. Of the five elements that Kop (2011) delineates, instructors are one of the least researched (Veletsianos & Shepherson, 2016; Zhu et al., 2018). To address this gap, in the present study, MOOC personalization was explored from an instructor perspective. More specifically, this study focuses on the four research questions listed below.

1. How much self-identified effort do instructors place on addressing unique learner needs in the design and development of their MOOCs?

2. What are the personalization practices of MOOC instructors in terms of the pedagogical activities and task structures employed?

3. What are the personalization practices of MOOC instructors in terms of content resources and associated technology tools employed?

4. How would these instructors structure their next MOOC differently in terms of personalization?

To answer these questions, this study explores the practices of experienced MOOC instructors. By interviewing experts to develop a questionnaire, and then surveying MOOC instructors from a wide range of disciplines and locales, it was hoped that this research would help reveal instructional design and delivery practices toward personalization that could enhance the quality and long-term impact of MOOCs.

There is some early history to build upon in terms of MOOC personalization. In 2010, for instance, a MOOC titled "Personal Learning Environments Networks and Knowledge" (aka PLENK2010) was taught with personalized learning as an objective (Kop, Fournier, & Mak, 2011). Levy (2011) asserts that this particular MOOC used connectivistic theory and ideas throughout. Such a course later became categorized as a "cMOOC" (Reeves & Hedberg, 2014; Siemens, 2012a). A cMOOC is more focused on knowledge generation and sharing than on knowledge consumption and passive forms of learning (Kop & Fournier, 2015). It is in the loosely organized learning networks or spaces of a cMOOC that the facilitator (or instructor) helps foster connections between the participants and the open sharing of knowledge and resources (Kop & Fournier, 2015). PLENK2010 required participants to use social media, including tools such as Second Life and Facebook, to share and co-create knowledge, thereby enhancing learner motivation through the creation of personal networks (Kop, 2011; Kop et al., 2011). In effect, there was enhanced learner choice in how participants would engage with and reflect upon the content and ideas related to the course (Kop et al., 2011).

In 2011, another type of MOOC emerged: the xMOOC (Sneddon, 2015). xMOOCs were based on interactive media such as videos, texts, and lectures that leveraged structured learning pathways on central platforms (Sneddon, 2015). Despite the sudden popularity of xMOOCs within Ivy league universities and abundant media attention (Pappano, 2012; Rodriguez, 2012), there was extensive concern related to how instructors could be responsive to learners in such large-scale courses. Unlike cMOOCs, xMOOCs focused more on content delivery and individual learning. As such, they were criticized for adopting instructional approaches more akin to behavioral theories and models, rather than learning through peers and social networks as with cMOOCs (Bates, 2012; Bonk et al., 2018; Daniel, 2012).

MOOC Personalization

While several researchers have evaluated MOOC elements for personalization, such as course design, assessments, and means of content delivery (de Oliveira Fassbinder, Fassbinder, & Barbosa, 2015), there is a dearth of empirical studies that specifically investigate MOOC personalization from instructor perspectives (Veletsianos & Shepherson, 2016; Zhu et al., 2018). Instead, much of the focus of the literature on MOOCs examines learner completion trends and participant-based data (Balch, 2013; Heutte, Kaplan, Fenouillet, Caron, & Rosselle, 2014; Jordan, 2014). MOOC research also trends towards descriptive case studies based on an individual MOOC (Fini, 2009), rather than analyzing a spectrum of MOOCs through meta-analyses. However, in one meta-analysis of MOOC-related studies from 2008-2013, Nkuyubwatsi (2013) determined that MOOCs provided adult learners opportunities to engage with materials while personalizing their learning environment through content manipulation.

Recently, Hayworth (2016) suggested that a range of technologies can help personalize learning environments, such as social bookmarking, wikis, blogs, image sharing, and collaborative tools. He also notes that such personalized learning environments (PLEs) have significant implications for distance educators, instructional designers, life-long learners, and administrators in terms of the mixing and sharing of content and resources, monitoring and managing the learning process, making learning-related suggestions and recommendations, content creation, and so on (Hayworth, 2016). Hayworth cautioned, however, against placing too much emphasis on technology-based solutions. As he and others (e.g., McLoughlin& Lee, 2010) point out, adult learners often exhibit a preference for learning which is social, participatory, and media supported rather than technocentric (Hayworth, 2016; McLoughlin & Lee, 2010). Too often researchers exploring personalization in online environments focus on technology infrastructures rather than the pedagogical scaffolds provided by instructors and instructional designers to support learners (Aleven, Stahl, Schworm, Fischer, & Wallace, 2003). According to researchers like McLoughlin and Lee (2010), online instructor roles, instructional practices, and design decisions must be evaluated holistically to better understand how online personalized learning environments can be crafted.

Personalized forms of learning are grounded in learner-centered and constructivist learning perspectives (Reigeluth, Myers, & Lee, 2017; Watson & Watson, 2017). Such theoretical viewpoints attempt to address specific learner needs based on their learning interests and preferences, prior knowledge and experiences, and overall backgrounds (Levy, 2011; Xu, Huang, Wang, & Heales, 2014). In effect, personalization is the means used to tailor a particular learning environment's resources, tools, activities, and content to better address individual learner needs, skills, and issues (Kelly, 2016). From a learning theory standpoint, the personalization of instructional spaces lends itself to a more learner-centered paradigm that can address diverse learner requirements, competencies, and backgrounds (Green, Facer, Rudd, Dillon, & Humphreys, 2005). Also vital from this point of view is learner-learner interaction and dialogue (Brown, Collins, & Duguid, 1989; Reigeluth et al., 2015). Peers can often offer guidance that is more relevant to true learner needs and experiences (Rogoff, 1990; Vygotsky, 1978).

Siemens (2007) offered a simplified definition of personalized learning that includes two key elements: (1) the tools, and (2) the ideals that guide the design. His colleague, Downes (2016), argued that the phrase "personalized learning" has appeared so much in the educational literature during the past decade that it has begun to "lose its meaning" (para. 1). According to Downes, some refer to personalized learning as the pedagogical differentiation of instruction according to different participant variables such as learning styles and preferences of learning, whereas others refer to decisions made related to the order or pathways in which the curriculum can be offered. Instead of externally provided personalized environments, Downes claims that personalized learning must empower learners by allowing them to customize and organize their own learning directives. From this viewpoint, greater emphasis is placed on the learner deciding what to learn, how to learn, and where to learn (Downes, 2016).

While empathizing with Downes' (2016) perspective, this study focuses on how MOOC instructors adapt their instruction and set of course resources and tasks to personalize the learning process in a MOOC. As a result, for the purpose of our study, we chose to define personalization as: the process by which MOOC instructors adapt their courses and instructional practices to meet diverse learner needs, skills, prior experiences, and situations.

In an example of MOOC personalization with extensive peer reliance, Kim and Chung (2015) mapped out how they attempted to create an ecology of learning in their MOOC "Designing a New Learning Environment," which was hosted on the Stanford Venture-Lab/NovoEd MOOC platform. The participants in this MOOC supported one another through social media like Twitter and discussion forum solicitations when there was missing or incomplete information (Kim & Chung, 2015). For instance, some participants responded to peer requests by creating low bandwidth versions of instructor videos for those who lived in developing regions of the world, and others translated these videos into other languages and added words and nuances that were specific to the local language to make them understandable to target groups (Kim & Chung, 2015). Instructors facilitated a space which allowed learners to personalize content for their peers so that issues of access and linguistic barriers would not hinder learning (Kim & Chung, 2015).

Similarly, Severance (2015), who has taught three different and highly successful MOOCs (i.e., Python Programming, Programming for Everybody, and Internet History, Security, and Society) has attempted to personalize his MOOC offerings by taking a learner point of view. For instance, he has designed unique "Office Hours" in cafes, hotel lobbies, and other locations wherein he locally meets his global participants in cities around the world to discuss the course with them and get their suggestions for improvement (Severance, 2015). He also has a YouTube channel specific for his MOOCs that features personal stories and contributions from participants that appear as "Voices of the Students in MOOCs" (Severance, 2015). The creation of the YouTube channel and "Office Hours" allows participants to integrate their life experiences with MOOC experiences facilitating a unique type of blended personalized learning experience (Severance, 2015).

The primary intent of the present study is to explore the extent to which MOOC instructors use such forms and types of personalization practices in their MOOCs. Just how is personalization operationalized in the design and delivery of MOOCs?

Method

To understand how MOOC instructors personalize their courses to best meet individual learner needs, both quantitative and qualitative data were employed. The study is comprised of two distinct datasets: (1) email interviews of 25 international MOOCs experts related to how to personalize the MOOC experience; these experts were selected since they all had recently contributed to an edited book on MOOCs and open education, and (2) an online survey questionnaire which was sent via SurveyMonkey to more than 1,026 MOOC instructors, of which 152 qualified and completed the instrument.

Expert Email Interviews

It is important to mention that the email interviews provided the thematic and categorical foundations from which the survey instrument was created. The experts had useful and insightful advice and pedagogical ideas that helped in the design of the survey instrument.

Web-Based Survey

A survey comprised of 30 questions was designed based, in part, on the responses of 25 MOOC and open education experts. This questionnaire, which focused on personalization within MOOCs taught by the 152 survey respondents, consisted of 25 close-ended items and five optional, open-ended questions. The primary selection criteria for MOOC instructor participation in the questionnaire were past or present experience teaching or designing a MOOC, which was the first survey item. Instructor participants were selected from an extensive researcher-created database.

To create the database of MOOC instructors to whom the questionnaire would be distributed, the names and affiliations of the MOOC instructors, course title, subject area, course URL, institution, course start and end date, and course duration for over 1,000 MOOCs were mined from Class Central and the MOOC List (which included courses from Open2study, Canvas, NovoEd, Blackboard, iversity, and Kadenze). Additionally, the researchers directly searched individual vendors and organizational sites (e.g., specific vendor lists from Coursera, edX, FutureLearn, and Open2study) to ensure the maximum scope within the MOOC listings database. The researchers further compiled a list of approximately 50 Korean MOOCs (i.e., K-MOOCs) (http://www.kmooc.kr/). Next, the researchers cross checked the database for redundancy and errors. The final list included MOOC instructors from universities, organizations, and institutions in more than two dozen countries, including Australia, Belgium, Canada, China, Denmark, Germany, Grenada, India, Ireland, Italy, Japan, Korea, Macau, Mexico, the Netherlands, New Zealand, Norway, Russia, Singapore, South Africa, Spain, Sweden, Switzerland, the United Kingdom, and the United States. The largest percentage of participants were from institutions in the United States.

Results

Expert Email Interviews

In terms of the email interviews, some of the experts in the field of MOOCs and open education argued for greater use of collaborative projects, whereas others mentioned the need for MOOC toolkits or platforms that are designed for access in low bandwidth conditions as a means to personalize the experience. Among these experts, a senior education specialist from the Open Learning Campus of the World Bank indicated that they attempted to incorporate badging and customized discussion forums as a means to personalize the experience. Another MOOC expert in the Philippines stated that “one feature that we have integrated into our MOOCs... to personalize learning is to allow the learner to choose whether to learn through the video lessons, text lessons, or podcasts." These expert interviews were thematically coded to develop the Web survey of MOOC instructors, mentioned earlier. Survey questions were drafted related to how MOOC instructors fostered feedback, interaction, and engagement in the learning process. Questions were also drafted related to the types of course resources that were embedded to help personalize the MOOC.

Online Survey Results

Some of the online survey findings are recapped below starting with key demographic data related to the instructor experience with MOOCs. Of the 978 valid survey requests, 152 individuals completed the survey. This 15.5% response rate is considered more than acceptable for opt-in, online surveys (Cho & LaRose, 1999). These 152 instructors taught MOOCs in fields such as science, social sciences, the humanities, engineering, medicine, business, language, mathematics, art, and law. Nearly one-third of the MOOC respondents were from medical and health sciences, or from the field of education. Another 9% came from the field of business, and 9% from computer science (see Figure 1).

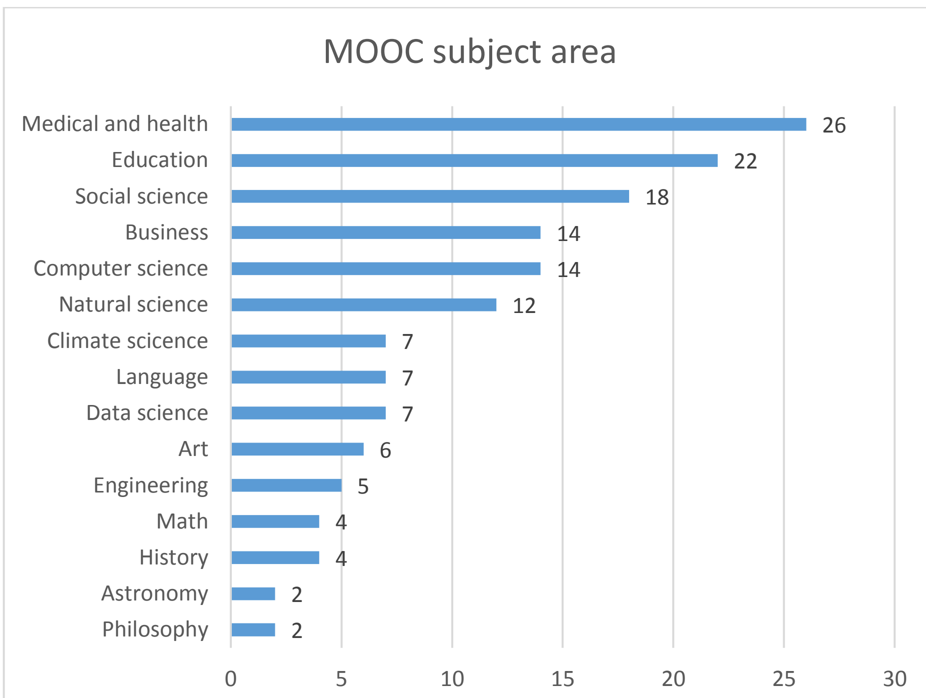


Figure 1. MOOC instructor departmental or primary discipline affiliations (n=150).

The prior MOOC teaching experience among the survey participants was quite varied. Of these 152 respondents, roughly 55.3% had taught just one MOOC, 19.7% had taught two MOOCs, and nearly 25% had taught three or more MOOCs in the past. In contrast, more than half of these instructors (n=84; 55.2%) had never completed a MOOC as a learner, while 25 (16.5%) had completed one MOOC in the past. It is also important to note that 43 (28.3%) of the respondents had completed two or more MOOCs.

In terms of MOOC enrollment, 71 out of 150 responding MOOC instructors (47.3%) taught courses with less than 10,000 people, 36 of the respondents (24.0%) had courses with 10,000-25,000 enrolled, 19 (12.7%) had courses with 25,001-50,000, and 15 respondents (10.0%) had courses with 50,001-100,000 participants. Just nine respondents (6.0%) had MOOCs with more than 100,000 enrolled. While precise enrollment information was not requested, these self-reported enrollment figures were clearly lower than 40,000 median MOOC participants reported by Jordan (2014).

The instructors were requested to reflect on their instructional practices for their most recent MOOC. Roughly six in 10 (n=91/150) of the instructors taught instructor-led courses: 64 instructors (42.7%) used additional aids such as teaching assistants, moderators, and/or tutors, while the other 27 instructors (18.0%) had no additional teaching support. Of the remaining 59 courses, 19 (12.7%) were participant driven, 21 (14.0%) were self-paced, nine (6.0%) were a hybrid or blended type of MOOC, and 10 (6.7%) used other methods.

Research Question #1

How much self-reported effort do instructors place on addressing the unique participant or learner needs in the design and development of their MOOCs?

As course personalization can depend on an instructor’s involvement in the course design, participants (n=152) were asked to rank on a scale of 1 (low) to 10 (high) their involvement in designing the course. When collapsed to three categories (i.e., 1-3 Low; 4-7 Medium; and 8-10 High), only five instructors (3.3%) indicated low involvement in designing the course, and 17 (11.2%) exerted modest involvement (see Figure 2). The remaining 130 MOOC instructors (85.5%) indicated a high level of involvement, of which 94 (72.3%) instructors marked “10” out of 10 on the scale. The average rating was 8.92 (SD=1.88); indicating heavy involvement from instructors in the design of their MOOCs.

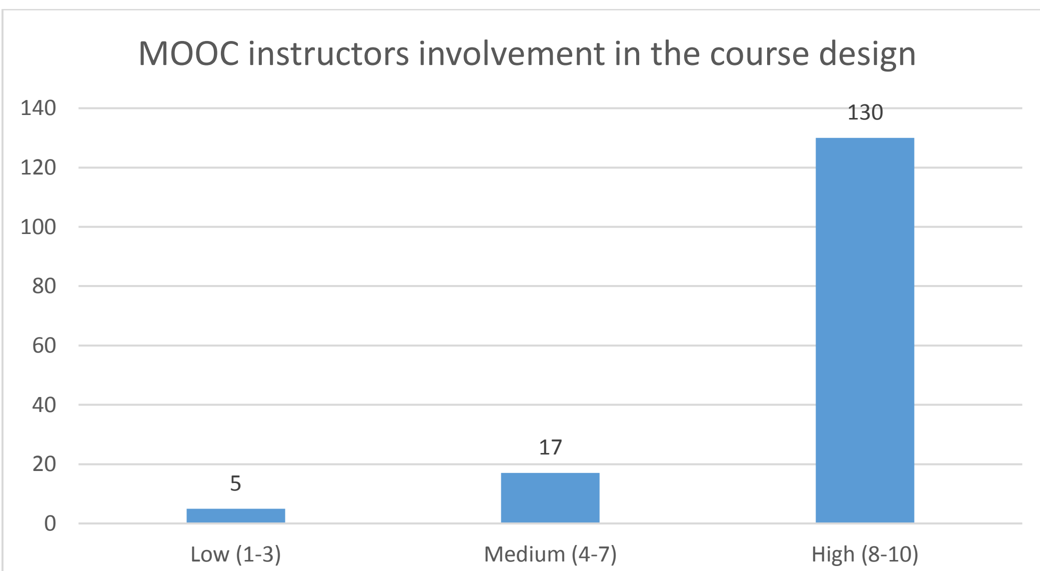


Figure 2. MOOC instructor involvement in designing course content for the MOOC. Note: on a scale of 1 (low) to 10 (high) (n=152).

Given that the vast majority of the respondents were extensively involved in the design of their most recent MOOC, they had some influence over the degree to which that course was adapted to learner needs and preferences. Figures 3 and 4 represent the self-identified efforts or energies expended of MOOC instructors to personalize their courses during the design phase and delivery phase of the MOOC, respectively.

The degree of effort placed on meeting unique learner needs when designing their most recent MOOC was also investigated. As shown in Figure 3, only 50 of the 144 respondents (34.7%) felt that they placed a high degree of effort on meeting unique participant or learner needs during the design of their most recent MOOC. An additional 46 respondents (31.9%) placed modest effort, whereas the remaining 48 (33.3%) admitted to not exerting much effort in this regard (M=5.63; SD=3.03).

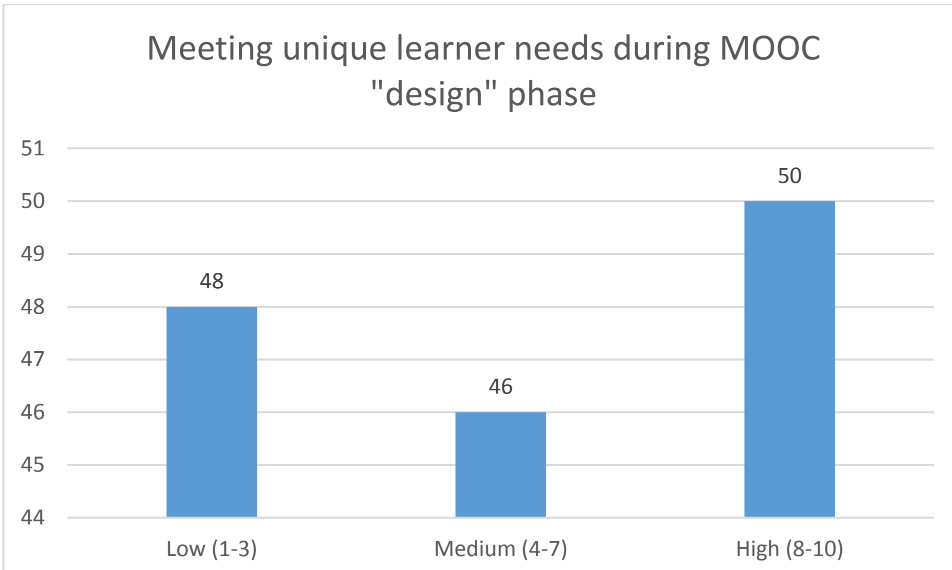


Figure 3. Effort placed on meeting unique learner needs when designing most recent MOOC. *Note:* on a scale of 1 (low) to 10 (high) (n=144).

As noted in Figure 4, only 41 of these respondents (28.5%) felt that they placed high effort on meeting the MOOC participant or learner needs during the implementation and delivery of the MOOC. While 61 (42.4%) placed modest effort in this regard, nearly three in 10 MOOC instructors (n=42; 29.1%) did not commit much effort toward meeting participant needs during the implementation and delivery phase (M=5.53; SD=2.80).

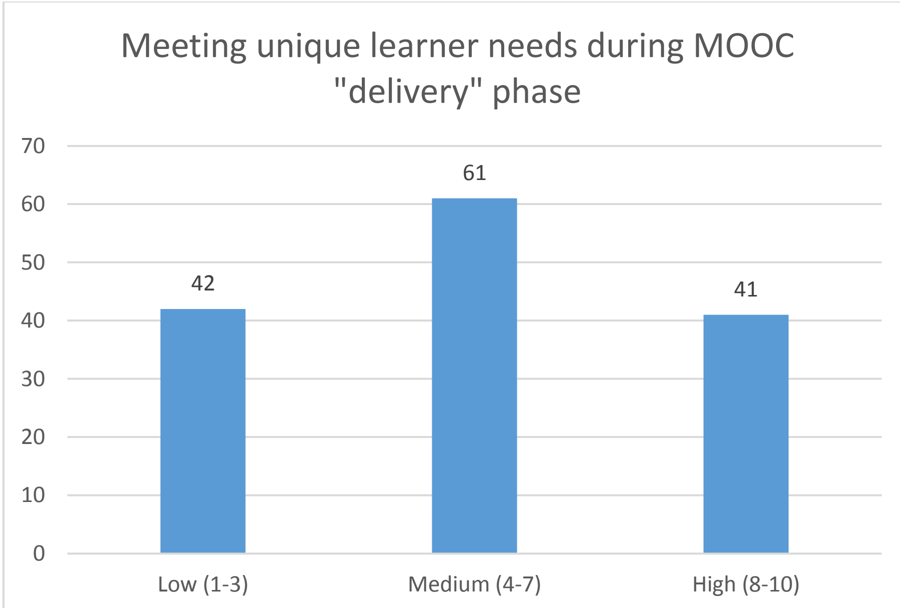


Figure 4. Effort placed on meeting unique learner needs when delivering most recent MOOC. *Note:* on a scale of 1 (low) to 10 (high) (n=144).

Research Question #2

What are the personalization practices of MOOC instructors in terms of the pedagogical activities and task structures employed?

Participant interaction is another means to address learner needs as exemplified in the differences between cMOOCs and xMOOCs. In this study, MOOC instructors indicated that they attempted to foster learner-to-learner connections and interactions to some degree, with an average of 6.24 on a scale of 1 (low) to 10 (high) (n=137). However, when asked about the ways in which peer interaction was encouraged in their most recent MOOC, the methods selected were limited. When presented with a list of nine options (including "not applicable"), more than 80% of MOOC instructors indicated that they relied on system-built discussion forums for learner-learner forms of interaction. No other resource or activity was employed by more than half of the respondents. For instance, only one in four instructors checked that they used pair-based assignments or tasks (e.g., critical friend activities). Furthermore, synchronous forms of meetings or conferencing were used by less than one in 10 of the respondents. Break-out discussion forums or groups were employed by 31 (22.6%) of the respondents, whereas local meet ups were being used by 22 (16.1%) of the MOOC instructors.

As mentioned earlier, Downes (2016) argues that learner empowerment and choice is a key part of personalization. When asked about the structures that they provided in their most recent MOOC from a list of ten items, the survey participants (n=126) primarily relied on optional readings (74.6%) and learner selected incentives such as certificates, badges, or course credit (64.3%). The respondents also indicated that they employed course tasks and assignments (38.1%), learner discussion and negotiation of content

(36.5%), multimedia elements to explain concepts (31.7%), learner-driven or contributed content (30.2%), and learner selected learning pathways (19.0%).

Using an open-ended item, the questionnaire provided space for respondents to elaborate on the MOOC personalization practices that they employed to address those who had enrolled. In this space, some respondents specifically referred to pedagogical adaptations. For instance, one respondent designed her course, “To give [sic] different case studies and examples, considering different backgrounds and interests. To have higher order and lower [sic] order assessments, considering the personal interest for deepening into content.” Another reflected that, “it’s all about expectations and communication. From the first day of 'launching' we have moderators & academics assigned to welcome and encourage learners to ask questions and post comments for peer-to-peer feedback.” One instructor noted that, “in terms of pathways, there was no thought to giving learners precise pathways and choices - instead [of] using flexible deadlines and flexible drop/reenroll, students get a good hybrid of structured/self-paced. Some students move fast and others take material quite slowly. Students vary their own pace as the course progresses according to their needs, skills, and time available for the course.”

Personalization also requires monitoring learner progress and awareness of learning accomplishments (Reigeluth et al., 2015). In terms of monitoring or tracking learner progress in a MOOC, 42.3% of MOOC instructors (n=137) relied on learner self-monitoring and evaluation. Approximately, one in three (34.3%) employed modular or unit-based forms of assessment. About one in four (24.8%) used weekly or daily reports from learning analytics. A similar percentage (23.4%) used moderator, tutor, or teaching assistant feedback to monitor or track progress. While 13.9% used a hybrid system of tracking learner progress and participation, another 13.1% relied on peer-based reports. Just 7.3% employed personal tracking from the instructor; in contrast 14.6% noted that learner progress was not tracked.

Human and system forms of feedback are another mechanism to address learner needs in a MOOC. Given the typically large number of MOOC participants, it was not too surprising that peer feedback was used by 87 (64.4%) of the 135 instructors who responded to this “check all that apply” question. In addition, 78 (57.8%) of the respondents relied on computer or system-based forms of feedback (57%) (see Figure 5). Also important were moderator, tutor, or teaching assistant feedback (n=58; 43.9%), instructor feedback (n=54; 40.0%), and feedback via task or assignment rubrics (n=50 or 37.0%). Less frequent was the use of forms of self-feedback (n=36; 26.7%). Nearly nonexistent, was feedback coming from outside experts (n=4; 3.0%).

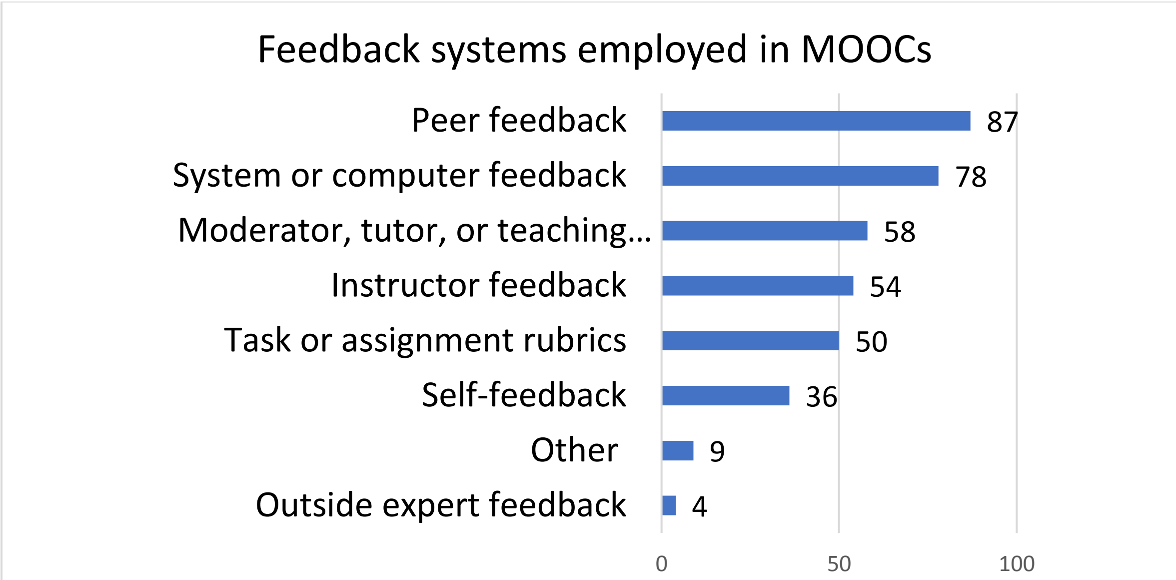


Figure 5. Number of MOOCs that offer different types of learner feedback (n=135).

Research Question #3

What are the personalization practices of MOOC instructors in terms of content resources and associated technology tools employed?

There are many resources, activities, and technology tools from which to make attempts to personalize MOOCs. Survey participants were asked to check items most frequently used from a list of 22 types of learning resources. Consistent with the literature, MOOC instructors often provided discussion forums (91.5%), video lectures and tutorials (76.8%), and readings (76.1%). More than half of the respondents offered content in the form of practice quizzes (57.7%), interactive assessments (50.7%), and expert interviews (50.0%). Additionally, many relied on PowerPoint and other presentations (47.9%), instructor lecture notes (44.4%), animations and interactive content (43.0%), content visualizations (e.g., concept maps, diagrams, flowcharts, etc.) (42.3%), and video examples (e.g., TED talks) (39.4%). Blogs, wikis, podcasts, mobile applications, simulations, and social media were used infrequently. While the respondents selected from a pre-established list of options, the findings indicated that there are an array of resources and tools which MOOC instructors and designers rely upon to craft their courses.

One open-ended question allowed for the discussion of how technology might be employed to personalize learning. One instructor stated, "[t]he most personal way was a brief video (less than 5 minutes) made at the end of each week where I responded to specific posts made in the discussions forums." Another stated, "I held virtual office hours during each of the three offerings of my course. In several, I had teaching associates join in. In the last offering, I used the first part of the meetup to share current nutrition related news and studies to help keep the course more up to date (we also posted news and studies)." Similarly, another respondent mentioned that he hosted, "periodic Google Hangouts to support learners and volunteer teaching assistants in my course. I also use a Twitter account for sharing less formal, more personal thoughts about the course and its content."

Enhancing the intelligence of the system has the potential to result in greater personalization of the course. As more than half of the MOOC instructors were utilizing computer-based forms of feedback to enhance their courses, the role of automation and artificial intelligence (AI) for personalization warranted further probing. As evident in Figure 6, the use of an automated grading system was the only feature leveraged by more than half of the MOOC instructors (n=67 of 127 respondents; 52.8%). Automated or system generated feedback was employed by 28 (22.1%) of the 127 respondents. Similarly, automated alerts for missed assignments were used by 24 (18.9%) of the respondents and automated alerts to participants who do not log in regularly were used in 21 (16.5%) of the MOOCs. Almost nonexistent were tools for automated group allocation (n=7; 5.5%), automated forms of plagiarism checking and detection (n=5; 3.9%), and embedded agents for learner advice (n=3; 2.4%). System adaptation to user performance was found in a single course (n=1; 0.8%).

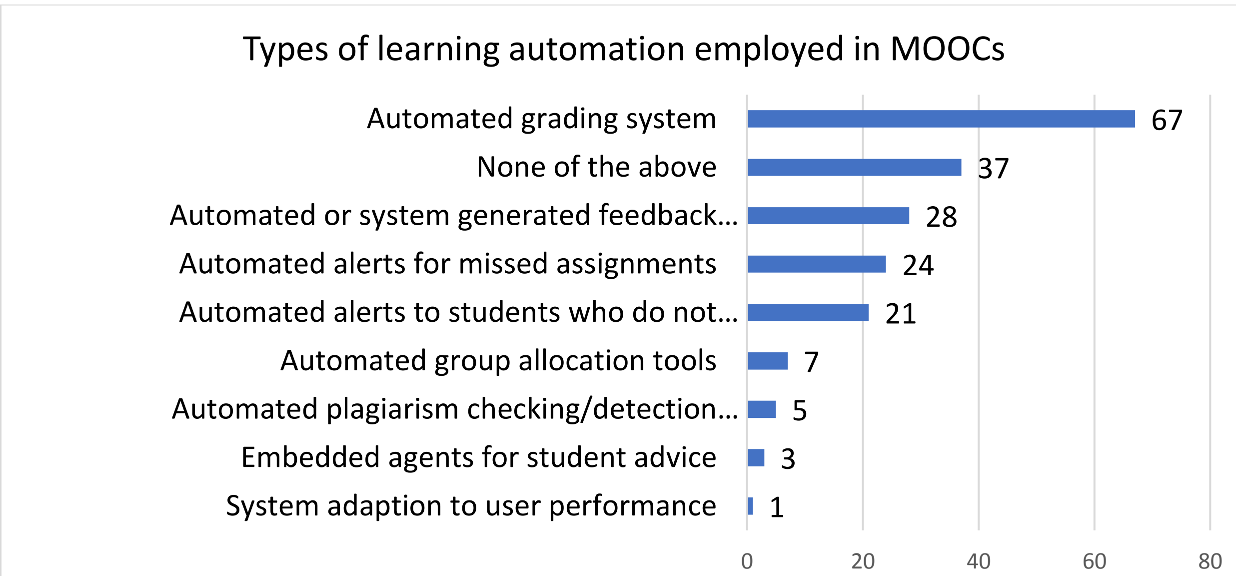


Figure 6. Number of MOOCs that offer different types of learning system automation and adaptation (n=127).

Another line of inquiry on personalization and tools was centered on MOOC participant communication to instructors, especially if barriers exist. Over half of the 135 respondents indicated that learners could email the course or system (n=78; 57.8%) or send direct emails to instructors (n=75; 55.6%). Less common was emailing teaching assistants (n=42; 31.1%) or relying on social media for support (n=35; 25.9%). Even fewer used synchronous conferencing (n=18; 13.3%), synchronous chat tools (n=11; 8.2%), or face-to-face meet ups (n=4; 3.0%). Nearly nonexistent was the use of personal visits (n=1), virtual world types of environments (n=1), and mobile phones (including text messaging) (n=0).

Research Question #4

How would these instructors structure their next MOOC differently in terms of personalization?

One of the most significant findings was that the majority of MOOC instructors aspired to do a better job of addressing personalization in their next MOOC experience (n=134, M=6.63; SD=2.91). Of the 134 respondents who answered the question stated above, 56 (41.8%) were highly interested in learning new ways to personalize their next MOOC, 48 (35.8%) were moderately interested, and 30 (22.4%) expressed limited interest (see Figure 7). Combining the modest and high interest groups shows that three-fourths of MOOC instructors were interested in MOOC personalization in the future. Advocating for MOOC instructor professional development and training, therefore, seems highly warranted.

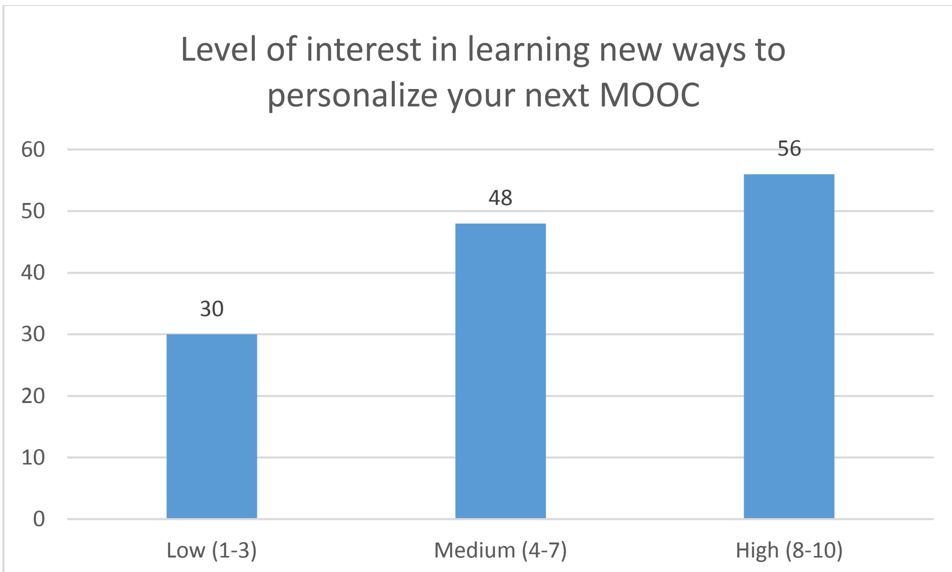


Figure 7. MOOC instructor interest in learning new ways to personalize their next MOOC offering. Note: on a scale of 1 (low) to 10 (high) (n=134).

Several interesting comments were proposed in the open-ended question regarding how respondents might redesign their courses to enhance course personalization and overall effectiveness. For instance, one MOOC instructor would "hire some of our students and alumni to get involved - the students really loved the additional points-of-view and the interaction." Another instructor stated that she would, "introduce Google Hangouts. Develop alternative pathways for content. Allow students more space to share own competencies and knowledge levels (perhaps wikis etc.)." Another example is an instructor planning to "offer more examples on different topics and offer different tracks (e.g., just video, video and quizzes, video, quizzes and peer review assignments, etc.)."

Additional Open-Ended Comments

Across the open-ended questions, other personalization practices of the respondents included greater instructor participation in discussion forums, increasing opportunities for learner reflection, designing online learning communities, creating shorter and less formal videos, fostering more peer interaction, subtitling content in different languages, and utilizing formative assessments in the form of participant surveys at the end of each week. The most frequent comment from these MOOC instructors was that they attempted to incorporate "flexible deadlines," including allowing students to post discussion comments and complete tasks at their own pace. In addition, many also leveraged social media, multimedia, mobile applications, and readings to supplement course materials. Among the other personalization methods employed, several instructors mentioned relying on guest speakers, whereas others employed case-based learning. A few instructors attempted to empower the participants by allowing them to choose their own assignments, make multiple attempts to complete assignments, or create their own student groups.

Discussion

The purpose of this study was to investigate how MOOC instructors adapt their courses to the individualized learning needs of students who enroll in a MOOC. In effect, the goal was to better understand the instructional design and personalization approaches of instructors related to MOOCs. The researchers realize that the personalization of MOOCs is a highly idealized and contested concept. We also acknowledge that the massive size of MOOCs makes personalization extremely difficult, if not impossible. However, the goal was to push toward a more personalized MOOC experience through the exploration of MOOC instructor activities, resources, and technologies involved in MOOC design and implementation.

As detailed in the findings, numerous resources, technology tools, and instructional practices are used by instructors when teaching a MOOC. Not surprisingly, most instructors rely on discussion forums, video lectures, supplemental readings, and quizzes. In the open-ended items, MOOC instructors mentioned additional means in which they attempted to better address learner needs beyond the standard MOOC platform tools and features. For instance, some respondents mentioned the use of flexible deadlines, options for course tasks, virtual office hours, integrated media elements, interactive cases, and guest speakers as among the ways in which they personalized their massive courses. This study finds that personalization methods are so varied that it is difficult to accurately capture all forms of MOOC personalization used by an instructor or design team without additional measures such as in-depth interviews, focus groups, and course observations.

Among the key findings was a disconnect between MOOC instructor perceived degree of involvement in the actual design of their courses, and their perceived effort in the design and delivery of their MOOC related to addressing the unique participant or learner needs. Simultaneously, these MOOC instructors desired further training in techniques for such personalization when designing or revamping their next MOOC.

As shown in this study, myriad options exist to attempt to personalize a MOOC. The 152 instructors who completed the questionnaire employed a gamut of feedback techniques, pedagogical activities, resources, interactions, and assessments to address learner needs. There is a range of instructional techniques, technology tools, and learning resources at the MOOC instructor’s disposal for attempting to ameliorate gaps in knowledge and address particular learning needs. Such techniques and resources will only increase in the coming years, thereby adding to the already complex instructional task confronting MOOC instructors and designers. Given that most MOOC instructors surveyed in this study had only taught one MOOC, such limited experiences with MOOCs may constrain the degree to which many of these instructors feel comfortable addressing learner personal needs. Follow-up research could be directed at the more experienced MOOC instructors to investigate if practices and tools vary.

One issue noted in this study was the lack of learner monitoring and feedback. Learner progress was left to self-monitoring or was ignored all together. Similarly, peer feedback and system feedback, while important to learner success, were more pervasive than that coming from the instructor or instructional assistants. Finding ways to build expert feedback (including soliciting alumni of these courses for feedback), which was rare in this study, might be one way to foster greater learner personalized attention and overall success. There were a variety of ways in which to have participant questions answered (i.e., contacting the instructor, teaching assistants, social media, synchronous chat, meet ups, synchronous conferencing, etc.). This issue is consistent with challenges faced by MOOC instructors and designers as they struggle to develop a feedback mechanism which "reinforces learning and identifies inconsistencies in the learner process" (Davis et al., 2014, p. 8). Perhaps social media interactions and local meet ups with peers and instructors within MOOCs will increase in the coming decade (see Severance, 2015 for ideas).

Among the more interesting findings from the survey of 152 MOOC instructors polled was that automated alerts, adaptive forms of instruction, and AI do not seem to be playing much of a role in MOOCs. While only addressed in a single questionnaire item, the findings lend doubt to claims that such technologies and systems will soon be taking on a prominent role in MOOCs and other forms of open education. In fact, automated checking of participant progress and the flagging of potential issues were not widely implemented in these MOOCs, nor was the sending of reminders or feedback on accomplishments.

While several prominent technology pioneers have been promoting adaptive digital courseware and AI technology to help reform education, including Mark Zuckerberg (Singer, 2017) and Bill Gates (Schaffhauser, 2014; Straumsheim, 2016), these findings seem to indicate that the impact of AI thus far in the field of MOOCs and open education is quite limited. Even if AI technology was more prominent in MOOCs, automated alerts, reminders, and feedback do not offer MOOC participants "a sense of being treated as an individual, and, therefore," such forms of course automation fall "short in providing personalized learning" (Fournier & Kopp, 2015, p. 298). As Bates (2012) laments, at present, technologies embedded in MOOCs do not yet offer the timely and pointed comments and questions that can nurture rich and interactive online discussions, a sense of caring and encouragement, and a robust understanding of individual student needs. Nevertheless, much investment is being made today in AI technology around the world that should eventually lead to inroads toward more customized and personalized MOOC experiences (Metz & Satariano, 2018).

Limitations

As with any educational research project, there are several important limitations to mention. First of all, as indicated in the methods section, we assembled a database of more than 1,000 MOOC instructor names, courses, and associated contact information from selected lists and vendor websites. However, the researchers did not collect information from all MOOC vendors, nor were MOOCs taught in languages other than English or Korean included, unless the course was cross listed in a researcher-mined MOOC vendor list. Secondly, participants self-selected into this study on "how massive open online course (MOOC) instructors personalize learning." Therefore, survey respondents may have devoted more time to their instructional and pedagogical approaches than those who did not respond. Thirdly, no actual teaching was directly observed nor was any instructional content analyzed. Additionally, the researchers did not conduct follow-up interviews or focus groups with survey participants on their specific personalization and other instructional design practices. Another limitation is that while survey participants were provided with a loose definition of personalization, the 25 experts were not. By not operationally defining personalization for all participants, any in vivo thematic coding schemes created by the researchers have potential constraints and flaws. At the same time, however, it is important to recognize that the term "personalization" has many different connotations and interpretations; one definition may not work for all stakeholders. Another term not explicitly defined was "effort." Once again, each respondent may have a vastly different understanding of what incredibly high or low effort might entail.

Future Directions

Findings from these data sets are merely the first steps in the process. There is a clear and present need to perform in-depth, follow-up inquires with MOOC instructors about their actual instructional design practices; specifically, the means by which personalized learning is attempted, and any instructional modifications and adaptations implemented over time. Interviews with instructors, via email or Web conferencing, would help uncover effective instructional practices undertaken for MOOC personalization as well as course redesign efforts pending or in progress. In addition to interviews, follow ups can take place via focus groups, content analysis, active participation in MOOCs, reviews of historical records, additional surveys, or a combination of these methods. MOOC participants and instructional designers could be solicited to verify and extend the findings of the knowledge base related to MOOC personalization during design and development. Additional research on MOOC personalization is necessary to create effective instructional design and delivery guidelines, frameworks, and models. A better understanding of instructors and participants will help foster more engaging, personalized, and culturally sensitive MOOC-based learning environments.

Implications and Final Comments

Research undertaken in this vein has the possibility of enhancing the planning, development, and delivery of courses that impact millions of learners. Even if minor or modest enhancements are made, the potential impact is immense. Recent data from Class Central indicate that in 2017, over 78 million students signed up for more than 9,400 MOOCs offered by more than 800 different universities (Lederman, 2018; Shah, 2018). Such data is a huge increase from the prior year which documented over 700 universities worldwide offering nearly 7,000 MOOCs to more than 58 million participants in 2016. In comparison, just 35 million learners enrolled in MOOCs at 500+ universities in 2015 (Shah, 2015). Coursera accounted for 30 million of the MOOC enrollments in 2017 as compared to 23 million in 2016 (Shah, 2016, 2017). Another 14 million enrollments were in edX in 2017; 4 million more than in 2016 (Shah, 2016, 2017). Equally impressive, 23 million participants in 2016 registered for a MOOC for the first time (Shah, 2016), and another 20 million new MOOC participants enrolled in 2017 (Shah, 2017). What is clear from this data is that MOOCs are a phenomenon that is receiving accelerating attention, investment, and overall societal importance. They are no longer a cultural anomaly or learning novelty that has limited value due to low completion rates. Instead, tens of millions of individuals are apparently finding some value from enrolling in MOOCs offered by thousands of universities worldwide.

Even when considering the highly advertised course retention and completion problems and issues, MOOCs are impacting scores of lives around the planet each day. Clearly, better understanding of how MOOCs are designed and participant progress is monitored should eventually result in higher quality course design and delivery, and improved completion and retention rates. Continued research in this area can assist countless MOOC instructors to enhance their massively open online courses with techniques, activities, and resources that engage and inspire learners from around the world into their respective disciplines. The study also informs MOOC vendors about MOOC platforms and associated tool design. In addition, it can apprise government funding agencies about the types of MOOC tools and resources that can foster improvements in the evolution of the field of open and distance learning for capacity building.

Given the number of participants that MOOCs attract, this study has the potential to provide marked insight into an emerging phenomenon that has immense global, local, and societal ramifications. With such wide impact potential, our research team continues to expand the database of MOOC instructors and courses that we have collected. The goal as we move forward is to determine more about the psychological, instructional, and technological issues, challenges, and opportunities of MOOCs and other emerging types of open online courses and educational experiences.

References

Aleven, V., Stahl, E., Schworm, S., Fischer, F., & Wallace, R. (2003). Help seeking and help design in interactive learning environments. *Review of Educational Research, 73*(3), 277-320. doi: 10.3102/00346543073003277

Balch, T. (2013). About MOOC completion rates: The importance of student investment. *The Augmented Trader* [Weblog post]. Retrieved from https://augmentedtrader.com/2013/01/06/about-mooc-completion-rates-the-importance-of-investment/

Bates, T. (2012, August 5). What's right and what's wrong about Coursera-style MOOCs. *Learning and Distance Education Resources Blog* [Weblog post]. Retrieved from http://www.tonybates.ca/2012/08/05/whats-right-and-whats-wrong-about-coursera-style-moocs/

Bethke, R. (2016, June 17). Trend: Online learning going personal. *eCampus News*. Retrieved from http://www.ecampusnews.com/technologies/personalized-learning-online

Bonk, C. J., Lee, M. M., Reeves, T. C., & Reynolds, T. H. (Eds.). (2015). *MOOCs and open education around the world*. NY: Routledge.

Bonk, C. J., Lee. M. M., Reeves, T. C., & Reynolds, T. H. (2018). The emergence and design of massive open online courses. In R. A. Reiser & J. V. Dempsey (Eds.), *Trends and issues in instructional design and technology* (4th Ed.), (pp. 250-258). New York, NY: Pearson Education.

Bowman, K. D. (2012, Summer). Winds of change: Is higher education experiencing a shift in delivery? *Public Purpose Magazine* (from the American Association of State Colleges and Universities). Retrieved from http://www.aascu.org/WorkArea/DownloadAsset.aspx?id=5570

Brown, J., Collins, A., & Duguid, P. (1989). Situated cognition and the culture of learning. *Educational Researcher*, 18(1), 32–42. https://doi.org/10.3102/0013189X018001032

Cho, H., & LaRose, R. (1999). Privacy issues and Internet surveys. *Social Science Computer Review*, *17*(4), 421-434. doi: 10.1177/089443939901700402

Daniel, J. (2012). Making sense of MOOCs: Musings in a maze of myth, paradox, and possibility. *Journal of Interactive Media in Education*, 3. Retrieved from http://jime.open.ac.uk/articles/10.5334/2012-18/

Davis, H., Dickens, K., León Urrutia, M., Sánchez Vera, M. del M., & White, S. (2014). MOOCs for universities and learners: An analysis of motivating factors. *In Proceedings of the 6th International Conference on Computer Supported Education*. Barcelona. Retrieved from http://eprints.soton.ac.uk/363714/1/DavisEtAl2014MOOCsCSEDUFinal.pdf de Oliveira Fassbinder, A. G., Fassbinder, M., & Barbosa, E. F. (2015, October). From flipped classroom theory to the personalized design of learning experiences in MOOCs. *Proceedings of Frontiers in Education Conference (FIE), 32614,* 1-8.

Deng, R., & Benckendorff, P. (2017). A contemporary review of research methods adopted to understand students' and instructors' use of massive open online courses (MOOCs). *International Journal of Information and Education Technology*, 7(8). doi: 10.18178/ijiet.2017.7.8.939

Downes, S. (2016, February 17). Personal and personalized learning. *European Multiple MOOCs Aggregator Newsletter*. Retrieved from http://www.downes.ca/post/65065

Fan, H., & Poole, M. S. (2006). What is personalization? Perspectives on the design and implementation of personalization in information systems. *Journal of Organizational Computing and Electronic Commerce, 16*(3-4), 179-202. doi:10.1080/10919392.2006.9681199

Fini, A. (2009). The technological dimension of a massive open online course: The case of the CCK08 course tools. *The International Review of Research in Open and Distributed Learning*, *10*(5), 14-26. Retrieved from http://www.irrodl.org/index.php/irrodl/article/view/643/1402

Fournier, H., & Kop, R. (2015). MOOC learning experience design: Issues and challenges. *International Journal on E-Learning*, *14*(3), 289-304. Retrieved from https://www.learntechlib.org/p/150661/

Green, H., Facer, K., Rudd, T., Dillon, P., & Humphreys, P. (2005). *Personalisation and Digital Technologies*. Bristol: Futurelab.

Hayworth, R. (2016). Personal learning environments: A solution for self-directed learners. *TechTrends*, *60*, 359-364. doi:10.1007/s11528-016-0074-z

Hew, K. F., & Cheung, W. S. (2014). Students' and instructors' use of massive open online courses (MOOCs): Motivations and challenges. *Educational Research Review, 12*, 45-58. https://doi.org/10.1016/j.edurev.2014.05.001

Heutte, J., Kaplan, J., Fenouillet, F., Caron, P. A., & Rosselle, M. (2014) MOOC user persistence. In L. Uden, J. Sinclair, T.H. Tao, & D. Liberona (Eds.), Learning technology for education in cloud. MOOC and big data. LTEC 2014. *Communications in computer and information science* (Vol 446, pp. 13-24). New York, NY: Springer. DOI: https://doi.org/10.1007/978-3-319-10671-7_2

Jagannathan, S. (2015). Harnessing the power of open learning to share global prosperity and eradicate poverty. In C. J. Bonk, M. M. Lee, T. C. Reeves, & T. H. Reynolds (Eds.), *MOOCs and open education around the world* (pp. 218-231). New York: Routledge.

Jordan, K. (2014). Initial trends in enrolment and completion of massive open online courses. *The International Review of Research in Open and Distributed Learning*, *15*(1), 133-160. Retrieved from http://www.irrodl.org/index.php/irrodl/article/view/1651/2774

Kelly, R. (2016, July). 7 universities receive grants to implement adaptive learning at scale. *Campus Technology*. Retrieved from https://campustechnology.com/articles/2016/07/14/7-universities-receive-grants-to-implement-adaptive-learning-at-scale.aspx

Kim, P., & Chung, C. (2015). Creating a temporary spontaneous mini-ecosystem through a MOOC. In C. J. Bonk, M. M. Lee, T. C. Reeves, & T. H. Reynolds (Eds.), *MOOCs and open education around the world* (pp. 157-168). New York, NY: Routledge.

Kop, R. (2011). The challenges to connectivist learning on open online networks: Learning experiences during a massive open online course. *International Review of Research in Open and Distance Learning, 12*(3), 19-38. Retrieved from http://www.irrodl.org/index.php/irrodl/article/view/882/1689

Kop, R., Fournier, H., & Mak, J. S. F. (2011, November). A pedagogy of abundance or a pedagogy to support human beings? Participant support on massive open online courses. *International Review of Research on Open and Distance Learning, 12*(7). Retrieved from http://www.irrodl.org/index.php/irrodl/article/view/1041/2025

Kop, R., & Fournier, H. (2015). Peer2peer and open pedagogy of MOOCs to support the knowledge commons. In C. J. Bonk, M. M. Lee., T. C. Reeves, & T. H. Reynolds (Eds.), *MOOCs and open education around the world* (pp. 303-314). NY: Routledge.

Lederman, D. (2018, February 14). MOOCs: Fewer new students, but more are paying. *Inside Higher Ed*. Retrieved from https://www.insidehighered.com/digital-learning/article/2018/02/14/moocs-are-enrolling-fewer-new-students-more-are-paying-courses

Levy, D. (2011). Lessons learned from participating in a connectivist massive online open course (MOOC). In Y. Eshet-Alkalai, A. Caspi, S. Eden, N. Geri, & Y. Yair (Eds.), *Proceedings of the Chais Conference on Instructional Technologies Research 2011: Learning in the Technological Era* (pp. 31-36). Raanana: The Open University of Israel.

Liyanagunawardena, T. R., Adams, A. A., & Williams, S. A. (2013). MOOCs: A systematic study of the published literature 2008-2012. *The International Review of Research in Open and Distributed Learning*, *14*(3), 202-227. http://dx.doi.org/10.19173/irrodl.v14i3.1455

McLoughlin, C., & Lee, M. J. (2010). Personalised and self-regulated learning in the Web 2.0 era: International exemplars of innovative pedagogy using social software. *Australasian Journal of Educational Technology*, *26*(1), 28-43. Retrieved from https://ajet.org.au/index.php/AJET/article/view/1100/355

Metz, C., & Satariano, A. (2018, July 3). Silicon Valley's giants take their talent hunt to Cambridge. *The New York Times*. Retrieved from https://www.nytimes.com/2018/07/03/technology/cambridge-artificial-intelligence.html

MOOC @ Edinburgh 2013 – Report #1 (2013). *MOOC @ Edinburgh 2013 – Report #1*. University of Edinburgh, Edinburgh, Scotland. Retrieved from https://www.era.lib.ed.ac.uk/bitstream/handle/1842/6683/Edinburgh_MOOCs_Report2013_no1.pdf?sequence=1&isAllowed=y

Nkuyubwatsi, B. (2013, October). Evaluation of massive open online courses (MOOCs) from the learner's perspective. *Proceedings of the12th European Conference on e-Learning, Sophie Antipolis, France, 12*, 340-346. Retrieved from http://hdl.handle.net/2381/28553

Pappano, L. (2012, November 2). The year of the MOOC. *The New York Times*, 2(12). Retrieved from http://www.nytimes.com/2012/11/04/education/edlife/massive-open-online-courses-are-multiplying-at-a-rapid-pace.html

Prain, V., Cox, P., Deed, C., Dorman, J., Edwards, D., Farrelly, C., & Waldrip, B. (2013). Personalised learning: Lessons to be learnt. *British Educational Research Journal, 39*(4), 654-676. doi:10.1080/01411926.2012.669747

Reeves, T. C., & Hedberg, J. G. (2014). MOOCs: Let's get REAL. *Educational Technology*, *54*(1), 3-8. Retrieved from https://www.jstor.org/stable/pdf/44430228.pdf

Reigeluth, C. M., Aslan, S., Chen, Z., Dutta, P., Huh, Y., Lee, D., & Watson, W. R. (2015). Personalized integrated educational system: Technology functions for the learner-centered paradigm of education. *Journal of Educational Computing Research, 53*(3), 459–496. doi: 10.1177/0735633115603998

Reigeluth, C. M., Myers, R. D., & Lee, D. (2017). The learner-centered paradigm of education. In C. M. Reigeluth, B. J. Beatty, & R. D. Myers (Eds.), *Instructional-Design Theories and Models* (pp. 5-32). Hillsdale, NJ: Routledge.

Rodriguez, O. C. (2012). MOOCs and the AI-Stanford like courses: Two successful and distinct course formats for massive open online courses. *European Journal of Open, Distance and E-Learning, 1*(2), 1-13. Retrieved from https://files.eric.ed.gov/fulltext/EJ982976.pdf

Rogoff, B. (1990). *Apprenticeships in thinking*. New York: Oxford University Press.

Saadatdoost, R., Sim, A. T. H., Jafarkarimi, H., & Hee, J. M. (2015). Exploring MOOC from education and information systems perspectives: A short literature review. *Educational Review, 67*(4), 505-518. doi:10.1080/00131911.2015.1058748

Schaffhauser, D. (2014, October 1). Gates Foundation picks seven to vie for $20 million digital courseware investments. *Campus Technology*. Retrieved from https://campustechnology.com/Articles/2014/10/01/Gates-Foundation-Picks-Seven-To-Vie-for-$20-million-Digital-Courseware-Investments.aspx?p=1

Severance, C. (2015). Learning about MOOCs by talking to students. In C. J. Bonk, M. M. Lee, T. C. Reeves, & T. H. Reynolds, T. H. (Eds.), *MOOCs and open education around the world* (pp. 169-179). New York: Routledge.

Shah, D. (2015). By the numbers: MOOCs in 2015. *Class Central*. Retrieved from https://www.class-central.com/report/moocs-2015-stats/

Shah, D. (2016). By the numbers: MOOCs in 2016. *Class Central*. Retrieved from https://www.class-central.com/report/mooc-stats-2016/

Shah, D. (2018, January 22). A product at every price: A review of MOOC stats and trends in 2017. *Class Central*. Retrieved from https://www.class-central.com/report/moocs-stats-and-trends-2017/

Siemens, G. (2007). PLEs – I acronym, therefore I exist. *Elearnspace: Learning, Networks, Knowledge, Technology, Community* [weblog]. Retrieved from http://www.elearnspace.org/blog/archives/002884.html

Siemens, G. (2012a, January 19). *Connectivist learning theory*. Retrieved from the P2P Foundation Wiki: http://p2pfoundation.net/Connectivist_Learning_Theory_-_Siemens

Siemens, G. (2012b, June 3). What is the theory that underpins our moocs? *E-LearningSpace*. Retrieved from http://www.elearnspace.org/blog/2012/06/03/what-is-the-theory-that-underpins-our-moocs/

Singer, N. (2017, June 6). The Silicon Valley billionaires remaking America's schools. *The New York Times*. Retrieved from https://www.nytimes.com/2017/06/06/technology/tech-billionaires-education-zuckerberg-facebook-hastings.html

Sneddon, S. (2015, March 31 - April 2). *Could you make it a bit more MOOCy?* Paper presented at the Socio Legal Studies Association Annual Conference. University of Warwick, England.

Straumsheim, C. (2016, June 23). Learning to adapt. *Inside Higher Ed*. Retrieved from https://www.insidehighered.com/news/2016/06/23/study-finds-inconclusive-results-about-efficacy-adaptive-learning

Veletsianos, G., & Shepherson, P. (2016). A systematic analysis and synthesis of the empirical MOOC literature published in 2013-2015. *International Review of Research on Open and Distributed Learning*, *17*(2), 198-221. Retrieved from http://www.irrodl.org/index.php/irrodl/article/view/2448/3655

Vygotsky, L. S. (1978). *Mind in society: The development of higher psychological processes*. Cambridge, MA: Harvard University Press.

Watson, W. R., & Watson, S. L. (2017). Principles for personalized instruction. In C. M. Reigeluth, B. J. Beatty, & R. D. Myers (Eds.), *Instructional-design theories and models* (pp. 93-120). Hillsdale, NJ: Routledge.

Xu, D., Huang, W. W., Wang, H., & Heales, J. (2014). Enhancing e-learning effectiveness using an intelligent agent-supported personalized virtual learning environment: An empirical investigation. *Information & Management*, *51*(4), 430-440. doi: 10.1016/j.im.2014.02.009

Yuan, L., Powell, S., & Olivier, B. (2014). *Beyond MOOCs: Sustainable online learning in institutions – A white paper*. Cetis – Centre for Educational Technology, Interoperability, and Standards. University of Bolton, UK. Retrieved from http://publications.cetis.org.uk/wp-content/uploads/2014/01/Beyond-MOOCs-Sustainable-Online-Learning-in-Institutions.pdf

Zhu, M., Sari, A., & Lee, M. M. (2018). A systematic review of research methods and topics of the empirical MOOC literature (2014-2016). *The Internet and Higher Education, 37,* 31-39.

International **R**eview of **R**esearch in **O**pen and **D**istributed **L**earning
Volume 19, Number 4

September – 2018

Motivation and Knowledge: Pre-Assessment and Post-Assessment of MOOC Participants From an Energy and Sustainability Project

Juan Antonio Valdivia Vázquez*, Maria Soledad Ramirez-Montoya, and Jaime Ricardo Valenzuela Gónzalez
Tecnologico de Monterrey
**Corresponding author*

Abstract

Understanding factors promoting or preventing participants' completion of a massive open online course (MOOC) is an important research topic, as attrition rates remain high for this environment. Motivation and digital skills have been identified as aspects promoting student engagement in a MOOC, and they are considered necessary for success. However, evaluation of these factors has often relied on tools for which the psychometric properties have not been explored; this suggests that researchers may be working with potentially inaccurate information for judging participants' profiles. Through a set of analyses (*t*-test, exploratory factor analysis, correlation), this study explores the relationship between information collected by administering valid and reliable pre and post instruments to measure traits of MOOC attendees. The findings from this study support previously reported outcomes concerning the strong relationships among motivation, previous knowledge, and perceived satisfaction factors for MOOC completers. Moreover, this study provides evidence of the feasibility of developing valid assessments for evaluation purposes.

Keywords: MOOC assessment, exploratory factor analysis, assessment validity

Introduction

Since their emergence in 2008, massive open online courses (MOOCs) have ignited the academic community due to their potential concerning a variety of interests beyond presenting a flexible educational alternative (Gaebel, 2013). Ranging from college instructional purposes (e.g., blended learning; Rayyan et al., 2016) to international workforce training (Garrido et al., 2016), educators constantly evolve MOOC scopes, moving forward educational content design and technological platforms (Zhang & Nunamaker, 2003). As a result of the variety of applications that involve fewer resources and financial costs when compared to a traditional options, MOOC projects have become a feasible response to contemporary massive educational challenges (Pegler, 2012).

However, beyond a merely educational response perspective, MOOCs have the potential to become a massive research laboratory (Diver & Martinez, 2015). By individualizing learning, this environment challenges well examined dynamics under traditional educative settings (Mazoue, 2013). For instance, unlike traditional courses, MOOCs' characteristics not only determine the ways in which content is delivered (e.g., asynchronically, massively, etc.; Kilgore, Bartoletti, & Freih, 2015), but they also challenge what is known about students' learning characteristics (e.g., learning and habit styles, interest in learning, etc.; Barcena, Martin-Monje, & Read, 2015). Moreover, given that MOOCs are courses designed to reach needs sought by huge audiences (Kennedy, 2014), a continuous research approach is required to understand better teaching and learning characteristics present in this format. Therefore, researchers are contributing constantly to the literature by examining MOOCs' technology, design, delivery conditions, and learning and assessment, among other aspects (Daradoumis, Bassi, Xhafa, & Caballe, 2013).

However, despite an increasing amount of research promoting learning aspects in MOOC participants, MOOC completion rates remain low (0.7%–52.1%, with a median value of 12.6%; Jordan, 2015). This makes it necessary to examine what prevents or promotes an attendee's completion of a MOOC, as completion rates challenge efforts to ensure a MOOC meets quality features for its educational content (Kilgore, Bartoletti, & Freih, 2015) or design (Kerr, Houston, Marks, & Richford, 2015).

In this regard, educational and psychological aspects have been reexamined to compare outcomes between traditional and MOOC learning settings (e.g., students' characteristics, course design, etc.; Durksen, Chu, Ahmad, Radil, & Daniels, 2016). However, given that within a traditional setting, learner´s expectations are more standardized and course completion rates can be a sign of student success (Littlejohn, Hood, Milligan, & Mustain, 2016), researchers must evaluate outcomes from this environment when working with MOOC attendees.

Examining MOOC completers has become a common strategy to evaluate participants' performance (time spent, execution of tasks, etc.; Stevanovic, 2014), where research shows motivation and digital skills are features strongly supported by MOOC literature to predict learners' performance (Pursel, Zhang, Jablokow, Choi, & Velegol, 2016; Xu & Yang, 2016).

Given that motivation is strongly related to student engagement (Shapiro et al., 2017), MOOC researchers have included this factor into their agenda. Now, educators deem motivation as an important ingredient for participants´ self-regulated learning (Magen-Nagar & Cohen, 2017) and as a requirement to succeed when acquiring content from a MOOC (Barak, Watted, & Haick, 2016).

Although social motivation is an important aspect for traditional learners, inner factors are required to learn from MOOC (e.g., intrinsic and extrinsic motivations; Xiong et al., 2015). Because the scope of MOOCs enables the delivery of education asynchronously and massively (Chen, 2013), continuing to examine motivation remains a fruitful direction for research (de Barba, Kennedy, & Ainley, 2016) as MOOCs reach enormous and diverse audiences (Admiraal, Huisman, & Pilli, 2015).

On the other hand, digital skills are essential features to address in MOOC research, as technology is part of the MOOC environment by definition (Rivera & Ramírez, 2015). Moreover, these courses evolve continuously thanks to educational technology (Yuan & Powell, 2013). It has been found that people with high levels of digital skills choose to participate in MOOCs whereas people with lower levels opt for traditional training (Castaño-Muñoz, Kreijns, Kalz, & Punie, 2017). Thus, limited technology skills hamper participants' opportunities to finish a MOOC as this format involves a high level of self-management of educational content (Onah, Sinclair, & Boyatt, 2014).

Among the required skills to attend a MOOC, searching and processing information and digital communication are central (Aesaert, Nijlen, Vanderlinde, & Braak, 2014). Thus, it is not surprising that researchers are interested in continuing to evaluate motivation and digital skills given their importance for MOOC education.

Although traditional assessments (e.g., scoring, providing feedback, etc.) are considered to examine a learner's motivation and digital skills, these kinds of assessment cannot be used in a MOOC design because a course offered under this format reaches a massive audience regularly (Admiraal, Huisman, & Pilli, 2015). Even though validity aspects of traditional tools used to assess readiness toward e-learning remains uncertain (Farid, 2014), criterion-referenced (Dray, Lowenthal, Miszkiewicz, Ruiz-Primo, & Marczynski, 2011); and theoretical or empirical data can be used to develop valid and reliable tools to explore factors contributing to or impeding students' participation in MOOCs (Xiong et al., 2015).

Given the existing need to reinforce tools used to evaluate motivation and digital skills traits, along with the data-enriched environment of a MOOC (Thille, Scheneider, Piech, Halawa, & Greene, 2014), information collected from MOOC participants is a suitable opportunity to research motivation and digital skill assessments.

Because it is imperative to understand learning specific to the MOOC context (Littlejohn et al., 2016), and to continuously gather information about factors encouraging MOOC completion (Blackmore, 2014), this study examines participants' motivation and digital knowledge characteristics via data collection using a new set of pre assessments and post assessments.

The objective of this study is to examine relationships between motivation and digital aspects influencing participants to attend a MOOC. In addition, using information obtained from MOOC completers, this examination is extended to evaluate pre-reports and post-reports. To accomplish this objective, procedures were executed (a) identify information among MOOC completers and non-completers, (b) evaluate psychometric properties of the post-measurement tool, and (c) correlate initial and ending information from MOOC completers.

Method

Sample

Participants (n = 1,315; males= 746, females = 589) from a MOOC titled "La reforma enérgetica y sus oportunidades" (Energetic reform and its opportunities; Tecnológico de Monterrey, 2017) comprised the data set for this study. Their ages ranged from 15 to 77 years (mean = 30.88, standard deviation [SD] = 10.55), and they reported the following educational levels: high school, 23%; associate's degree, 9%; bachelor's degree, 50%; graduate degree, 14%; and not reported, 4%. In terms of discipline, this pool reported having the following backgrounds: health, 1.75%; art and humanities, 3.35%; business, 12.77%; social sciences, 23.65%; science and engineering, 29.81%; and not defined, 28.66%. Most participants attended this MOOC from a Mexican location (97.5%); the remaining locations included Argentina, Colombia, and Ecuador. For a second set of analyses, available information from participants who finished the mentioned MOOC were included (n = 313).

Instrument

For the first set of analyses, information collected using the second section of the "Encuesta inicial sobre intereses, motivaciones y conocimientos previos en MOOC" ("Initial assessment for evaluate interests, motivation and previous knowledge"; EIIMC-MOOC; Valenzuela, Mena, & Ramírez-Montoya, 2017a) was evaluated. This section collects information regarding participants' reported motivation and previous knowledge related to attending this MOOC. The EIIMC-MOOC presents reliability coefficients of $\alpha = .898$ for the overall structure and $\alpha_1 = .872$, $\alpha_2 = .879$, and $\alpha_3 = .728$ for motivation, previous general knowledge (measuring digital skills), and previous specific knowledge factors, respectively (Valdivia Vazquez, Valenzuela, & Ramírez-Montoya, 2017).

For the second set of analyses, we used the "Encuesta final sobre intereses, motivaciones y conocimientos previos en MOOC" ("Ending assessment for interests, motivations, and previous knowledge"; EFMC-MOOC; Valenzuela, Mena, & Ramírez-Montoya, 2017b). The EFMC-MOOC is a mixed-format, 17-item tool designed to evaluate the changes in motivation and knowledge that participants experience after attending a MOOC related to the topic of energy. Given that the EFMC-MOOC was conceived to post-evaluate participants' motivation and knowledge, its second section emulates the EIIMC-MOOC tool in content and format. Examples of the items include "Este curso satisfizo las necesidades de formación que me llevaron a inscribirme en él" ("This course satisfied the training needs that motivated me to enroll in it"; motivation and interests) and "Creo que este curso me permitió adquirir los conocimientos básicos de los contenidos estudiados" ("I believe this course allowed me to acquire basic knowledge from the content explored"; acquired knowledge). Experts in education and methodology have evaluated the EFMC-MOOC for content validity, and its format and content have been piloted to evaluate examinees' comprehension (Valdivia, Valenzuela, & Ramirez-Montoya, 2017). For this study, the second section of the EFMC-MOOC was examined for its psychometric properties (the first section collects demographics).

Procedure

The EIIMC-MOOC and EFMC-MOOC were administered at the beginning and end of the "La reforma enérgetica y sus oportunidades" (Energetic reform and its opportunities) MOOC using links embedded in the course. These links took participants to an online survey service where directions to answer and statements regarding authorizing the use of information collected and confidentiality were presented for each tool. Participation was voluntary, without incentive, and the time needed to complete the survey was approximately 30 minutes.

Analysis

Participants from the "La reforma enérgetica y sus oportunidades" MOOC were divided into two groups—participants who completed both tools (completers) and those who completed the initial tool only (noncompleters). The rationale for employing these groups was to create a proxy to consider participants finishing (group 2) and not finishing (group 1) the course. Thus, to identify profile differences and similarities, as a first set of analyses, a series of *t*-test analyses was conducted for the defined groups across scores for each factor (motivation, previous general knowledge, and previous specific knowledge) measured by the EIIMC-MOOC tool.

Next, the structure of the EFMC-MOOC tool was examined via exploratory factor analysis using the axis factoring method including oblique rotation (direct oblimin); reliability was estimated via Cronbach's alpha. Examining the EFMC-MOOC structure allowed the instruments' scopes to be contrasted, as psychometric properties for the EIIMC-MOOC have already been reported (Valdivia Vazquez, Valenzuela, & Ramírez-Montoya, 2017).

Finally, as content validity for both instruments were already established by a panel of experts before examining the psychometric properties of the EFMC-MOOC tool, correlation analysis was conducted to evaluate associations between pre and post information collected from participants in group 2; to this end, scores yielded from the initial and ending tools were used as variables. All analyses were executed using SPSS 24.0 software.

Results

t-Test Analyses

Table 1 shows that on average, participants who finished the MOOC scored higher across variables (motivation, previous general knowledge, and specific knowledge) measured by the initial survey. However, although all mean scores presented significant differences when compared to scores from participants who did not finish the course, the results represented a low effect size (r range of .097 to .223; see Table 2).

Table 1

Means by Group

Variable	MOOC finished?	N	Means	Std. dev.	Std. error
Motivation	N	1004	19.55	6.086	.192
	Y	313	20.88	4.712	.266
General knowledge	N	1004	16.48	5.430	.171
	Y	313	17.68	3.837	.217
Specific knowledge	N	1004	5.3	2.139	.068
	Y	313	5.99	1.702	.096

Table 2

Independent Samples t-Test

Variable	Equal variances	F	t	df	Mean diff.	Std. error diff.	Lower	Upper	Effect size
Motivation	assumed	6.47 *	-3.56 *	1315	-1.34	0.38	-2.07	-0.60	0.10
	not assumed		-4.07 *	664.95	-1.34	0.33	-1.99	-0.69	0.15
General knowledge	assumed	20.04*	-3.64 *	1315	-1.20	0.33	-1.85	-0.55	0.10
	not assumed		-4.35 *	734.27	-1.20	0.28	-1.74	-0.66	0.16
Specific knowledge	assumed	18.35*	-5.17 *	1315	-0.68	0.13	-0.94	-0.42	0.14
	not assumed		-5.81 *	646.06	-0.68	0.12	-0.91	-0.45	0.22

Notes. a) *Significant at the $p<.01$ level. b) Lower and upper levels at 95% of confidence intervals of the difference.

Exploratory Factor Analysis

The descriptive statistics showed that the normality assumptions were met; the set of 13 items presented an absolute value smaller than 2.3 for skewness (mean of −1.39; range from −2.34 to −0.76), and kurtosis had a mean of 3.29 (range from -0.009 to 9.13). In the presence of large samples, absolute values greater than 3.0 and 10.0 indicate problematic skew and kurtosis indices, respectively (Kline, 2005).

The Kaiser Meyer Olkin (KMO) measure verified the sampling adequacy for the analysis; the result was .97, which is well above the acceptable limit of .5 (Kaiser, 1974). Bartlett's test of sphericity, χ^2 (78) = 2123.559, $p < .00$, indicated that correlations between items were sufficiently large for executing an exploratory factor analysis procedure.

An initial analysis was run to obtain eigenvalues for each factor in the data. Two factors had eigenvalues over Kaiser's criterion of 1. In combination, they explained 52.18% of the variance (see Table 3).

Table 3

Total Variance Explained for the EFMC-MOOC Sample

	Initial eigenvalues			Extraction sums of squared loadings		
Item	Total	% of variance	Cumulative %	Total	% of variance	Cumulative %
1	6.65	51.15	51.15	6.19	47.64	47.64
2	1.01	7.77	58.93	0.59	4.54	52.18
3	0.87	6.71	65.64			
4	0.76	5.89	71.53			
5	0.63	4.90	76.43			
6	0.55	4.24	80.67			
7	0.48	3.75	84.43			
8	0.44	3.40	87.84			
9	0.38	2.96	90.80			
10	0.37	2.88	93.68			
11	0.34	2.43	96.11			
12	0.27	2.10	98.20			
13	0.23	1.80	100			

Note. Extraction method: principal axis factoring.

This criterion is a good indicator for the number of factors that are tenable to retain when considering a combination of sample size (>250), and the average retained communality is .51 or higher (Field, 2009). Table 4 shows the item communalities extracted for this solution.

Table 4

Communalities for the EFMC-MOOC Sample

Item	Initial	Extraction
1	0.43	0.45
2	0.52	0.58
3	0.64	0.62
4	0.45	0.42
5	0.48	0.45
6	0.35	0.27
7	0.50	0.45
8	0.51	0.66
9	0.50	0.54
10	0.42	0.40
11	0.60	0.66
12	0.57	0.58
13	0.67	0.71

Note. Extraction method: principal axis factoring.

The scree plot showed a clear inflexion that would justify retaining two factors (Figure 1). Thus, given the large sample size, convergence of the scree plot, and Kaiser criterion found on this solution, two factors were retained in the final analysis.

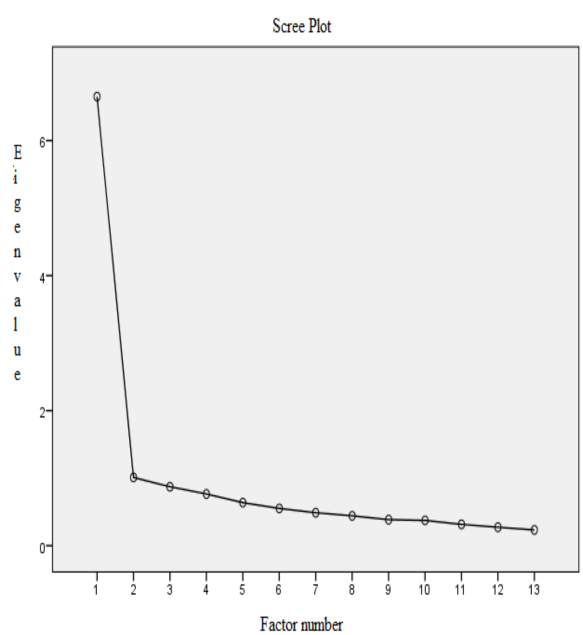


Figure 1. Scree plot for the EFMC-MOOC sample.

A clear pattern matrix was obtained for this two-factor solution (see Table 5). The items that clustered higher than 0.40 on the same components suggested that Factor 1 represents a motivation and interest dimension (6 items), whereas Factor 2 represents gained knowledge (4 items).

Table 5

Pattern Matrix for the EFMC-MOOC Sample

Item	Factor 1	Factor 2
1		0.91
2		0.63
3		0.44
4		0.72
5	0.71	
6	0.80	
7	0.66	
8	0.86	
9	0.72	
10		
11	0.53	
12		
13		

Notes. Extraction method: principal axis factoring. Rotation method: oblimin with Kaiser; rotation method converged in 10 iterations.

Reliability analysis estimated via Cronbach's method presented $\alpha = .898$ for the structure. The values were $\alpha_1 = .829$ and $\alpha_2 = .882$ for Factors 1 and 2, respectively.

Correlations

In terms of the correlation results obtained when preinformation and postinformation was obtained from participants who finished the MOOC, there were significant ($p < .01$ level) outcomes across all factors examined. Motivation presented a higher correlation when examined with factors taken from the final tool ($r = .606$ and $r = .506$ for Factors 1 and 2, respectively). As for the other initial factors, previous general and specific knowledge correlated moderately significantly with final Factors 1 and 2, although previous specific knowledge presented a weaker relationship (see Table 6).

Table 6

Correlations Between Initial and Final Information

Variable	n	Factor 1	Factor 2
Factor 1	313	1	0.70 **
Factor 2	313	0.70 **	1
Motivation	294	0.61 **	0.51 **
Previous general knowledge	296	0.50 **	0.47 **
Previous specific knowledge	301	0.36 **	0.40 **

***Note.* Correlation significant at the 0.01 level (two-tailed). Factor 1= professional development, factor 2= technology skills.

Discussion

MOOC environments are becoming an important setting for exploring learners' characteristics. Accordingly, the results from this study support efforts to continue investigating such characteristics, especially to understand the participants' motivation, knowledge (previous and acquired), and levels of satisfaction. This research line is important because after a completer"s profile is identified, MOOCs can be personalized to engage attendance more effectively as a strategy to reduce dropout rates (Alario-Hoyos, Pérez-Sanagustín, Delgado-Kloos, Parada, & Muñoz-Organero, 2014).

When examining the initial information, the scores for motivation and previous general and specific content knowledge factors were higher for the completers group compared with the non-completers group. These outcomes also showed low effect sizes, suggesting that the results need to be interpreted cautiously; however, they are in agreement with the literature reporting that completers obtain significantly higher ratings because they have confidence in their ability to complete MOOCs successfully (Barak et al., 2016). Moreover, it is notable that the scores were consistently significant across all factors, although the categories for grouping attendees (completers vs. non-completers) did not account for heterogeneous background profiles. Thus, future analysis to differentiate attendees' profiles should also consider reviewing other types of information (e.g., educational levels, work training, etc.) about participants to evaluate differences by subcategories as well.

As for the structure of the EFMC-MOOC, the results support the claim that this tool meets the initial validity and reliability standards. Item loadings for each factor suggest this tool measures participants' levels of satisfaction about the gains obtained after attending the MOOC. This satisfaction level can be evaluated by a two-factor structure involving (a) professional development gains and (b) technology skills growth. These factors correlate highly, but they are well differentiated (r = .737), and, together, they explain 52% of the variance, which is consistent with the findings reported in the literature when exploratory analyses are executed. In terms of reliability, the EFMC-MOOC shows internal consistency for the overall structure and across factors. An advantage of examining the psychometric structure of an instrument relates to the viability of interpreting students' scores properly, for instance, to identify students at risk (Farid, 2014). In traditional education, administering pre-assessment and post-assessment tools with similar content is a regular activity to evaluate learning; however, for MOOC environments, this activity is still developing (Chudzicki, Chen, Zhou, Alexandron, & Pritchard, 2015). Accordingly, the present results align with such efforts. Moreover, developing reliable measures provides opportunities for current efforts to track and understand participants' changes in behavior and performance occurring across MOOC attendance (Aiken et al., 2014; Perna et al., 2014). Future research projects could include using valid tools as formative assessments to track such changes, as it is desirable to have immediate measures rather than a delayed measure of situational interest (de Barba et al., 2016).

In terms of the pre-information and post-information derived from attendees finishing the MOOC, all scores from factors measured initially correlated significantly to the final scores. The results showed a consistent moderate association across variables. As in a previous report about the role motivation plays in perceived learning (Horzum, Kaymak, & Gungoren, 2015), the motivation factor measured in this study appeared to be the stronger variable associated with perceived satisfaction levels for attending a course. In contrast, the previous specific knowledge variable correlated less with the final information, and although prudence recommended when to interpret previous knowledge self-evaluation scores (Lui & Li, 2017), this finding agrees with reports asserting that this factor not only relates to engagement, but is also a strong predictor for success in a MOOC (Kennedy, Coffrin, & de Barba, 2015).

Overall, the findings from this study are consistent with the previous literature focussing on the need to understand attrition factors and motivational transition across MOOCs (Xu & Yang, 2016). Accordingly, it has also been suggested that pedagogical models should consider the technology practices involved (e.g., digital skills) to engage participants continuously to increase retention (Petronzi & Hadi, 2016). The combination of factors evaluated in this study (motivation, knowledge, satisfaction level) follows suggestions about not relying on behavioral aspects exclusively, but instead, including cognitive elements, as both aspects are related to MOOC engagement, and both increase the probability of completing a course (Li & Baker, 2016).

Finally, examining potential relationships among information collected before and after attending a course and comparing initial profiles of completers and non-completers may have benefits in terms of orienting MOOCs to the work market because a solely academic-oriented objective can detract from participants' learning, as transfer of knowledge is not guaranteed (Sanchez-Acosta, Escribano-Otero, & Valderrama, 2014). Thus, future research should consider how motivation and previous knowledge result when MOOCs target different objectives, as in the applied project supporting participants from this MOOC. Moreover, data emerging for such research should also consider an open-access perspective because by nature, MOOCs comprise open-access learning materials. Thus, the results and tools derived from MOOCs should align to this perspective to ensure that they are innovative (McGreal, Mackintosh, & Taylor, 2013).

Acknowledgements

This research is a product of Project 266632 of the "Laboratorio Binacional para la Gestión Inteligente de la Sustentabilidad Energética y la Formación Tecnológica" ["Bi-national Laboratory on Smart Sustainable Energy Management and Technology Training"], funded by the CONACYT SENER Fund for Energy Sustainability (Agreement: S0019=2014=01).

.

References

Admiraal W, Huisman B., & Pilli, O. (2015). Assessment in massive open online courses. *The Electronic Journal of e-Learning, 13*(4), 207-216.

Aesaert, K., van Nijlen, D., Vanderlinde, R., & van Braak, J. (2014). Direct measures of digital information processing and communication skills in primary education: Using item response theory for the development and validation of an ICT competence scale. *Computers & Education*, *76*, 168–181. doi:10.1016/j.compedu.2014.03.013

Aiken, J. M., Lin, S., Douglas, S. S., Greco, E. F., Thoms, B. D., Schatz, M. F., & Caballero, M. D. (2013). The initial state of students taking an introductory physics MOOC. *Proceedings of the 2013 Physics Education Research Conference,* Portland, OR. doi:10.1119/perc.2013.pr.001

Alario-Hoyos, C., Pérez-Sanagustín, M., Delgado-Kloos, C., Parada, H. A., & Muñoz-Organero, M. (2014). Delving into participants' profiles and use of social tools in MOOCs. *IEEE Transactions on Learning Technologies*, *7*(3), 260–266. doi:10.1109/TLT.2014.2311807

Barak, M., Watted. A., & Haick, H. (2016). Motivation to learn in massive open online courses: Examining aspects of language and social engagement. *Computers & Education*, *94,* 49–60. doi:10.1016/j.compedu.2015.11.010

Barcena, E., Martin-Monje, E., & Read, T. (2015). Potentiating the human dimension in Language MOOCs. *Proceedings of the European MOOC Stakeholder Summit,* Mons, Belgium, 46–54.

Blackmore, K. (2014). *Measures of success: Varying intention and participation in MOOCs.* Paper presented at the ACS Annual Canberra Conference, Canberra, Australia.

Castaño-Muñoz, J., Kreijns, K., Kalz, M., & Punie, Y. (2017). Does digital competence and occupational setting influence MOOC participation? Evidence from a cross-course survey. *Journal of Computing in Higher Education*, *29*, 28–46. doi:10.1007/s12528-016-9123-z

Chen, J.C. (2013). Opportunities and challenges of MOOCS: Perspectives from Asia. *Proceedings of the IFLA World Library and Information Congress 79th IFLA General Conference and Assembly* (pp. 1-16), Singapore: The International Federation of Library Associations and Institutions.

Chudzicki, C., Chen, Z., Zhou, Q., Alexandron, G., & Pritchard, D. E. (2015). Validating the pre/post-test in a MOOC environment. In A. D. Churukian, D. L. Jones, & L. Ding (Eds.), *Proceedings of the 2015 Physics Education Research Conference* (pp. 83-86). Maryland: American Association of Physics Teachers. doi:10.1119/perc.2015.pr.016

Daradoumis, T., Bassi, R., Xhafa, F., & Caballe, S. (2013). *A review of massive e-learning (MOOC) design, delivery and assessment.* Paper presented at the *Eighth International Conference on P2P, Parallel, Grid, Cloud and Internet Computing*, Compiegne, France. doi:10.1109/3PGCIC.2013.37

de Barba, P. G., Kennedy, G. E., & Ainley, M. D. (2016). The role of students' motivation and participation in predicting performance in a MOOC. *Journal of Computer Assisted Learning*, *32*, 218–231. doi:10.1111/jcal.12130

Diver, P., & Martinez, I. (2015). MOOCs as a massive research laboratory: Opportunities and challenges. *Distance Education*, *36*(1), 5–25. doi:10.1080/01587919.2015.1019968

Dray, B. J., Lowenthal, P. R., Miszkiewicz, M. J., Ruiz-Primo, M. A., & Marczynski, K. (2011). Developing an instrument to assess student readiness for online learning: A validation study. *Distance Education*, *32*(1), 29–47. doi:10.1080/01587919.2011.565496

Durksen, T. L., Chu, M., Ahmad, Z. F., Radil, A. I., & Daniels, L. M. (2016). Motivation in a MOOC: A probabilistic analysis of online learners' basic psychological needs. *Social Psychology of Education*, *19*, 241–260. doi:10.1007/s11218-015-9331-9

Farid, A. (2014). Student online readiness assessment tools: A systematic review approach. *Electronic Journal of e-Learning*, *12*(4), 375–382.

Field, A. (2009). *Discovering statistics using SPSS* (3rd ed.). London, UK: SAGE Publications.

Gaebel, M. (2013). MOOCs—Massive open online courses. *Report of the European University Association (EUA)*. Retrieved from http://www.eua.be/Libraries/publication/EUA_Occasional_papers_MOOCs.pdf?sfvrsn=2

Garrido, M., Koepke, L., Andersen, S., Mena, A., Macapagal, M., & Dalvit, L. (2016). *An examination of MOOC usage for professional workforce development outcomes in Colombia, the Philippines, & South Africa*. Seattle, WA: Technology & Social Change Group, University of Washington Information School.

Horzum, M. B., Kaymak, Z. D., & Gungoren, O. C. (2015). Structural equation modeling towards online learning readiness, academic motivations, and perceived learning. *Educational Sciences: Theory & Practice*, *15*(3), 759–770. doi:10.12738/estp.2015.3.2410

Jordan, K. (2015). Massive open online course completion rates revisited: Assessment, length and attrition. *International Review of Research in Open and Distributed Learning*, *16*(3), 341–358.

Kaiser, H. F. (1974). An index of factorial simplicity. *Psychometrika*, *39*, 31–36.

Kennedy, G., Coffrin, C., & de Barba, P. (2015.). Predicting success: How learners' prior knowledge, skills and activities predict MOOC performance. *Proceedings of the Fifth International Conference on Learning Analytics and Knowledge* (pp. 136–140). Poughkeepsie, NY: ACM Publications. doi:10.1145/2723576.2723593

Kennedy, J. (2014). Characteristics of massive open online courses (MOOCs): A research review, 2009-2012. *Journal of Interactive Online Learning, 13*(1), 1-16.

Kerr, J., Houston, S., Marks. L., & Richford, A. (2015). Building and executing MOOCs: A practical review of Glasgow's first two MOOCs (*Massive Open Online Courses*). Glasgow, Scotland: University of Glasgow. Retrieved from http://www.gla.ac.uk/media/media_395337_en.pdf

Kilgore, W., Bartoletti, R., & Freih, M. A. (2015). Design intent and iteration: The #HumanMOOC. *Proceedings of the European MOOC Stakeholder Summit* (pp. 7-12). *Mons, Belgium:* 2015 eMOOCS conference committee.

Kline, R. B. (2005). *Principles and practice of structural equation modeling*. New York, NY: Guilford Press.

Li, Q., & Baker, R. (2016). Understanding engagement in MOOCs. In T. Barnes, M. Chi, & M. Feng (Eds.) *Proceedings of the 9th International Conference on Educational Data Mining* (pp. 605-606). Raleigh, NC; International Conference on Educational Data Mining (EDM) 2016.

Littlejohn, A., Hood, N., Milligan, C., & Mustain, P. (2016). Learning in MOOCs: Motivations and self-regulated learning in MOOCs. *Internet and Higher Education*, *29*, 40–48. doi:10.1016/j.iheduc.2015.12.003

Lui, J., & Li, H. (2017). Exploring the relationship between student pre-knowledge and engagement in MOOCs using polytomous IRT. In X. Hu, T. Barnes, A. Hershkovitz, & L, Paquette (Eds.) *Proceedings of the 10th International Conference on Educational Data Mining* (pp. 410-411). Wuhan, China: International Conference on Educational Data Mining (EDM) 2017.

Magen-Nagar, N., & Cohen, L. (2017). Learning strategies as a mediator for motivation and a sense of achievement among students who study in MOOCs. *Education and Information Technologies*, *22*, 1271–1290. doi:10.1007/s10639-016-9492-y

Mazoue, J. G. (2013). The MOOC model: Challenging traditional education. *Formamente*, *8*(1–2), 161–174.

McGreal, R., Mackintosh, W., & Taylor, J. (2013). Open educational resources university: An assessment and credit for students initiative. In R. McGregor, W. Kinutia, & S. Marshall (Eds.), *Open educational resources: Innovation research and practices* (pp. 47–59). Vancouver, BC: Commonwealth of Learning.

Onah, D.F., Sinclair, J., & Boyatt, R. (2014). Dropout rates of massive open online courses: Behavioural patterns. *Proceedings of the 6th International Conference on Education and New Learning Technologies (EDULEARN14), Barcelona, Spain*. doi:10.13140/RG.2.1.2402.0009

Pegler, C. (2012). Reuse and repurposing of online digital learning resources within UK higher education: 2003-2010. (Unpublished doctoral dissertation). The Open University. United Kingdom. Retrieved from http://oro.open.ac.uk/32317/1/Pegler_PhD_final_print_copy.pdf

Perna, L. W., Ruby, A., Boruch, R. F., Wang, N., Scull, J., Ahmad, S., & Evans, C. (2014). Moving through MOOCs: Understanding the progression of users in massive open online courses. *Educational Researcher*, *43*(9), 421–432. doi:10.3102/0013189X14562423

Petronzi, D., & Hadi, M. (2016). Exploring the factors associated with MOOC engagement, retention and the wider benefits for learners. *European Journal of Open, Distance and e-Learning*, *19*(2), 129–146.

Pursel, B. K., Zhang, L., Jablokow, K. W., Choi. G. W., & Velegol, D. (2016). Understanding MOOC students: Motivations and behaviours indicative of MOOC completion. *Journal of Computer Assisted Learning*, *32*, 202–217. doi:10.1111/jcal.12131

Rayyan, A., Fredericks, C., Colvin, K. F., Liu, A., Teodorescu, R., Barrantes, A., . . . Pritchard, D. E. (2016). A MOOC based on blended pedagogy. *Journal of Computer Assisted Learning*, *32*, 190–201. doi:10.1111/jcal.12126

Rivera, N., & Ramirez, M. S. (2015). Digital skills development: MOOC as a tool for teacher training. *Proceedings from International Conference of Education, Research, and Innovation (ICERI2015)*, Seville, Spain.

Sanchez-Acosta, E., Escribano-Otero, J. J., & Valderrama, F. (2014). Motivación en la educación masiva online. Desarrollo y experimentación de un sistema de acreditaciones para los MOOC. [Motivation in massive education online: Development and testing of a system of accreditation badges for MOOC]. *Digital Education Review*, *25*, 18–35.

Shapiro, H. B., Lee, C. H., Wyman Roth, N. E., Li, K., Cetinkaya-Rundel, M., & Canelas, D. A. (2017). Understanding the massive open online course (MOOC) student experience: An examination of attitudes, motivations, and barriers. *Computers & Education*, *110*, 35–50. doi:10.1016/j.compedu.2017.03.003

Stevanovic, N. (2014). *Effects of motivation on performance of students in MOOC.* Paper presented at Sinteza 2014— Impact of the Internet on Business Activities in Serbia and Worldwide, Belgrade, Serbia. doi:10.15308/sinteza-2014-418-422

Tecnológico de Monterrey (Producer). (2017). La reforma energetica y sus oportunidades: MOOC. [The energy reform and its opportunities: MOOC]. Retrieved from https://energialab.tec.mx/es/la-reforma-energetica-y-sus-oportunidades

Thille, C., Scheneider, R.F., Piech, C., Halawa, S.A., & Greene, D.K. (2014). The future of data–enriched assessment. *Research and Practice in Assessment, 9,* 5-16.

Valdivia, J.A., Valenzuela, J.R., & Ramírez-Montoya, M.S. (2017). Pilotaje de contenido de instrumentos MOOC [Content pilot for MOOC instruments]. Retrieved from https://repositorio.itesm.mx/bitstream/handle/11285/622345/170210-Reporte%20Pilotaje%20Instrumentos.pdf?sequence=1&isAllowed=y

Valdivia Vázquez, J.A., Valenzuela, J.R., & Ramirez-Montoya, M.S. (2017). Encuesta inicial sobre intereses, motivaciones y conocimientos previos en MOOC: Reporte de validación y confiabilidad. [Initial assessment to evaluate interests, motivation and previous knowledge: Validity and reliability report]. Retrieved from https://repositorio.itesm.mx/bitstream/handle/11285/622442/Encuesta_inicial_motivacioones MOOC.pdf?sequence=1&isAllowed=y

Valenzuela, J.R., Mena, J.J., & Ramírez-Montoya, M.S.(2017a). Encuesta inicial sobre intereses, motivaciones y conocimientos previos en MOOC [Initial assessment to evaluate interests, motivation and previous knowledge]. Retrieved from https://repositorio.itesm.mx/bitstream/handle/11285/622349/170210-EncuestaInicial.pdf?sequence=1

Valenzuela, J.R., Mena, J.J., & Ramírez-Montoya, M.S.(2017b). Encuesta final sobre intereses, motivaciones y conocimientos previos en MOOC [Final assessment to evaluate interests, motivation and previous knowledge]. Retrieved from https://repositorio.itesm.mx/bitstream/handle/11285/622348/170210-EncuestaFinal.pdf?sequence=1&isAllowed=y

Xiong, Y., Li, H., Kornhaber, M. L., Suen, H. K., Pursel, B., & Goins, D. D. (2015). Examining the relations among student motivation, engagement and retention. *Global Education Review*, *2*(3), 23–33.

Xu, B., & Yang, D. (2016). Motivation classification and grade prediction for MOOCs learners. *Computational Intelligence and Neuroscience*, *2016*, 1–7. doi:10.1155/2016/2174613

Yuan, L., & Powell, S. (2013). *Open education: Implications for higher education*. Retrieved from https://www.researchgate.net/publication/265297666_MOOCs_and_Open_Education_Implications_for_Higher_Education

Zhang, D., & Nunameker, J. F. (2003). Powering e-learning in the new millennium: *Information Systems Frontiers, 5*(2), 207-2018.

International **R**eview of **R**esearch in **O**pen and **D**istributed **L**earning
Volume 19, Number 4

September – 2018

Defining OER-Enabled Pedagogy

David Wiley[1, 2] and John Hilton[2]
[1] Lumen Learning, [2] Brigham Young University

Abstract

The term “open pedagogy” has been used in a variety of different ways over the past several decades. In recent years, its use has also become associated with Open Educational Resources (OER). The wide range of competing definitions of open pedagogy, together with its semantic overlap with another underspecified term, open educational practices, makes it difficult to conduct research on the topic of open pedagogy. In making this claim we do not mean to cast doubt on the potential effectiveness of the many pedagogical approaches labeled open. In this article, rather than attempting to argue for a canonical definition of open pedagogy, we propose a new term, “OER-enabled pedagogy,” defined as the set of teaching and learning practices that are only possible or practical in the context of the 5R permissions that are characteristic of OER. We propose criteria used to evaluate whether a form of teaching constitutes OER-enabled pedagogy and analyze several examples of OER-enabled pedagogy with these criteria.

Keywords: OER-enabled pedagogy, open pedagogy, open learning, open educational practices

Introduction

The term "open pedagogy" has a long history and has been used in many contexts. For example, Elliot (1973) describes a tension between "closed" and "open" pedagogies with the former tending to be more focused on didactic discussion and the latter being connected with leading less formal discussions and students co-creating the context of the class. Mai (1978) discusses open pedagogy in the context of creating an "informal classroom where children might be trusted to learn by exploring according to their own interests, instead of being bored, demeaned, and alienated" (p. 231). Dufeu (1992) argues that open pedagogy is a philosophy in which the content of the course, as well as its progression, is determined by the needs and preferences of participants. Daniel (2004) refers to open pedagogy as one "that treats the student as an intellectual equal" (p. 9).

The association of "open pedagogy" with student-centered approaches has been strengthened in recent years concurrent with the development of new technologies. Hodgkinson-Williams and Gray (2009) use the term to refer to "the opening up of educational processes...enabled by Web 2.0 technologies" and argue that open pedagogy will play a more transformational role than open content (p.101). An Athabasca University white paper written in 2011 associates open pedagogy with learning digital literacies and teaching that is centered on the pedagogy of discovery (Day, Ker, Mackintosh, McGreal, Stacey, & Taylor, 2011). Hegarty (2015) defines open pedagogy as a broad range of attributes from participatory technologies to innovation and creativity.

In addition, "open pedagogy" has become closely associated with the creation, use, and sharing of open educational resources (OER). Weller (2013) states that open pedagogy "makes use of...abundant, open content (such as open educational resources, videos, podcasts), but also places an emphasis on the network and the learner's connections within it" (p. 10). Wiley (2013) similarly emphasized the link between OER and open pedagogy. Other authors have preferred the related term "open educational practices," which Cronin (2017) defines as "a broad descriptor of practices that include the creation, use, and reuse of open educational resources (OER) as well as open pedagogies and open sharing of teaching practices" (p. 16). The Open Educational Quality Initiative (OPAL; 2011) define open educational practices as "a set of activities around instructional design and implementation of events and processes intended to support learning. They also include the creation, use and repurposing of Open Educational Resources (OER) and their adaptation to the contextual setting. They are documented in a portable format and made openly available" (p. 13). Adding to the complexity, some people treat the term "open educational practices" as being synonymous with "open pedagogy," while others hold them to be distinct from each other.

The connection between open educational resources and open pedagogy marks a significant departure from the way the term was used in the 20th and early 21st centuries. The "open" in open educational resources indicates that these materials are licensed with copyright licenses that provide permission for everyone to participate in the 5R activities - retain, reuse, revise, remix, and redistribute. Wiley (n.d.) describes the 5Rs in more detail:

- **Retain -** the right to make, own, and control copies of the content (e.g., download, duplicate, store, and manage).

- **Reuse -** the right to use the content in a wide range of ways (e.g., in a class, in a study group, on a website, in a video).

- **Revise -** the right to adapt, adjust, modify, or alter the content itself (e.g., translate the content into another language).

- **Remix -** the right to combine the original or revised content with other material to create something new (e.g., incorporate the content into a mashup).

- **Redistribute -** the right to share copies of the original content, your revisions, or your remixes with others (e.g., give a copy of the content to a friend).

For several years, advocates, practitioners, and researchers in the open education movement have worked to prevent the weakening of the term "open" by calling out examples of "openwashing" - attempts by people and organizations to apply the label "open" to contexts in which copyright restrictions prohibit teachers and learners from engaging in the 5R activities (Weller, 2013; Pomerantz & Peek, 2016). Those interested in OER care about the way the word "open" is used in educational contexts.

The wide range of variation in the many recent definitions of open pedagogy makes it increasingly difficult to make sense of the term, potentially leading to claims of openwashing and creating other practical problems in the context of teaching and learning practices. From a research perspective, the dearth of agreement on a common definition makes evaluating the impacts of open pedagogy on student learning, student engagement, and other metrics of interest essentially impossible since we cannot specify what we are evaluating. In making this claim, we do not mean to cast doubt on the potential effectiveness of the many pedagogical approaches labeled open. Indeed, many of these pedagogies are inspiring, have the appearance of effectiveness, and seem worthy of replication. However, in order to move research in the field forward, there is a need for clarity.

Rather than attempting to propose a single, canonical definition of open pedagogy, we propose a new term, "OER-enabled pedagogy." We define OER-enabled pedagogy as the set of teaching and learning practices that are only possible or practical in the context of the 5R permissions which are characteristic of OER. Pedagogy is not generally described in terms of copyright, so we pause here to explain the relationship between permission to engage in the 5R activities and teaching and learning practices.

We accept as axiomatic that students learn by doing. The function of copyright is to prohibit people from engaging in broad categories of activity (e.g., making copies or creating derivative works) without permission from a rights holder. If students learn by doing, and copyright makes it illegal to engage in certain kinds of doing without a license, then copyright necessarily functions to limit the ways in which students can learn. The permissions to engage in the 5R activities that are granted in association with OER lift these restrictions. Consequently, when using OER, as opposed to traditionally copyrighted resources, students are free to engage in a broader range of activities and, therefore, to learn in a broader range of ways. The core ideas of OER-enabled pedagogy are in many ways a combination of openness as characterized by the 5Rs and Papert's (1991) notion of constructionism. Papert writes that the simplest definition of constructionism is “learning-by-making,” and relates the following story of how he arrived at the idea:

> More than 20 years ago, I was working on a project at the Muzzey Junior High School in Lexington, MA, which had been persuaded by Wally Feuerzeig to allow a seventh grade to "do Logo" instead of math for that year. This was a brave decision for a principal who could not have known that the students would actually advance their math achievement score, even though they didn't do anything that resembled normal school math that year! But the story I really want to tell is not about test scores. It is not even about the math/Logo class. It is about the art room I used to pass on the way. For a while, I dropped in periodically to watch students working on soap sculptures and mused about ways in which this was not like a math class. In the math class students are generally given little problems which they solve or don't solve pretty well on the fly. In this particular art class they were all carving soap, but what each student carved came from wherever fancy is bred and the project was not done and dropped but continued for many weeks. It allowed time to think, to dream, to gaze, to get a new idea and try it and drop it or persist, time to talk, to see other people's work and their reaction to yours--not unlike mathematics as it is for the mathematician, but quite unlike math as it is in junior high school. I remember craving some of the students' work and learning that their art teacher and their families had first choice. I was struck by an incongruous image of the teacher in a regular math class pining to own the products of his students' work! An ambition was born: I want junior high school math class to be like that. I didn't know exactly what "that" meant but I knew I wanted it. I didn't even know what to call the idea. For a long time it existed in my head as "soap-sculpture math.” (para. 8)

In soap-sculpture math, Papert (1991) saw that learning “happens especially felicitously in a context where the learner is consciously engaged in constructing a public entity” (para. 2) - something that others can see, review, critique, and value. In introducing the idea of OER-enabled pedagogy, we ask what it means to add the 5R permissions to these public entities - to be consciously engaged in either building upon work previously done by another or to construct a new public entity that explicitly offers other learners permission to publicly transform and adapt it. When student works are openly licensed, granting others 5R permissions in their use of the artifacts, each work becomes the beginning of an ongoing conversation in which other learners participate as they contextualize and extend the work in support of their own learning. Open licensing also ensures that these artifacts will be perpetually and freely available to all who wish to engage them as part of their learning. Rather than a single assignment that is completed, displayed, and archived (or recycled), the artifacts constructed in the context of open become a source of renewal and additional learning-by-making for later learners.

One concrete example of combining constructionism and openness into OER-enabled pedagogy is Wiley’s (2013) notion of “renewable assignments,” which he contrasts with “disposable assignments.” Disposable assignments are those assignments that both faculty and students understand will ultimately be thrown away. Essays are examples of assignments that frequently fit into this category - students write the essays, faculty grade and provide feedback on the essays and return them to students, and students do or do not look through faculty comments and then throw the paper in the recycle bin (or delete it). In discussing disposable assignments, Wiley does not imply that these kinds of assignments cannot result in powerful student learning for that student in that context. He only calls our attention to the fact that millions of hours of work are done, graded, and thrown away each year. We echo this concern over what seems to be a missed opportunity. In contrast to disposable assignments, Wiley introduces the idea of renewable assignments - assignments which both support an individual student's learning and result in new or improved open educational resources that provide a lasting benefit to the broader community of learners.

We might consider a continuum of criteria that distinguish disposable assignments from renewable assignments, as indicated in Table 1.

Table 1

Criteria Distinguishing Different Kinds of Assignments

	Student creates an artifact	The artifact has value beyond supporting its creator's learning	The artifact is made public	The artifact is openly licensed
Disposable assignments	X			
Authentic assignments	X	X		
Constructionist assignments	X	X	X	
Renewable assignments	X	X	X	X

Thus, in determining whether a particular approach should be labeled OER-enabled pedagogy, it matters whether openly licensed resources are a vital part of the practice. We propose the following four-part test to determine the extent to which a specific teaching and learning practice qualifies as OER-enabled pedagogy, as exemplified by the idea of renewable assignments:

1. Are students asked to create new artifacts (essays, poems, videos, songs, etc.) or revise / remix existing OER?
2. Does the new artifact have value beyond supporting the learning of its author?
3. Are students invited to publicly share their new artifacts or revised / remixed OER?
4. Are students invited to openly license their new artifacts or revised / remixed OER?

In the remainder of the paper we provide several examples of OER-enabled pedagogy and analyze these examples using the four-part test listed above. We then close by providing suggestions for how future research on OER-enabled pedagogy might be conducted.

Examples of OER-Enabled Pedagogy

Here we provide several examples of types of OER-enabled pedagogies. This set of categories is meant to be illustrative and not comprehensive.

OER-enabled pedagogies resulting in the creation of supplementary learning resources designed to facilitate the learning of other students. OER-enabled pedagogies can result in the creation of supplementary learning resources designed to improve the understanding of future students. Wiley, Webb, Weston, and Tonks (2017) describe how student-created OER in a secondary (middle and high school) setting helped improve student learning. The context for this study was a Digital Photography course at Mountain Heights Academy. Each semester that the course has been taught since its introduction in 2011, students were given the option to release their own photos with a Creative Commons license. The openly licensed photos were evaluated by the instructor and the best examples of each particular concept were selected to be integrated into the course and used by students in subsequent semesters.

Students were also offered extra credit to create tutorial videos, chapter summaries, and review games for a particular topic; these tutorial resources were also evaluated by the teacher and some were selected to be integrated into the course. Students who demonstrated high levels of mastery in the course were then offered the opportunity to be a teaching assistant for the upcoming semester. These students created additional materials, including guided notes for each unit that provide deeper explanations of concepts, study guides for exams, tutorial videos that provide scaffolding and support to learners who benefit from having the material presented from a different perspective or in a different medium, and review presentations and games that can assist students to learn in a variety of ways. These ancillary materials are all licensed as OER and added to the course after review by the teacher. The results of the study reported by Wiley et al. (2017) were that the average grade on student assignments rose significantly as more student-created OER were added to the course.

To examine the extent to which this approach qualifies as OER-enabled pedagogy, we apply the four-part test listed above:

1. **Are students asked to create new artifacts (essays, poems, videos, songs, etc.) or revise / remix existing OER?**

   Yes. New artifacts were created.

2. **Does the new artifact have value beyond supporting the learning of its author?**

   Yes. The artifacts were meant to also support the learning of other students.

3. **Are students invited to publicly share their new artifacts or revised / remixed OER?**

   Yes, students were invited to publicly share their creations, which are available online.

4. Are students invited to openly license their new artifacts or revised / remixed OER?

Yes.

Based on the answers to these questions, this approach clearly qualifies as OER-enabled pedagogy.

A second example from this genre comes from Jhangiani (2017), who also describes using OER-enabled pedagogy to facilitate the learning of current students while potentially improving the learning of future students. Over the course of a semester, he asked students taking a Social Psychology class to create test questions based on the material they were learning. Jhangiani felt that having his students write well-crafted questions (including plausible distractors) would help them attain a deeper level of understanding; moreover, it would help create a test bank for the open textbook that was being used in the course (and did not have an associated test bank). Jhangiani's class of 35 students wrote 1,400 questions throughout the semester. While Jhangiani did not consider the resulting test bank to be sufficiently polished to be used by other instructors, it provides a base that can be modified and improved on by future students.

Again, to examine the extent to which this approach qualifies as OER-enabled pedagogy, let us apply the four-part test listed above:

1. Are students asked to create new artifacts (essays, poems, videos, songs, etc.) or revise / remix existing OER?

Yes. New artifacts were created based on existing OER, namely a test bank.

2. Does the new artifact have value beyond supporting the learning of its author?

Yes. The questions provide formative, self-check opportunities for other students in the class and, perhaps eventually, other students.

3. Are students invited to publicly share their new artifacts or revised / remixed OER?

Not yet. The questions were available to class members but deemed not yet ready for public consumption.

4. Are students invited to openly license their new artifacts or revised / remixed OER?

Jhangiani does not report on this.

Because students were adding value to a pre-existing OER, if we assume that their resulting work was openly licensed, this approach would qualify as OER-enabled pedagogy.

OER-enabled pedagogy and worked examples. In his meta-meta-analysis of a range of educational practices, Hattie (2009) identified worked examples as an educational intervention associated with strong improvements in student learning. Worked examples provide students with step-by-step templates of how to complete tasks or solve problems and are particularly prevalent in math. Figure 1 provides an example of a worked example of a trigonometry problem (Ctcleung, 2014).

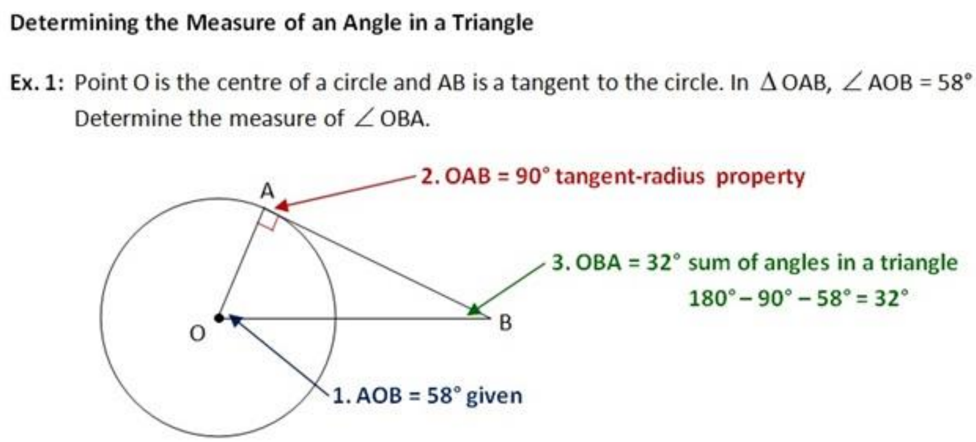


Figure 1. A sample worked example.

Through an OER-enabled pedagogy approach, students might create or modify openly licensed worked examples, specifically in topics that have proven troublesome to students in past semesters. This approach benefits students who create the worked examples, as creating the worked problems expands and deepens their knowledge. Moreover, it is beneficial for future students who can use these worked examples to help them process difficult topics in future semesters. In evaluating this approach, we find the following answers to the four-part test described above:

1. **Are students asked to create new artifacts (essays, poems, videos, songs, etc.) or revise / remix existing OER?**

   Yes. These worked examples could be independent of pre-existing resources, or be built to align with OER, or could include revisions and remixes of existing worked examples.

2. **Does the new artifact have value beyond supporting the learning of its author?**

   Yes. Worked examples can support the learning of future students.

3. **Are students invited to publicly share their new artifacts or revised / remixed OER?**

   Yes, these works could be posted online.

4. **Are students invited to openly license their new artifacts or revised / remixed OER?**

   Yes. Doing so would allow for the worked examples to be used in other contexts.

Because students would be creating new learning material (possibly connected with pre-existing OER), the first criterion is met. If we assume that their resulting work is openly licensed and publicly available, then this technique would be OER-enabled pedagogy.

OER-enabled pedagogy and student summaries. Another way that students could generate resources that would both demonstrate their learning and help future generations of learners is to create summaries of key concepts related to a course. For example, in an English course in which students are studying *A Tale of Two Cities*, students could produce written or video-based presentations that summarize key historical context or important aspects of the storyline. Such summaries could include identifying symbolism or making connections between events of the book and contemporary society. These summaries could be both used and improved upon by future generations of learners. The answers to the four-part test for this approach are the same as the previous example.

OER-enabled pedagogy and new contexts. One challenge all learners face is the transferring knowledge from one context to another. For example, a student may know that the earth revolves around the sun, but may struggle to understand whether this rotation influences the appearance of the moon in the night sky. Students could be assigned to take a principle or concept taught in class and concretely explain it in another context. Such an approach would benefit both current and future learners. The answers to the four-part test for this approach are the same as the previous example.

OER-enabled pedagogy that results in primary course resources such as textbooks. Another broad category of OER-enabled pedagogy approaches concern the creation or revision/remixing of learning resources. For example, Robin DeRosa of Plymouth State University became concerned about the high cost of the textbook in the course she was teaching (DeRosa, 2016). In this American literature class, the majority of the texts that comprised her textbook were in the public domain, which made it seem incongruent to require students to purchase a textbook that cost nearly $100.00.

Working with students she hired, DeRosa (2016) set about creating a basic open access anthology for her students. However, her students were somewhat dismayed at the lack of contextual introductions to each text in the anthology, as introductions are typically included in traditional textbooks and provide important background information. As part of the course, students created these introductions throughout the class, generally submitting them prior to the text being covered in class, and often revised after class. Student made other helpful edits to the anthology, such as modernizing spelling and creating videos, discussion questions, and other assignments that were related to the primary texts.

In evaluating this potential approach using the four-part test, we find the following:

1. **Are students asked to create new artifacts (essays, poems, videos, songs, etc.) or revise / remix existing OER?**

   Yes. Students were involved in both collating, organizing and creating OER.

2. **Does the new artifact have value beyond supporting the learning of its author?**

Yes. The anthology will be of value to future students and other interested in the topic.

3. Are students invited to publicly share their new artifacts or revised / remixed OER?

Yes.

4. Are students invited to openly license their new artifacts or revised / remixed OER?

Yes, they were integrated into the learning materials.

This example is a clear (and some would say classic) example of OER-enabled pedagogy.

Another example of this general category is the textbook *Project Management for Instructional Designers* (described in Randall, Johnson, West, & Wiley, 2013). This book came about when David Wiley was teaching a course on this topic and found that there was no suitable textbook available. However, there was a pre-existing, openly licensed textbook on project management that Wiley was able to collaboratively revise with his students (as part of their coursework) to create a version specifically for instructional designers. They did so by adding examples relevant to educational technology, integrating new video case studies they produced, and making other changes that further improved the book for educational technology students. Students in future iterations of the course made further revisions and remixes. An analysis of this example is similar to the previous one.

OER-enabled pedagogy and Wikipedia. Another category of OER-enabled pedagogy is connected with Wikipedia. The basic idea behind many of these approaches is that a major assignment that students complete is writing or rewriting Wikipedia articles. One classic example of this type of pedagogy comes from a class titled “Murder, Madness & Mayhem.” Beasley-Murray (n.d.) was teaching a course at the University of British Columbia that focused on Latin American literary texts. He assigned students to edit (and if necessary create) Wikipedia articles about each of the texts covered in class. Beasley-Murray felt that this project would be important because it had “tangible and public, if not necessarily permanent, effects” (para. 9) in contrast with a final essay or exam which would be “written in haste; for one particular reader, the professor; and thereafter discarded” (para. 9). Another advantage of this assignment was that it motivated students to “re-read and reflect upon their own work” (para. 10). As Wikipedia requires sources for its entries, students were pushed to make sure that they were properly using prior research. Moreover, there were many people (besides the professor) reading their work and ensuring accuracy. Ultimately, 12 articles were created as part of this class; three of them achieved “featured article” status and eight achieved “good article” status (at the time, fewer than .5% of Wikipedia articles achieved either of these statuses).

Other examples of this type of OER-enabled pedagogy are plentiful. Azzam et al. (2016) taught classes to fourth year medical students over a two-year period in which editing Wikipedia articles related to medicine was the primary purpose of the class. In this class, 43 students made a total of 1,528 edits and added 274 references (and deleted several lower-quality references). These 43 articles were viewed over one million times, indicating a significant contribution to society. In examining these Wikipedia-related examples using the four-part test described above, we find the following:

1. **Are students asked to create new artifacts (essays, poems, videos, songs, etc.) or revise / remix existing OER?**

   Yes. The nature of the assignment is the creation or modification of OER.

2. **Does the new artifact have value beyond supporting the learning of its author?**

   Yes. Wikipedia articles are viewed by millions of people each month.

3. **Are students invited to publicly share their new artifacts or revised / remixed OER?**

   Yes. By definition, Wikipedia articles are publicly shared.

4. **Are students invited to openly license their new artifacts or revised / remixed OER?**

   Yes. By definition, Wikipedia articles are openly licensed.

This is an excellent example of OER-enabled pedagogy - it would not have been possible or practical if the only available encyclopedias were copyrighted.

Further Research Needed

Several years ago, Ehlers (2011) identified a need for research to determine the efficacy of OER. At that time some believed that, because OER are free of cost, they are necessarily inferior to commercial alternatives and that students who use OER would learn less. Conversely, some argued that open textbooks would dramatically improve student learning as students gained greater access to learning resources. Six years later, there have been more than a dozen studies, most of which have found OER to have a small positive impact on learning (Hilton, 2016). Will widespread adoption of OER-enabled pedagogy spark dramatic improvements in learning? We need more use of renewable assignments and other OER-enabled pedagogies, as well as more research, to answer this question. For example, a study might examine the question how much additional benefit is gained from the various criteria associated with OER-enabled pedagogy? For example, consider the following questions:

- Do students assigned to create, revise, or remix artifacts find these assignments more valuable, interesting, motivating, or rewarding than other forms of assessment? Why or why not?

- Do students who make their assignments publicly available demonstrate greater mastery of learning outcomes or show more enthusiasm for their work than students assigned traditional assessments? Why or why not?

- Do students who openly license their work find additional learning benefits? Does openly licensed student work produce additional benefits to the broader community?

- Are there any drawbacks (real or perceived) that are voiced by students or faculty that participate in OER-enabled pedagogy?

Those who study these questions need to carefully consider the metrics they use when determining whether OER-enabled pedagogy leads to increased learning outcomes. In what ways would we expect OER-enabled pedagogy to make a difference in student learning? Much of the OER efficacy research done to date focuses on GPA, pass rates, and other traditional metrics. These might be appropriate for measuring the influence of adopting OER-enabled pedagogy; however, there may be better metrics. For example, OER-enabled pedagogy could conceivably lead to changes in student creativity, enthusiasm, satisfaction, and other outcomes sometimes labeled "deeper learning." Pre-existing and new instruments could be used to measure gains or losses in these areas.

Conclusion

In the early days of OER adoption, research found that there are ways of adopting OER that actually cost more than using commercial materials. For example, Wiley, Hilton, Ellington, and Hall (2012) illustrate how a poorly planned print-on-demand strategy can make OER more expensive than publisher textbooks. Just as researchers spent time in the early years of OER adoption research specifically investigating the whether-or-nots and hows of cost savings, we need to spend time in these early years of researching OER-enabled pedagogy specifically investigating the value students and faculty find in doing this work, how motivating or engaging they find it, and how it can be improved.

Students are the authors and copyright holders of the homework and other artifacts they create as part of their education. There is no morally or ethically appropriate scenario in which faculty can *require* students to openly license their homework or other creations as part of an assignment. Caution is especially important when working with students who are minors. However, faculty can espouse the benefits of openness and appropriately advocate for students to license their works under a Creative Commons license. This advocacy will be more effective if the faculty member is using OER in the class and can point to OER they have created and shared.

Powerful examples of OER-enabled pedagogy will give faculty specific and direct reasons to adopt OER. As faculty come to understand that OER allows for the benefits of open pedagogy, the adoption of OER will significantly accelerate. This accelerated adoption of OER will, in turn, significantly increase the quality (through OER-enabled pedagogy) and affordability (through cost savings) of education for learners everywhere.

References

Azzam, A., Bresler, D., Leon, A., Maggio, L., Whitaker, E., Heilman, J. ... McCue, J. (2017). Why medical schools should embrace Wikipedia: Final-Year medical student contributions to Wikipedia articles for academic credit at one school. *Academic Medicine*, *92*(2), 194.

Beasley-Murray, J. (n.d.). Was introducing Wikipedia to the classroom an act of madness leading only to mayhem if not murder? Retrieved from https://en.wikipedia.org/wiki/User:Jbmurray/Madness

Ctcleung. (2014). A geometry worked-example demonstrating the tangent-radius property. Retrieved from https://en.wikipedia.org/wiki/Worked-example_effect#/media/File:Worked_Example.jpg

Cronin, C. (2017). Openness and praxis: exploring the use of open educational practices in higher education. *The International Review of Research in Open and Distributed Learning*, *18*(5). DOI: http://dx.doi.org/10.19173/irrodl.v18i5.3096

Daniel, J. (2004). From the triangle to the pentagon: Open universities in the 21st century. *Commonwealth of Learning,* 2-9. Retrieved from http://hdl.handle.net/11599/1446

Day, R., Ker P., Mackintosh W., McGreal R., Stacey P., & Taylor J. (2011). Open education resources (OER) for assessment and credit for students project: Towards a logic model and plan for action. Technology Enhanced Knowledge Research Institute, Athabasca University. Retrieved from https://auspace.athabascau.ca/bitstream/handle/2149/3039/Report_OACS-FinalVersion.pdf

DuFeu, B. (1992, January). Pour une pedagogie ouverte (For an Open Pedagogy). *Francais dans le Monde, 246*, 39-45.

DeRosa, R. (2016). My open textbook: Pedagogy and practice. Retrieved from http://robinderosa.net/uncategorized/my-open-textbook-pedagogy-and-practice/

Ehlers, U.-D. (2011). Extending the territory: From open educational resources to open educational practices. *Journal of Open, Flexible, and Distance Learning*, *15*(2). Retrieved from http://www.jofdl.nz/index.php/JOFDL/article/view/64

Elliott, J. (1973). Is instruction outmoded? *Cambridge Journal of Education, 3*(3), 169-181. doi:10.1080/0305764730030305

Hattie, J. A. (2009). *Visible learning: A synthesis of over 800 meta analyses relating to achievement.* New York, NY: Routledge.

Hegarty, B. (2015). Attributes of open pedagogy: A model for using open educational resources. *Educational Technology, (July – August), 3 – 13.*

Hilton, J. (2016). Open educational resources and college textbook choices: a review of research on efficacy and perceptions. *Educational Technology Research and Development, 64*(4), 573-590. doi: https://doi.org/10.1007/s11423-016-9434-9

Hodgkinson-Williams , C., & Gray, E. (2009). Degrees of openness: The emergence of open educational resources at the University of Cape Town. *International Journal of Education and Development Using Information and Communication Technology*, *5*(5), 101-116.

Jhangiani, R. (2017) Why have students answer questions when they can write them? Retrieved from http://thatpsychprof.com/why-have-students-answer-questions-when-they-can-write-them/

Mai, R. P. (1978). Open education: From ideology to orthodoxy. *Peabody Journal of Education, 55*(3), 231-237. doi:10.1080/01619567809538192

Open Educational Quality Initiative. (2011). Beyond OER: Shifting the focus to open educational practices. *The 2011 OPAL Report.* Retrieved from http://duepublico.uni-duisburg-essen.de/servlets/DerivateServlet/Derivate-25907/OPALReport2011_Beyond_OER.pdf

Papert, S. (1991). Situating constructionism. In S. Papert & I. Harel (Eds.), *Constructionism* (pp. 1-11). New York, NY: Ablex Publishing. Retrieved from http://www.papert.org/articles/SituatingConstructionism.html

Pomerantz, J., & Peek, R. (2016). Fifty shades of open. *First Monday*, *21*(5). DOI: https://doi.org/10.5210/fm.v21i5.6360

Randall, D. L., Johnson, J. C., West, R.E., & Wiley, D.A. (2013). Teaching, doing and sharing project management: The development of an instructional design project management textbook. *Educational Technology*, *53*(6), 24-28.

Weller, M. (2013). The battle for open - a perspective. *Journal of Interactive Media in Education*, *2013*(3), Art. 15. doi: http://doi.org/10.5334/2013-15

Wiley, D. (2013). What is open pedagogy? Retrieved from https://opencontent.org/blog/archives/2975

Wiley, D. (n.d.). Defining the "open" in open content and open educational resources. Retrieved from http://opencontent.org/definition/

Wiley, D., Hilton, III, J., Ellington, S., & Hall, T. (2012). A preliminary examination of the cost savings and learning impacts of using open textbooks in middle and high school science classes. *International Review of Research in Open and Distance Learning, 13*(3), 262-276. Retrieved from http://www.irrodl.org/index.php/irrodl/article/view/1153/2256

Wiley, D., Webb, A., Weston, S., & Tonks, D. (2017). A preliminary exploration of the relationships between student-created OER, sustainability, and student success. *The International Review of Research in Open and Distributed Learning*, *18*(4).

doi:http://dx.doi.org/10.19173/irrodl.v18i4.3022

International **R**eview of **R**esearch in **O**pen and **D**istributed **L**earning
Volume 19, Number 4

September – 2018

A Framework for Implementing OER-Based Lesson Design Activities for Pre-Service Teachers

Dongho Kim
University of Florida

Abstract

The demand for qualified teachers with sufficient pedagogical knowledge and skills is high. However, existing teacher education programs do not provide adequate experiences through which to develop pre-service teachers' professional foundations. This study recognized Open Educational Resources (OER) as a means by which to address the issue of enhancing teacher education. The purpose of this study was to propose a framework to be used to integrate OER into lesson design activities for pre-service teachers. In this study, a focused literature review investigated the frameworks of distributed cognition and example-based learning. This review process resulted in a unified framework that provides a description of how pre-service teachers learn with OER at both the individual and cognitive system levels. Four principles and 10 guidelines are provided to guide the implementation of OER-based lesson design activities in real settings. The new framework has the potential to enhance pre-service teachers' Web resource-based professional development.

Keywords: open educational resources, lesson design, pre-service teacher education, example-based learning, distributed cognition

Introduction

A training period is critical for pre-service teachers because it is in that time that the largest influence occurs on their pedagogical knowledge and skills (Milner, 2010). Pre-service teachers acquire pedagogical knowledge and the related necessary skills to teach during a practicum or similar opportunity, such as a field observation (Liu, 2012). However, pre-service teachers assigned to schools for their training are exposed to limited practice while observing a few mentor teachers. As such, many beginning teachers often struggle to teach in real-life teaching situations (Blomberg, Stürmer, & Seidel, 2011).

One solution to the limitations of conventional pre-service teacher training is Web resource-based professional development. The forms of Web resource-based professional development range from formal online curricula offered by educational institutions to informal online learning, such as using online resources or participating in online teacher communities (Chen, Chen, & Tsai, 2009). Web resource-based training may also help pre-service teachers learn to receive just-in-time assistance and acquire situation-specific knowledge (Dede, Jass Ketelhut, Whitehouse, Breit, & McCloskey, 2008).

Open educational resources (OER), which are released under an open license that permits their free use or repurposing (Atkins, Brown, & Hammond, 2007), have the potential to support pre-service teachers' Web resource-based professional development. Permissions called 4Rs (i.e., Reuse, Revise, Remix, and Redistribute) differentiate OER from other types of resources and support the extensive use of OER (Wiley, Bliss, & McEwen, 2014). OER can serve as both learning and teaching resources because of their capacity to be freely adapted to new contexts under open licenses (Hassler, Hennessy, Knight, & Connolly, 2014). As pre-service teachers experience meaningful learning while discovering some form of intellectual property represented in OER, they can imagine how they might also adapt existing resources for their future students.

As the OER movement rapidly grows, more repositories dedicated to teachers (e.g., OER commons) are increasingly available. The dedicated repositories offer high quality materials for various purposes and serve as a community of educators. While structured OER (e.g., textbooks, complete courses) are often used "as-is" with little modification, unstructured OER (e.g., video clips, pictures) offer great flexibility for adaptive use.

This study noted the potential of OER for pre-service teachers' lesson design activity. The ability of OER to be adapted fits the nature of lesson design activities that involve creative processes, such as planning lessons and creating digital teaching materials. However, little research provides practical guidelines for integrating Web resources into lesson design activities.

The purpose of this study was to propose a framework by which to implement an OER-based lesson design activity that was based on two theories: The theory of distributed cognition and example-based learning. Both theories are concerned with the roles of external representations in enhancing cognitive processes of learners from different angles (Dyer et al., 2015; Zhang, 1997). This study recognized OER as external resources that represent existing teaching practices and noted the potential synergy of two distinct frameworks for providing an explanation as to how OER can support pre-service teachers' lesson design activities at both individual and cognitive system levels. The theory of distributed cognition serves as a lens through which to view OER as cognitive resources. The framework provides an insight into interactions between individuals (i.e., pre-service teachers) and cognitive resources (i.e., Web resources). Although the theory of distributed cognition is a useful framework through which to understand how cognitive resources amplify individual cognition at a cognitive system level, it falls short of explaining the internal learning mechanism. The example-based learning framework was thus employed to describe pre-service teachers' internal learning processes when learning from Web resources.

Method

Focused Literature Review

For this study, a focused literature review was conducted to find, analyze, and synthesize studies that addressed the frameworks of distributed cognition and example-based learning. Specifically, the following steps were taken. First, the theoretical frameworks of distributed cognition and example-based learning were investigated. Second, commonalities between these two theoretical frameworks were identified. Then, these commonalities were used as crucial connecting points for the construction of a novel unified framework. Following the construction of this new framework, principles and guidelines by which to implement this framework in practice were formed.

Initially, the sole author of this study undertook a search of 12 databases including ERIC, PsycINFO, and SocINDEX with Full Text using EBSCOHOST. An extensive search was used because the two theoretical frameworks had been addressed in multiple disciplines, such as education, sociology, anthropology, and informatics. The keywords searched were "example-based learning" and "distributed cognition(s)". To identify relevant studies on distributed cognition, either "technology" or "resource" were used as additional search terms. The search was limited to academic articles and books published between 1996 and 2016. The initial search resulted in 656 studies.

Criteria-Based Selection

In order to include only relevant studies, this study used some selection criteria. The author carefully examined the keywords, titles, and abstracts of the studies. The identified studies were finally included if they addressed the following topics within the two theoretical frameworks: learning with external resources or technology, knowledge acquisition, and/or knowledge transfer. The author excluded studies that did not address learning processes with resources or technology such as interface design research or usability test reports. As a result, 28 studies were identified to be relevant and used to examine the two theoretical frameworks.

Literature Review

Theory of Distributed Cognition

The theory of distributed cognition provides a framework through which to explain how thinking and learning take place in a cognitive system consisting of individuals and artifacts that have cognitive properties (Perkins, 1997). This concept assumes that learners' cognitions are distributed across human minds, artifacts, and groups of people as part of a larger cognitive system (Zhang & Patel, 2006). Cognitive processes are observed both inside and outside of human minds (Davies & Michaelian, 2016). Cognitive processing takes place when humans collectively use the distributed cognition that resides in external cognitive resources, such as other humans, symbolic media, the environment, and artifacts (Perkins, 1997). Individuals, with assistance of external resources can complete a cognitive task beyond their cognitive ability (Xu & Clarke, 2012; see Figure 1).

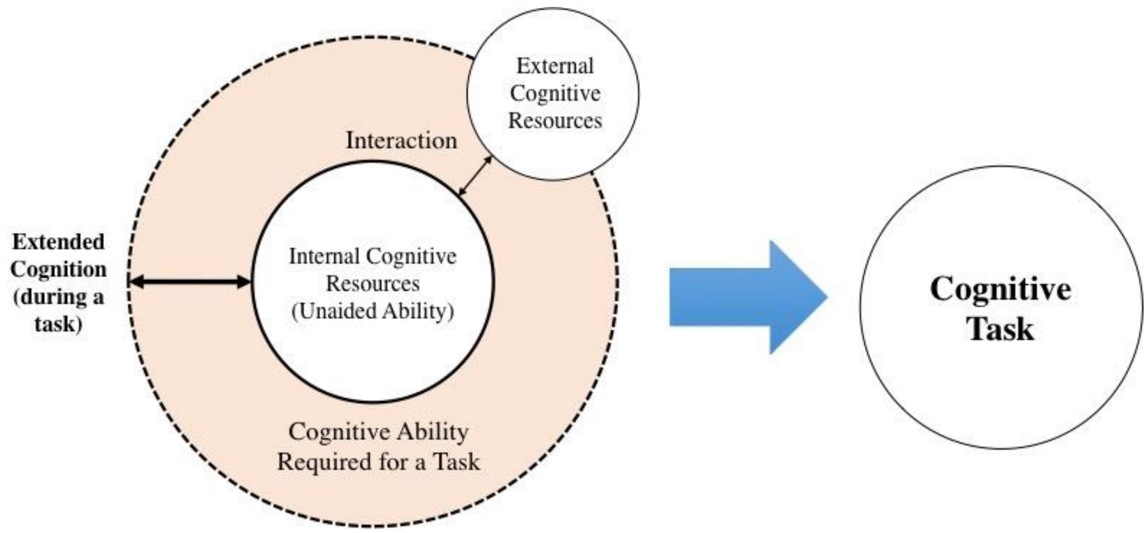


Figure 1. Theory of distributed cognition.

Distributed cognition researchers study a social system, while the traditional cognition researchers focus on individual cognitive processes (Morgan, Brickell, & Harper, 2008). As such, they pay attention to a collection of individuals, artifacts, and their interactions based on a comprehensive view that encompasses several research lines, such as sociology and cognitive science (Blandford & Furniss, 2006). According to distributed cognition theorists, the cognitive properties of a system cannot be fully understood from the cognitive properties of the individual components (Zhang & Patel, 2006). The distributed cognition approach is mainly concerned with the function of the cognitive system and seeks to understand how learners configure the environment to achieve a goal in the system (Xu & Clarke, 2012).

The theory of distributed cognition sheds light on individuals' extensions of cognition, which result from functional relationships among elements, including various forms of representations and physical tools, in a cognitive system (Xu & Clarke, 2012). The operations of cognitive systems can be described based on two main representational states: internal and external (Toon, 2014) . Internal representations are the cognitive resources (i.e., knowledge and structure) in individuals' minds, while external representations are the cognitive resources outside of the individuals (Morgan et al., 2008; Zhang & Norman, 1994). Cognition is viewed as the interaction between the individual and the surrounding representations involved in a cognitive activity (Morgan et al., 2008). Learners configure an environment in which they can use various types of external resources to accomplish a cognitive task (Xu & Clarke, 2012).

The notion of distributed cognition is distinctively characterized by its unique view of cognition as an information flow. Cognition flows across a variety of representations and individuals use cognitive properties as vehicles of thought to complete cognitive tasks (Perkins, 1997). The use of various types of external representations (e.g., diagrams, graphs) enhances access to essential knowledge as well as aids in information processing (Zhang, 1997). The completion of cognitive tasks is the result of "the interwoven processing of internal and external information that generates much of a person's intelligent behavior" (Zhang & Patel, 2006, p. 334). One individual, therefore, does not necessarily need to take on the entire extent of the cognitive task (Belland, 2011). Individuals, instead, engage in the coordination of distributed cognition to accomplish a cognitive task.

However, the extension of cognition does not necessarily imply a perpetual state of individual cognition (Perkins, 1997). Rather, the theory of distributed cognition poses that cognition is amplified during the use of a technology in a particular cognitive task (Davies & Michaelian, 2016). Meaningful learning requires learners to plan and organize behaviors to accomplish a cognitive task, and this process is referred to as executive functioning (Landry, Smith, & Swank, 2009). In the process, learners assume executive control that "supervises the selection, initiation, execution, and termination of each task" (Rubinstein, Meyer, & Evans, 2001, p. 763). In technology-supported learning environments, learners cede part of their executive function to external cognitive properties to overcome the lack of internal cognitive resources (Belland, 2011). Meaningful learning for transferable knowledge gain happens when learners gradually gain back their executive function as they gain mastery of a given task (Perkins, 1997).

The concept of transfer of executive function assumes that effective learning takes place when learners maintain their executive control "throughout the executive function of the system" (Belland, 2011, p. 584). Learners should, thus, be encouraged to independently select a path of action, explore accessible representations, and construct knowledge (Perkins, 1997). When accomplishing a given cognitive task, learners should actively engage in cognitive processing to situate relevant resources (Morgan et al., 2008). In computer-supported learning environments, independent problem solving is possible when learners are allowed to "make choices, explore consequences of options, and otherwise make decisions regarding strategies" (Belland, 2011, p. 584). In essence, during the different phases of learning, learners should remain as a cognitive agent (Landry et al., 2009).

Theory of Example-Based Learning

Example-based learning is an effective approach when students possess insufficient prior knowledge of a particular task (Atkinson, Derry, Renkl, & Wortham, 2000). For novice students, engaging in problem-solving without exposure to model examples is not an effective method (Van Gog & Rummel, 2010). The example-based learning framework encompasses three lines of research that focus on different types of examples: worked examples, modeling examples, and analogies. This study addressed worked examples and modeling examples because the analogical reasoning approach is largely dependent on whether an appropriate analogy is available (Holyoak, 2012).

According to Renkl (2014), despite varying applications of example-based learning that depend on example types or contexts, a consistent theme exists regarding phases of knowledge acquisition (see Figure 2). Firstly, in the observation and rule identification phases, learners observe relevant information from examples in order to identify abstract rules or principles (Renkl, 2014). They then engage in cognitive processing in order to coordinate the external information in accordance with the information retrieved from their schema, a step which involves high-level information processing such as reasoning or inference (Renkl, 2014). Finally, learners construct their schema by incorporating the new information (internalization), which is followed by the elaboration of the schema for later occasions (elaboration) (Renkl, 2014).

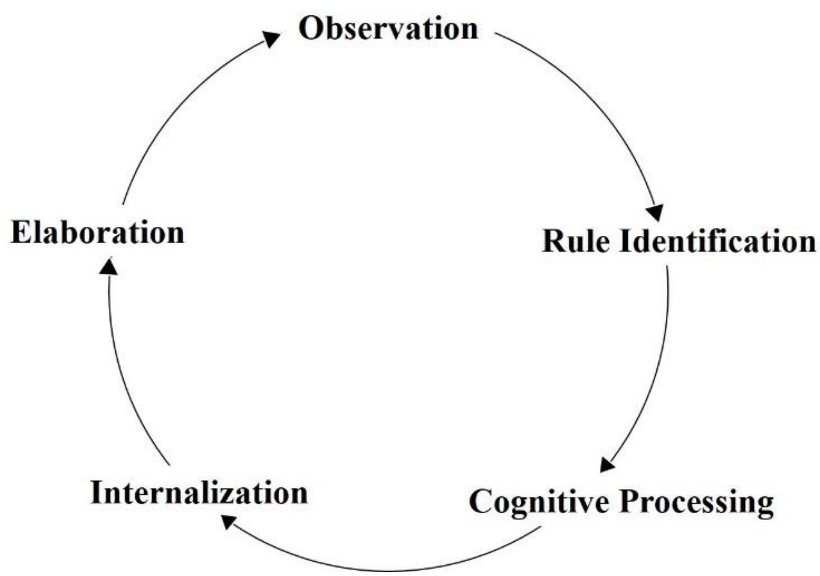


Figure 2. Learning process with examples.

Worked examples.

Worked examples allow learners to learn from a problem for which the solution is described (Crippen & Earl, 2007). Learners are, for example, presented key principles and steps that lead to a final solution in mathematics (Hilbert, Renkl, Schworm, Kessler, & Reiss, 2008). Worked examples are usually written accounts that show ideal or didactical procedures (Van Gog & Rummel, 2010).

Cognitive load theory provides an important theoretical foundation for the use of worked examples. Cognitive load is defined as "the load that performing a particular task imposes on the cognitive system" (Paas, Tuovinen, Tabbers, & Van Gerven, 2003, p.64). Novice learners often become overburdened when having to perform complex cognitive tasks without the initial understanding of the key principles (Sern, Salleh, Lisa Sulaiman, Mohamad, & Yunos, 2015). The lack of initial understanding may be problematic because novice learners' learning remain superficial due to limited working memory that otherwise could be dedicated to in-depth information processing (Van Gog & Rummel, 2010). Worked examples help learners focus on the important aspects of problems in order to avoid making mistakes or inefficiently studying to reach the intended solution (Dyer et al., 2015). The effects of worked examples are not limited to well-defined problems from particular domain subjects but also can be expanded to ill-defined problems in which learners are required to engage in critical decision-making or reasoning processes (Atkinson et al., 2000; Crippen & Earl, 2007; Dyer et al., 2015).

Modeling examples.

Modeling examples are generated using social models that perform particular tasks. A social model can use a real person, humanoid agent, or symbolic model. Modeling examples show various approaches by which to solve problems as opposed to worked examples that mostly show ideal procedures and solutions (Hoogerheide, Loyens, & van Gog, 2014). Coping models, for example, display erroneous performances and how to overcome them (Kitsantas, Zimmerman, & Cleary, 2000). Modeling examples entail the presence of social models and salient contextual information, such as social models' appearances or voices (Van Gog & Rummel, 2010). Models display cognitive patterns that learners need to perform and the demonstration encapsulates abstract representations of extensive domain knowledge and advanced skills (Angeli, 2005).

Observational learning with modeling examples relies on social sources in the beginning, while the shift to a self-learning phase occurs later in this process (Van Gog & Rummel, 2010). Schunk and Zimmerman (2007) highlighted the transitional process of observational learning from its social phases to its self-controlled phases. The shift to the self-controlled phase should happen as learners gradually internalize skills or strategies exhibited by social models (Bandura, 2001).

Using modeling examples contributes to the development of complex cognitive skills. Learners can acquire cognitive representations through observations in the form of schema (Morgan et al., 2008). Modeling examples help build cognitive schemas, which enable learners to use learned behaviors on later occasions (Van Gog & Rummel, 2010).

Modeling examples have been used in teacher education as a means to teach complex teaching skills (Ertmer, 2003). Pre-service teachers who studied expert modeling examples exhibited a more effective use of technologies in their lessons than did those pre-service teachers who created lessons without modeling examples (Angeli, 2005). Similarly, mentor teachers demonstrating technology integration in a science lesson led to pre-service teachers' integration of content knowledge into their lesson designs (Jang & Chen, 2010).

Consistent Themes in Distributed Cognition and Example-Based Learning Frameworks

While the distributed cognition perspective seeks to understand cognitive processes at a system level, example-based learning is concerned with learning processes at the individual level (see Table 1). It is logical that distributed cognition would be used to understand the interactions between an individual learner and

Web resources. On the other hand, the example-based learning framework explains the internal learning processes of the learner. Despite the different emphases used to explain cognitive processes, consistent themes underlie both theories that enables their integration into a unified framework.

First, the role of external representations is emphasized in regard to evoking cognitive processing. From the distributed cognition perspective, humans amplify their cognition by coordinating representational states using representational resources, such as media, device, and technologies (Belland, 2011). The example-based learning theory also focuses on how to incorporate relevant representations in examples to facilitate learners' cognitive processes. (Renkl, 2014; Van Gog & Rummel, 2010).

Second, both theories focus on increasing novice learners' cognitive capacities. The distributed cognition framework supports the notion that an individual learner, with the assistance of cognitive resources, is capable of solving complex problems that are beyond their abilities (Belland, 2011). The example-based learning framework describes two types of examples that contribute to reducing learners' unnecessary cognitive burdens. Worked examples are used to reduce learners' cognitive loads by directing their attention to the important aspects of a problem (Wittwer & Renkl, 2010). The modeling example also highlights the gradual internalization of the information exhibited by the social models.

Third, in-depth cognitive processing appears to be essential to constructing internal representations and transferring knowledge. From the distributed cognition perspective, cognitive processing plays a crucial role in helping learners coordinate cognition across internal minds and external representations (Zhang & Patel, 2006; Morgan et al., 2008). The example-based learning theory also supports the need for cognitive processing for transferable knowledge acquisition. For learning with worked or modeling examples to be transferred to solve other novel problems, information processing opportunities, in addition to a given example, should be provided (Van Gog & Rummel, 2010; Renkl, 2014).

Finally, both theories highlight the importance of the transition from reliance on external representations to self-control phases. The distributed cognition framework indicates that meaningful learning (i.e., the internalization of external resources) is observed when learners play a central role in the cognitive system (Perkins, 1997). Although learners rely on surrounds in early phases of a cognitive task to overcome their limited cognitive capacity, they gradually gain back their autonomy as they progress (Belland, 2011). Example-based learning research has also illustrated the transitional process of observational learning from social to self-regulated phases (Schunk & Zimmerman, 2007). After observing and emulating models' behaviors, a shift to the 'self-controlled phase' should happen, in which the learner incorporates the observed representations into their schema (Bandura, 2001).

Table 1

Consistent Themes in Distributed Cognition and Example-Based Learning Regarding Cognitive Processes

Cognitive processes		Consistent theme
Distributed cognition	Example-based learning	
Cognition is amplified through coordinating representational states of external tools	Examples facilitate learners' internal resources to facilitate cognitive processes	The importance of external representations for evoking cognitive processing
Novice learners, with the assistance of external cognitive resources, can solve problems beyond their ability	Examples help novice learners reduce unnecessary cognitive burdens	The importance of external representations for increasing cognitive capacity
In-depth cognitive processing helps learners coordinate internal and external resources	In-depth cognitive processing helps learners acquire transferable knowledge	The importance of in-depth cognitive processing
Meaningful learning takes place when learners gain back their autonomy	Meaningful learning takes place when learners successfully transition from the observation phase to the self-control phase	The importance of the transition from reliance on external representations to self-control phases

New Framework for OER-Based Lesson Design Activity

A number of OER repositories exist that offer high quality OER created by experienced teachers or experts (for more details, see Clements & Pawlowski, 2012). A majority of the licenses assigned to OER, unless otherwise prohibited (e.g., No Derivative Works), permit unlimited modification and adaption. A lesson design activity involving the manipulation of cognitive resources is expected to lead to the construction of the enhanced internal representations of pre-service teachers who initially have insufficient internal resources.

Figure 3 shows the new framework that integrates the distributed cognition and example-based frameworks. Pre-service teachers interact with external cognitive resources (OER) in order to accomplish design tasks. OER serve as both examples and design materials. The learning process reflects the same mechanism as in example-based learning. Pre-service teachers, in the early phases, observe examples by which to identify abstract rules of representation. They, then, increasingly internalize the representations through the adaptation of OER. Once the internalization process is completed in pre-service teachers' schema, their extended cognition outlasts the design task. Subsequent reflection and revision help them to refine their designs as well as elaborate their schema. As the lesson design process progresses, pre-service teachers gradually have executive control over their lesson designs. Pre-service teachers become independent of the inherent design or context of the original resources and focus on their own teaching contexts.

In summary, the lesson design activity with OER focuses on supporting pre-service teachers' transitions from observation to internalization. Pre-service teachers have the opportunity to integrate OER into their existing schema, while engaging with the design of a lesson.

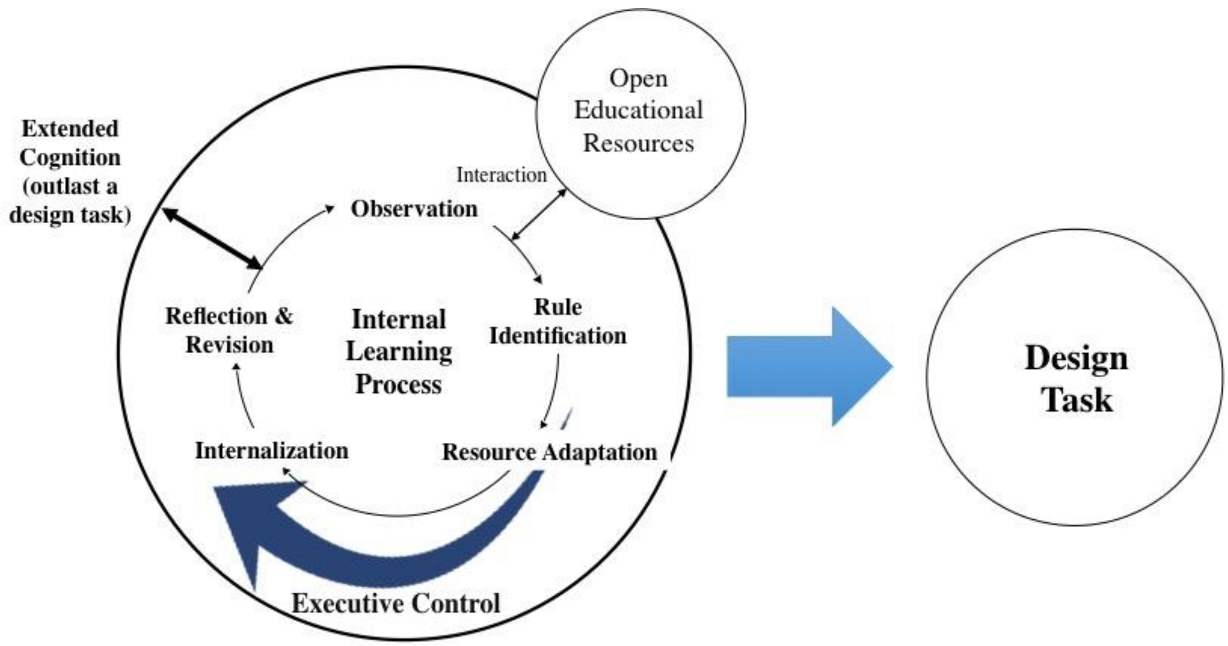


Figure 3. New framework for integrating OER into lesson design.

Principles and Guidelines for Implementation

Based on the proposed unified framework, four principles and guidelines for the implementation of an OER-based design activity are suggested (see Table 2). Corresponding lesson design phases were adapted from Angeli's (2005) model. This nine-phase model was chosen because it is specifically situated in teacher education contexts, and intended to guide pre-service teachers in designing a lesson using pedagogically appropriate technology. This study tailored the model to an OER-based lesson design activity and the following six steps are suggested: choosing a topic, observing teaching strategies, planning class activities, developing materials, evaluation, and revision.

Table 2

Principles and Guidelines for Implementation of OER-based Lesson Design Activity

Step	Lesson design phase	Principle & Guideline
Observation / Rule Identification	○ Choosing a topic ○ Observing teaching strategies	**Have pre-service teachers explorer oer that take different approaches to the same topics**
		• Encourage pre-service teachers to find OER that represent both worked (e.g., lesson plans) and modeling examples (e.g., classroom practice videos). • Encourage pre-service teachers to explorer OER that show a variety of pedagogical methods (e.g., collaborative learning, project-based learning). • Engage pre-service teachers in comparing identified OER in order to identify the critical features.
Resource Adaptation / / Executive Control / Internalization	○ Planning class activities ○ Developing materials	**Facilitate in-depth cognitive processing**
		• Have pre-service teachers come up with ideas to improve identified OER. • Have pre-service teachers revise and remix OER to their own lesson design contexts. • Encourage pre-service teachers not to replicate inherent designs of original resources for their lesson design.
		Allow pre-service teachers to have increasing autonomy over their lesson designs
		• Help pre-service teachers shift from observing structured OER (e.g., complete textbooks) to manipulating unstructured OER (e.g., micro content, learning objects). • Gradually remove guidance for OER use and lesson design.
Reflection / Revision	○ Evaluation ○ Revision	**Encourage peer interactions in order to improve lesson design outcomes**
		• Have pre-service teachers review and comment on their peers' design outcomes.

	• Have pre-service teachers reflect on and revise their lesson designs based on feedback from their peers.

Principle 1: Have Pre-Service Teachers Explorer OER That Take Different Approaches to the Same Topic

At the choosing a topic phase, pre-service teachers can benefit from exploring available materials as they learn from what topic other teachers chose and how the topic is taught in class. Observing teaching strategies used by other teachers help pre-service teachers discover important rules and principles for teaching. Being exposed to different pedagogical approaches also allows them to observe the consequences of implementing the approaches in classrooms, which is considered a form of observational learning. The exploratory observation would contribute to identifying what class activities pre-service teachers want to implement to teach the chosen topic effectively.

In Example-based learning, a first-schema abstraction does not necessarily transfer to other problem contexts (Renkl, 2014). The opportunity to compare multiple examples helps learners discover the critical aspects of a problem as well as gain deep insights into the content (Große & Renkl, 2006). Therefore, learners need to be exposed to different examples in order to understand the structural features of problems as well as avoid getting stuck on examples' surface features (Gerjets, Scheiter, & Schuh, 2008).

Using contrasting examples has received attention as a way by which to help novice learners "develop more differentiated knowledge structures" (Hilbert et al., 2008, p. 319). Learners tend to better concentrate on important underlying principles when they compare and contrast examples (Renkl, 2014). The mechanism is that learners become more capable of applying knowledge to widely different problems once they learn from many possible alternative solutions (Rittle-Johnson & Star, 2007).

It is also important to use a variety of examples for the acquisition of different skills (Renkl, 2014). Generally, worked examples are more suitable to teaching highly structured skills, such as calculation, because they present ideal solution procedures (Van Gog & Rummel, 2010). On the other hand, modeling examples often include irrelevant details or distracting information in order to represent realistic settings (Renkl, 2014). Therefore, modeling examples are suitable for directing learners' attention to complex situations.

Principle 2: Facilitate In-Depth Cognitive Processing

The main purpose of a lesson design activity is to prepare pre-service teachers for real-world teaching. A lesson design activity should, thus, support pre-service teachers' cognitive processes for knowledge construction (Doppelt & Schunn, 2008). Deep inquiry and reflection are required in order to enable pre-service teachers to construct transferable knowledge from design-based learning (Kolodner et al., 2003). Fortus, Dershimer, Krajcik, Marx, and Mamlok-Naaman (2004) identified the manipulation of information as a crucial design process that leads to knowledge construction in science.

At the planning class activities phase, pre-service teachers come up with ideas regarding how to transform representations they observed from OER into concrete activities that can be implemented in their classroom. OER are created in the local context of use, therefore they cannot be "simply transposed to a new setting" (Ponti, 2014, p. 155). There should be a process by which pre-service teachers internalize content. The developing materials phase is for pre-service teachers to deconstruct and recontextualize content represented in the OER (Littlejohn & Hood, 2017).

As previously described, the distributed cognition perspective stresses learners' engagement with cognitive processing as a method that leads to the construction of internal representations. It is important that the distributed cognition framework describes internal cognitive processing as being tightly coupled with the processing of external representations (Liu, Nersessian, & Stasko, 2008). To perform cognitive tasks, learners first need to process both the information provided by the external representations and the information retrieved from their internal representations (Zhang & Patel, 2006).

Previous research has provided theoretical and empirical evidence that cognitive processing contributes to knowledge construction. For example, Morgan et al. 2008 suggest that High-level processing of content should be undertaken in order to enable learners to gain an enhanced understanding of knowledge as well as produce more structured learning outcomes. Zhang and Patel (2006) recognized information processing as an essential activity by which to construct knowledge. Individuals can only generate intellectual outcomes through activities that help integrate perceived external representations and retrieve internal representations (Zhang & Patel, 2006). OER have inherent designs (Conole, McAndrew, & Dimitriadis, 2010; Ponti, 2014), and users are required to deconstruct and adapt the resources to their pedagogical patterns. Design activities involving the adaptive use of resources lead to an in-depth understanding of the content to be taught (Conole et al., 2010).

Principle 3: Allow Pre-Service Teachers to Have Increasing Autonomy Over Their Lesson Designs

Koehler and Mishra (2005) emphasized that participants of design activities should be the creators of knowledge rather than the consumers of it. Design involves learners' critical decisions in the process of creation as they undertake several iterative processes (e.g., exploring resources, revising solutions, reflecting on outcomes) to obtain satisfactory design outcomes (Doppelt & Schunn, 2008). A lesson design activity, in this regard, should give pre-service teachers autonomy over their design products.

The distributed cognition framework highlights the importance of a gradual increase in learner autonomy (Belland, 2011). Learners' autonomies in the distributed cognition framework imply that learners choose courses of actions and make autonomous decisions in order to define problems and devise solutions. Perkins (1997) argued that when learners rely on instructional guidance and tools, they do not get back their autonomy in the later phase of learning. The absence of transition to independent control over external resources engenders shallow learning if learners leave their executive control to external resources despite the completion of a target task. A transfer of responsibility can be achieved when learners maintain the executive control of given tasks (Belland, 2011). Allowing gradual increases in learner autonomy helps learners prepared for the transfer of learning.

The example-based learning approach also stresses the gradual shift to the self-regulated phase of learning. Learners rely on provided examples at the beginning of their learning, but increasingly internalize relevant principles and become ready to reproduce them in varying contexts (Schunk & Zimmerman, 2007). Example-based learning can, thus, be considered a form of scaffolding (Dyer et al., 2015). As outlined by Dyer et al., 2015, examples provide initial assistance in regard to understanding desirable solution steps. However, once the learners discover the important key principles from the examples, they can achieve "goals that would have been beyond their abilities without guidance" (Dyer et al., 2015, p. 2). The initial guidance should, thus, be gradually faded as learners progress toward the completion of their tasks.

Principle 4: Encourage Peer Interactions in Order to Improve Lesson Design Outcomes

In designing a lesson plan, the reflection phase is necessary to allow pre-service teachers develop a pedagogical rationale (Angeli, 2005). The revision phase that subsequently takes place leads to the refinement of lesson design as well as facilitates the design-based process (Angeli, 2005). Empirical evidence exists that shows that the mix of erroneous and correct models can be beneficial for learners when acquiring far transfer knowledge (Van Gog & Rummel, 2010). Peer models that pose familiar challenges to pre-service teachers can, thus, be good examples (Ryalls, Gul, & Ryalls, 2000). Peer models that correspond to the learners' levels of knowledge, in contrast, lead learners to "closer attention and deeper processing" (Renkl, 2014, p. 17).

The use of peer models has also been studied in the discipline of teacher education. Peer coaching, as a typical form of peer model-based learning, has been widely acknowledged as a method used to support teacher professional development (Ovens, 2004). Although not explicitly mentioned as example-based learning, peer coaching includes essential components of example-based learning, such as observations and the internalization of examples (Zhang, Liu, & Wang, 2016). Ovens (2004), for example, reported that peer coaching developed pre-service teachers' teaching techniques and promoted reflection on various instructional strategies. Peer coaching was revealed to provide a supportive context within which the pre-service teachers felt more accountable and committed (Ovens, 2004).

Peer coaching is more effective when learners engage in reflection and revision to improve their designs (Jenkins, Garn, & Jenkins, 2005). Design is not a linear process completed after producing one single design artifact (Hong & Choi, 2011). It is, rather, iterative processes that involve a series of activities in a cyclic manner (Hong & Choi, 2011). Teacher training is not an exception. Pre-service teachers can benefit from revising their designs based on reflection which occurs in the context of peer coaching. Jang and Chen (2010), for example, implemented peer coaching for the purpose of improving pre-service teachers' TPACK. The participants shared videotapes of their teaching and coached one another to learn how to integrate a new teaching method: an activity which prompted the pre-service teachers to reflect on how to revise their lessons (Jang & Chen, 2010). Similarly, Lee and Kim (2014) proposed an instructional design model that illustrates an iterative lesson design activity where pre-service teachers were required to review group members' video-recorded teaching videos and exchange ideas to improve their lessons. The lesson design activity involving peer coaching and subsequent revision improved their TPACK and lesson designs (Lee & Kim, 2014).

Conclusion

Given the potential advantages of Web resources for teacher professional development, teacher education institutes are urged to turn their attention to integrating OER into their curriculum (Cannell, Macintyre, & Hewitt, 2015; Sapire & Reed, 2011). Despite the growing recognition of potential advantages of OER, however, little is known about how to integrate OER into pre-service teacher training. Only few studies noted the potential of OER as a primary source for training pre-service teachers (Thakrar, Zinn, & Wolfenden, 2009). As indicated by Hassler et al. (2014), a majority of past research has not focused on teaching and learning mechanisms that need to be carefully examined in order to enact OER in practice. As a result, discrepancies exist between a growing interest in OER as a rising phenomenon and their applications in teacher education settings (Brent, Gibbs, & Gruszczynska, 2012). The significance of the proposed framework can be summarized as follows.

First, the unified framework overcomes what each of the two theoretical frameworks lacks in order to explain the students' learning with OER. The new framework provides a comprehensive description of how the students should interact with OER and what type of learning takes place. As discussed earlier, the theory of distributed cognition only provides a partial description of the students' internal learning processes. On the other hand, the theory of example-based learning lacks ideas on the entire cognitive system in resource-enriched learning contexts. The new framework provides insights into how lesson design activities with OER can lead pre-service teachers to interact with distributed knowledge as well as engage in sustainable professional development.

Second, practitioners would benefit from the flexibility of the proposed framework and guidelines. Pre-service teachers with different interests and levels of knowledge sit in the same classroom. OER-based training would allow pre-service teachers to design their lessons at their own paces. Therefore, teacher educators can provide individualized support in response to the pre-service teachers' personal needs and challenges. Teacher education programs are often required to offer classes on interdisciplinary topics (e.g., Lee & Kim, 2014). The use of OER has the potential to satisfy the various needs of pre-service teachers from diverse disciplines.

Furthermore, the possibility exists that the proposed framework and guidelines could be used for various groups, such as beginning teachers. Beginning teachers are known to feel the need for professional development as they are not often fully prepared for uncertain situations in practice (Avalos, 2011; Ulvik, Smith, & Helleve, 2009). Using OER for their own purposes would help them acquire new skills as well as refine the knowledge that they acquired during their studies.

References

Angeli, C. (2005). Transforming a teacher education method course through technology: Effects on preservice teachers' technology competency. *Computers & Education, 45*(4), 383–398.

Atkinson, R. K., Derry, S. J., Renkl, A., & Wortham, D. (2000). Learning from examples: Instructional principles from the worked examples research. *Review of Educational Research, 70*(2), 181–214.

Avalos, B. (2011). Teacher professional development in teaching and teacher education over ten years. *Teaching and Teacher Education, 27*(1), 10–20.

Bandura, A. (1986). *Social foundations of thought and action: A social cognitive theory*. Englewood Cliffs, NJ: Prentice Hall.

Bandura, A. (2001). Social cognitive theory of mass communication. *Media Psychology, 3*(3), 265–299.

Belland, B. R. (2011). Distributed cognition as a lens to understand the effects of scaffolds: The role of transfer of responsibility. *Educational Psychology Review, 23*(4), 577–600.

Blandford, A., & Furniss, D. (2006). DiCoT: A methodology for applying distributed cognition to the design of teamworking systems. In S. W. Gilroy & M. D. Harrison (Eds.), *Interactive systems. Design, specification, and verification* (pp. 26–38). Berlin Heidelberg: Springer-Verlag.

Blomberg, G., Stürmer, K., & Seidel, T. (2011). How pre-service teachers observe teaching on video: Effects of viewers' teaching subjects and the subject of the video. *Teaching and Teacher Education, 27*(7), 1131–1140.

Brent, I., Gibbs, G., & Gruszczynska, A. (2012). Obstacles to creating and finding open educational resources: The case of research methods in the social sciences. *Journal of Interactive Media in Education, 2012*(1). Retrieved from http://jime.ubiquitypress.com/articles/10.5334/2012-05/

Cannell, P., Macintyre, R., & Hewitt, L. (2015). Widening access and OER: Developing new practice. *Widening Participation and Lifelong Learning, 17*(1), 64–72.

Chen, Y., Chen, N.-S., & Tsai, C.-C. (2009). The use of online synchronous discussion for -based professional development for teachers. *Computers & Education, 53*(4), 1155–1166.

Clements, K. I., & Pawlowski, J. M. (2012). User-oriented quality for OER: Understanding teachers' views on re-use, quality, and trust. *Journal of Computer Assisted Learning, 28*(1), 4–14.

Conole, G., McAndrew, P., & Dimitriadis, Y. (2010). The role of CSCL pedagogical patterns as mediating artefacts for repurposing open educational resources. In P. Pozzi & D. Persico, *Techniques for fostering collaboration in online learning communities: Theoretical and practical perspectives* (pp. 206–223). Hershey, PA: IGI Global.

Crippen, K. J., & Earl, B. L. (2007). The impact of Web-based worked examples and self-explanation on performance, problem solving, and self-efficacy. *Computers & Education, 49*(3), 809–821.

Davies, J., & Michaelian, K. (2016). Identifying and individuating cognitive systems: A task-based distributed cognition alternative to agent-based extended cognition. *Cognitive Processing, 17*(3), 307–319. https://doi.org/10.1007/s10339-016-0759-4

Dede, C., Jass Ketelhut, D., Whitehouse, P., Breit, L., & McCloskey, E. M. (2008). A research agenda for online teacher professional development. *Journal of Teacher Education, 60*(1), 8–19. https://doi.org/10.1177/0022487108327554

Doppelt, Y., & Schunn, C. D. (2008). Identifying students' perceptions of the important classroom features affecting learning aspects of a design-based learning environment. *Learning Environments Research, 11*(3), 195–209.

Dyer, J.-O., Hudon, A., Montpetit-Tourangeau, K., Charlin, B., Mamede, S., & van Gog, T. (2015). Example-based learning: comparing the effects of additionally providing three different integrative learning activities on physiotherapy intervention knowledge. *BMC Medical Education, 15*(1). Retrieved from https://bmcmededuc.biomedcentral.com/articles/10.1186/s12909-015-0308-3

Ertmer, P. (2003). Transforming teacher education: Visions and strategies. *Educational Technology Research and Development, 51*(1), 124–128.

Fortus, D., Dershimer, R. C., Krajcik, J., Marx, R. W., & Mamlok-Naaman, R. (2004). Design-based science and student learning. *Journal of Research in Science Teaching, 41*(10), 1081–1110.

Gerjets, P., Scheiter, K., & Schuh, J. (2008). Information comparisons in example-based hypermedia environments: Supporting learners with processing prompts and an interactive comparison tool. *Educational Technology Research and Development, 56*(1), 73–92.

Große, C. S., & Renkl, A. (2006). Effects of multiple solution methods in mathematics learning. *Learning and Instruction, 16*(2), 122–138.

Hassler, B., Hennessy, S., Knight, S., & Connolly, T. (2014). Developing an open resource bank for interactive teaching of STEM: Perspectives of school teachers and teacher educators. *Journal of Interactive Media in Education, 2014*(1). https://doi.org/http://doi.org/10.5334/2014-09

Hilbert, T. S., Renkl, A., Schworm, S., Kessler, S., & Reiss, K. (2008). Learning to teach with worked-out examples: a computer-based learning environment for teachers. *Journal of Computer Assisted Learning, 24(*4), 316–332. https://doi.org/10.1111/j.1365-2729.2007.00266.x

Holyoak, K. J. (2012). Analogy and relational reasoning. *The Oxford Handbook of Thinking and Reasoning*, 234–259.

Hong, Y.-C., & Choi, I. (2011). Three dimensions of reflective thinking in solving design problems: a conceptual model. *Educational Technology Research and Development, 59*(5), 687–710.

Hoogerheide, V., Loyens, S. M., & van Gog, T. (2014). Effects of creating video-based modeling examples on learning and transfer. *Learning and Instruction*, *33*, 108-119.

Jang, S.-J., & Chen, K.-C. (2010). From PCK to TPACK: Developing a transformative model for pre-service science teachers. *Journal of Science Education and Technology, 19(*6), 553–564.

Jenkins, J. M., Garn, A., & Jenkins, P. (2005). Preservice teacher observations in peer coaching. *Journal of Teaching in Physical Education*, *24*(1), 2-23.

Kitsantas, A., Zimmerman, B. J., & Cleary, T. (2000). The role of observation and emulation in the development of athletic self-regulation. *Journal of Educational Psychology, 92*(4), 811–817.

Koehler, M. J., & Mishra, P. (2005). Teachers learning technology by design. *Journal of Computing in Teacher Education, 21*(3), 94–102.

Kolodner, J. L., Camp, P. J., Crismond, D., Fasse, B., Gray, J., Holbrook, J. ... Ryan, M. (2003). Problem-based learning meets case-based reasoning in the middle-school science classroom: Putting Learning by Design(tm) into practice. *Journal of the Learning Sciences, 12*(4), 495–547.

Landry, S. H., Smith, K. E., & Swank, P. R. (2009). New directions in evaluating social problem solving in childhood: Early precursors and links to adolescent social competence. *New Directions for Child and Adolescent Development, 123*, 51–68.

Lee, C.-J., & Kim, C. (2014). An implementation study of a TPACK-based instructional design model in a technology integration course. *Educational Technology Research and Development, 62*(4), 437–460. https://doi.org/10.1007/s11423-014-9335-8

Littlejohn, A., & Hood, N. (2017). How educators build knowledge and expand their practice: The case of open education resources. *British Journal of Educational Technology, 48*(2), 499–510. https://doi.org/10.1111/bjet.12438

Liu, S.-H. (2012). A multivariate model of factors influencing technology use by preservice teachers during practice teaching. *Journal of Educational Technology & Society, 15*(4), 137–149.

Liu, Z., Nersessian, N. J., & Stasko, J. T. (2008). Distributed cognition as a theoretical framework for information visualization. *Visualization and Computer Graphics, 14*(6), 1173–1180.

Milner, H. R. (2010). What does teacher education have to do with teaching? Implications for diversity studies. *Journal of Teacher Education, 61*(1-2), 118–131.

Morgan, M., Brickell, G., & Harper, B. (2008). Applying distributed cognition theory to the redesign of the "Copy and Paste" function in order to promote appropriate learning outcomes. *Computers & Education, 50*(1), 125–147.

Ovens, A. (2004). Using peer coaching and action research to structure the practicum: An analysis of student teacher perceptions. *New Zealand Physical Educator, 37*(1), 45–60.

Paas, F., Tuovinen, J. E., Tabbers, H., & Van Gerven, P. W. (2003). Cognitive load measurement as a means to advance cognitive load theory. *Educational Psychologist, 38*(1), 63–71.

Perkins, D. N. (1997). Person-plus: A distributed view of thinking and learning. In G. Salomon (Ed.), *Distributed cognitions: Psychological and educational considerations*. Cambridge University Press.

Ponti, M. (2014). Self-directed learning and guidance in non-formal open courses. *Learning, Media and Technology, 39*(2), 154–168.

Renkl, A. (2014). Toward an instructionally oriented theory of example-based learning. *Cognitive Science, 38*(1), 1–37. https://doi.org/10.1111/cogs.12086

Rittle-Johnson, B., & Star, J. R. (2007). Does comparing solution methods facilitate conceptual and procedural knowledge? An experimental study on learning to solve equations. *Journal of Educational Psychology, 99*(3), 561–574.

Rubinstein, J. S., Meyer, D. E., & Evans, J. E. (2001). Executive control of cognitive processes in task switching. *Journal of Experimental Psychology: Human Perception and Performance, 27*(4), 763–797.

Ryalls, B. O., Gul, R. E., & Ryalls, K. R. (2000). Infant imitation of peer and adult models: Evidence for a peer model advantage. *Merrill-Palmer Quarterly, 46*(1), 188–202.

Sapire, I., & Reed, Y. (2011). Collaborative design and use of open educational resources: A case study of a mathematics teacher education project in South Africa. *Distance Education, 32*(2), 195–211.

Schunk, D. H., & Zimmerman, B. J. (2007). Influencing children's self-efficacy and self-regulation of reading and writing through modeling. *Reading & Writing Quarterly, 23*(1), 7–25.

Sern, L. C., Salleh, K. M., Lisa Sulaiman, N., Mohamad, M. M., & Yunos, J. M. (2015). Comparison of example-based learning and problem-based learning in engineering domain. *Universal Journal of Educational Research, 3*(1), 39–45.

Thakrar, J., Wolfenden, F., & Zinn, D. (2009). Harnessing open educational resources to the challenges of teacher education in Sub-Saharan Africa. *The International Review of Research in Open and Distributed Learning, 10*(4). Retrieved from http://www.irrodl.org/index.php/irrodl/article/viewArticle/705/1319

Toon, A. (2014). Friends at last? Distributed cognition and the cognitive/social divide. *Philosophical Psychology*, *27*(1), 112-125.

Ulvik, M., Smith, K., & Helleve, I. (2009). Novice in secondary school – the coin has two sides. *Teaching and Teacher Education, 25*(6), 835–842. https://doi.org/10.1016/j.tate.2009.01.003

Van Gog, T., & Rummel, N. (2010). Example-based learning: Integrating cognitive and social-cognitive research perspectives. *Educational Psychology Review, 22*(2), 155–174. https://doi.org/10.1007/s10648-010-9134-7

Wiley, D., Bliss, T. J., & McEwen, M. (2014). Open Educational Resources: a review of the literature. In J. M. Spector, M. D. Merrill, J. Elen, & M. J. Bishop (Eds.), *Handbook of research on educational communications and technology* (pp. 781–789). Springer.

Wittwer, J., & Renkl, A. (2010). How effective are instructional explanations in example-based learning? A meta-analytic review. *Educational Psychology Review, 22*(4), 393–409.

Xu, L., & Clarke, D. (2012). What does distributed cognition tell us about student learning of science? *Research in Science Education, 42*(3), 491–510.

Zhang, J. (1997). The nature of external representations in problem solving. *Cognitive Science, 21*(2), 179–217.

Zhang, J., & Norman, D. A. (1994). Representations in distributed cognitive tasks. *Cognitive Science, 18*(1), 87–122.

Zhang, J., & Patel, V. L. (2006). Distributed cognition, representation, and affordance. *Pragmatics & Cognition, 14*(2), 333–341.

Zhang, S., Liu, Q., & Wang, Q. (2016). A study of peer coaching in teachers' online professional learning communities. *Universal Access in the Information Society, 15*(58), 1–11. https://doi.org/10.1007/s10209-016-0461-4

Appendix A

Descriptions of Literature Reviewed in This Study

Author (Alphabetical order)	Topic	Country	Research type
Atkinson et al. (2000)	A framework for designing effective instruction with worked examples	United States	Conceptual
Bandura (2001)	Social cognitive theory and symbolic communications between human and media	United States	Conceptual
Belland (2011)	Distributed cognition as a lens to understand the effects of scaffolds	United States	Conceptual
Conole et al. (2010)	Cultural historical activity theory and computer-supported collaborative learning enhanced by existing good practices	United Kingdom	Empirical
Crippen and Earl (2007)	The Impact of Web-based worked examples and self-explanation on students' performance, problem solving, and self-efficacy	United States	Empirical
Davies and Michaelian (2016)	Agent-based extended cognition to individuate cognitive systems in performing cognitive tasks	Canada	Conceptual
Dyer et al., 2015	Enhancing the effects of worked examples by using completion examples, self-explanation, and concept mapping	Canada	Empirical
Große and Renkl (2006)	Effects of presenting multiple worked-out examples on mathematics learning	Germany	Empirical
Hilbert et al. (2008)	Preparing mathematics and science teachers for teaching with worked-out examples	Germany	Empirical
Holyoak (2012)	Role of analogy as a key example of relational reasoning	United Kingdom	Conceptual
Kitsantas et al. (2000)	Effects of modeling and social feedback on the development of athletic self-regulatory processes	United States	Empirical
Landry et al. (2009)	Social problem solving to help school-age children develop executive functioning and social skills	United States	Empirical
Liu et al. (2008)	Use of visual representations as a means of amplifying cognition	United States	Conceptual

Morgan et al. (2008)	Use of 'Copy and Paste' function to enhance learners' cognitive functioning and its impact on learner-computer interaction in a computer-supported writing context	Australia	Empirical
Ovens (2004)	Effects of peer coaching and action research on pre-service teachers' teaching skills	New Zealand	Empirical
Paas et al. (2003)	The combination of performance and cognitive load measures for reliable estimate of the mental efficiency	Netherlands	Conceptual
Perkins (1997)	The distribution of thinking and learning through the use of tools	Israel	Conceptual
Renkl (2014)	Individual differences in learning from worked-out examples	Germany	Empirical
Rittle-Johnson and Star, 2007)	Effects of comparing solution methods to facilitate conceptual and procedural knowledge	United States	Empirical
Rubinstein et al. (2001)	The role of executive control in performing multiple tasks	United States	Empirical
Schunk and Zimmerman (2007)	The impact of modeling on children's self-efficacy and self-regulated of reading and writing	United States	Empirical
Sern et al. (2015)	Effects of example-based learning on student learning in comparison of problem-based learning in an engineering class	Malaysia	Empirical
Van Gog and Rummel (2010)	Worked examples and modeling as types of example-based learning	Netherlands	Conceptual
Xu and Clarke (2012)	Investigating students' interaction and achievement through the lens of distributed cognition in a science classroom	Australia	Empirical
Wittwer and Renkl (2010)	Instructional explanations to support example-based learning	Germany	Conceptual

Zhang (1997)	The role of external representations in problem solving	United States	Empirical
Zhang et al. (2016)	Effects of peer coaching on teacher professional development	China	Empirical
Zhang and Patel (2006)	Affordances as distributed representations in a cognitive system	United States	Conceptual

International **R**eview of **R**esearch in **O**pen and **D**istributed **L**earning
Volume 19, Number 4

September – 2018

Critical Factors of the Adoption of e-Textbooks: A Comparison Between Experienced and Inexperienced Users

Wei-Hsi Hung[1], Pei-Hsuan Hsieh[2], and Yao-De Huang[3]
[1]National Chengchi University, Taiwan, R.O.C., [2]National Cheng Kung University, Taiwan, R.O.C., [3]National Chung Cheng University, Taiwan, R.O.C.

Abstract

The use of e-textbooks has become popular in certain countries, yet there is debate in the literature about whether it is advantageous to adopt e-textbooks and if they positively influence students' learning and performance. Prior studies on the acceptance of e-textbooks were mainly based on one theoretical perspective, and did not differentiate samples between experienced and inexperienced users. From a social- and task-related view, this study aims to identify the critical factors that stimulate acceptance intentions of e-textbooks among tertiary students, particularly between experienced and inexperienced users. Based on 912 questionnaires, this study found that performance expectancy, perceived enjoyment, and perceived task-technology fit are the factors affecting students' behavioral intention for acceptance in both sampling groups. However, social impact only has significant influence on acceptance intention of inexperienced users. Also, gender has a moderating effect on the relationship of performance expectancy and behavioral intention of inexperienced users only. This study provides useful implications for marketing e-textbooks, and fills the literature gap.

Keywords: e-textbooks, technology acceptance, perceived task-technology fit, higher education, perceived cost

Introduction

E-textbooks are defined as the digital content which is developed for teaching and learning purposes in higher education, and which can be read from various types of electronic devices (e.g., laptops and electronic readers). E-textbooks are different from e-books, because they are used for studying a subject that is usually part of a course. There is debate in the literature about whether it is advantageous to adopt e-textbooks and if they positively influence students' learning performance (Baker, Al-Gahtani, & Hubona, 2010; Dennis, Abaci, Morrone, Plaskoff, & McNamara, 2016; Fischer, Hilton, Robinson, & Wiley, 2015). Many students find e-textbooks difficult to access and navigate. Also, working on an Internet-enabled device can add potential distractions, such as checking instant messages and visiting non-study related websites. These reasons may explain why the adoption of e-textbooks is still in beginning stages in some countries, although the technology is not a barrier to use e-textbooks. Most of the studies which have investigated students' perceptions of using e-textbooks only implied experiments to determine willingness to replace traditional paper books with e-textbooks (Woody, Daniel, & Baker, 2010). The literature lacks of research that can explain the acceptance of e-textbooks from the social and task perspectives.

In order to fill this gap, this study aims to identify critical factors that affect user acceptance and utilization of e-textbooks from both social and task perspectives. In terms of social perspective, this study adopts Venkatesh, Morris, Davis, and Davis' (2003) unified theory of acceptance and use of technology (UTAUT) to identify key factors of adopting e-textbooks. The UTAUT integrates various models of technology acceptance that consider both gender and user experience as significant moderating factors for their intention to adopt new technologies. However, the results regarding the moderating effect of gender are, apparently, unstable among the various studies which have been conducted in different contexts. Accordingly, the causal relationship between gender and user experience needs further testing, particularly concerning the user acceptance of e-textbooks.

In terms of task perspective, this study adopts the perceived task-technology fit (PTTF) concept to study the fit among individuals' feelings, the technology itself, and task requirements. Marcolin, Compeau, Munro, and Huff (2000) incorporated individual characteristics into a task-technology fit (TTF) model (Goodhue & Thompson, 1995), because an individual's perception is critical in utilizing the technology and performing tasks, and so influences an individual's perception of fit. In order to achieve the research objectives, a model based on combining the factors in the UTAUT and PTTF models is proposed for testing, in conjunction with two moderating factors, that is gender and experience. A survey of tertiary (college and university) students in Taiwan was conducted to verify the proposed model.

Literature Review

Adoption of e-Textbooks

The topic of e-books has been studied frequently in recent years. Yet, research on the acceptance of e-textbooks has received less attention, relatively. Most of the studies are from education-related journals, in which the technology acceptance model is considered the favorite theoretical model. Perceived ease of use and perceived usefulness are significant factors influencing users' acceptance (Al-Ali & Ahmed, 2015; Gu, Wu, & Xu, 2015; Hsiao, Tang, & Lin, 2015; Johnston, Berg, Pillon, & Williams, 2015; Ngafeeson & Sun, 2015; Stone & Baker-Eveleth, 2013). The review of the literature shows that more attention should be paid to students' perceptions of e-textbook acceptance from a more diversified view, particularly from the social perspective, in order to better explain the adoption of such technology.

Unified Theory of Acceptance and Use of Technology

Venkatesh et al. (2003) proposed a model, the UTAUT that integrates eight prior models into its theoretical basis to better explain the acceptance of information systems or technologies. The model contains four main dimensions, namely performance expectancy (PE), effort expectancy (EE), social influence (SI), and facilitating conditions (FC), which are further subject to the moderating effects from gender, age, experience, and voluntary use. Venkatesh et al. (2003) claimed that the UTAUT can explain more than 70% of the intentions for using different technologies, and that the theory represents a more extensive and complete model for acceptance research. The UTAUT has gained increased attention from researchers recently (e.g., Isa & Wong, 2015; Kaba & Touré, 2014; Kohnke, Cole, & Bush, 2014). Venkatesh, Thong, and Xu (2012) have extended the UTAUT by adding hedonic, habit, and price value factors, which is occasionally named UTAUT2. However, habit is not suitable. Moreover, utilizing e-textbooks, on the other hand, is more likely for achieving learning tasks in the classroom, rather than for amusement purpose. Thus, this study chose the original UTAUT model, rather than UTAUT2, for the basis of research model.

Perceived Task-Technology Fit Theory

Goodhue and Thompson (1995), based on Vessey's (1991) cognitive fit model, proposed the TTF theory to explain the best fit between information technology (IT) and personal tasks. The TTF theory includes five variables: Technology characteristics, task characteristics, individual performance, TTF, and system utilization. Marcolin et al. (2000) linked personal characteristics with TTF, and argued that individuals' characteristics and perceptions are necessary elements for measuring TTF. Thus, the PTTF is suitable for determining the relationships between attitudes toward the technological abilities and task requirements, as well as user capabilities (Kuo, 2011; Shin, Chung, Hart, Joun, & Koo, 2015).

Unified Theory of Acceptance and Use of Technology, and Perceived Task-Technology Fit Theory

While the UTAUT arguably has broader coverage, the model fails to account for the nature of tasks that the TTF theory explains. Recently, Gerhart, Peak, and Prybutok (2015) also suggested a positive fit exists between the UTAUT and TTF models. Accordingly, the integration of the UTAUT and TTF for developing an alternative model seems appropriate for studying technology acceptance. In recent years, several studies have adopted the concepts of both the UTAUT and TTF in researching models to investigate the factors that impact user intentions to adopt customer relationship management, mobile banking, and mobile search (e.g., Pai & Tu, 2011; Zhou, Lu, & Wang, 2010). To date, several studies have combined the

UTAUT and TTF in their models. Since an integrated approach with these two models can overcome their respective shortcomings, this study followed this tendency to clarify tertiary students' intentions toward using e-textbooks. Based on the literature, the antecedents which impact the acceptance intentions should be chosen purposely for the researches in various technologies and various contexts.

Methodology

The Research Model

This research proposes a model to further explore user intentions, based on the theoretical models including the UTAUT and TTF (see Figure 1). The factor, age, was in the UTAUT model, but it is excluded here because the students in tertiary level have limited variance in age.

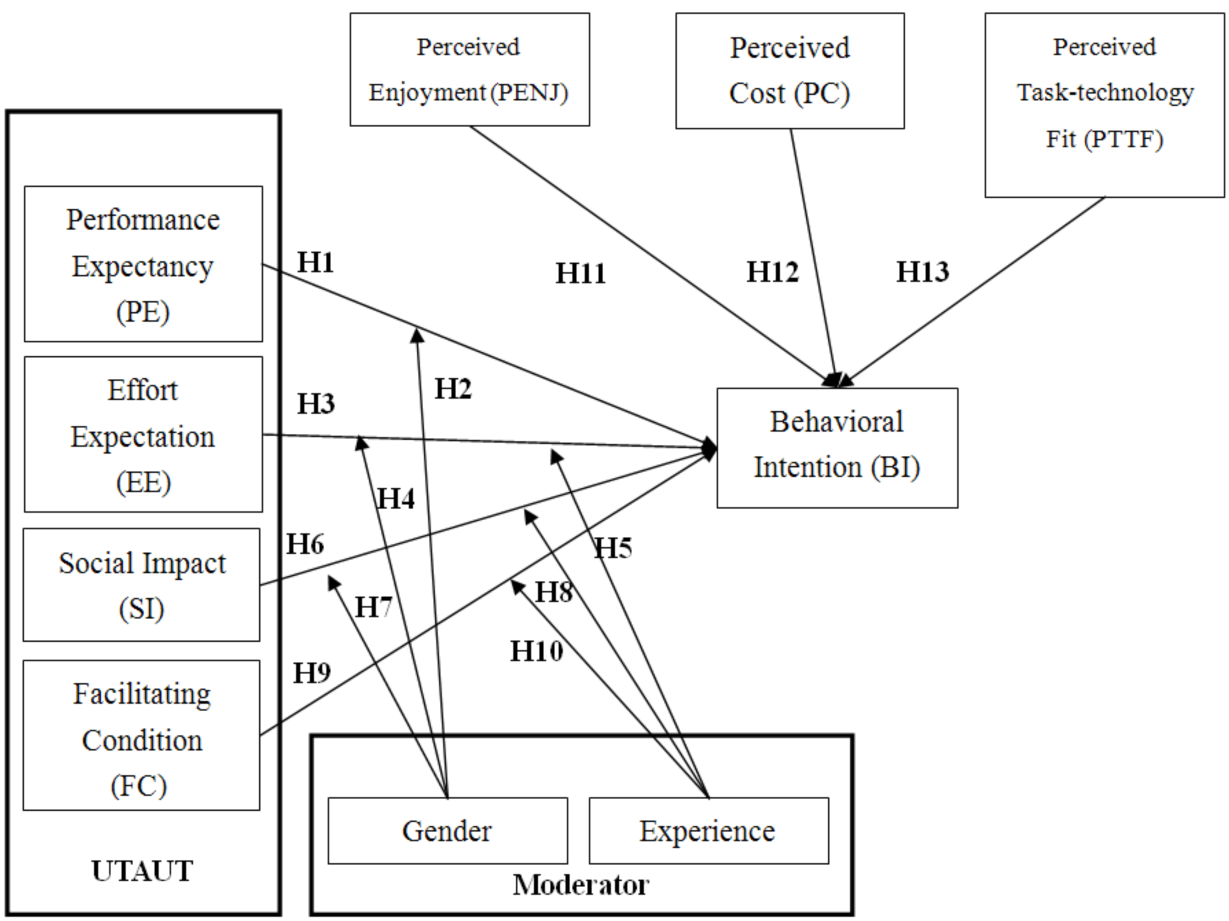


Figure 1. The research model.

PE is one of the most influential antecedents of intention to use IT (Venkatesh et al., 2003). Numerous studies have also identified that using IT can enhance high performance and create positive feelings (Bruner & Kumar, 2005; Moon & Kim, 2001; Venkatesh et al., 2003). E-textbooks can facilitate learning by offering keyword search functions, and dividing contents into sections, such as interactive maps and charts, to improve students' retention and learning performance (Maynard & Cheyne, 2005; Young, 2001). Previous studies showed that gender can serve as a moderating variable affecting expectancy and acceptance intention (e.g., Venkatesh et al., 2003; Venkatesh & Morris, 2000), whereby gender affects the impact of PE on intention in computer-oriented environments, especially for males. Accordingly, this study proposes the following two hypotheses:

> H1: PE has significant and positive effects on tertiary students' behavioral intentions (BIs) for using e-textbooks.

> H2: The moderating variable, gender, affects PE of tertiary students' BIs for using e-textbooks.

Prior studies indicated that EE was a strong determent for personal intentions (Venkatesh & Morris, 2000; Venkatesh, Morris, & Ackerman, 2000), with this factor having been discussed frequently at the early stage of new-technology acceptance, such as for smart devices (Davis, 1989; Venkatesh & Davis, 2000; Szajna, 1996). Past studies indicated that students' preferences and interactions with textbooks were associated with previous experiences (Clough, Jones, McAndrew, & Scanlon, 2008). Thus, prior experience can enhance the acceptance of new technology, while reducing the anxiety and difficulties of adoption (Clough et al., 2008). Venkatesh et al. (2003) suggested that, in addition to experience, gender can also affect the impact of EE on intention. Furthermore, this effect is more apparent with women, particularly when they lack technological experience. Adding to this, Gurung and Daniel's (2005) study on e-books also found that the adoption process would proceed more smoothly when a user had relevant experience. Thus, the following hypotheses are proposed:

> H3: EE has a significant and positive effect on tertiary students' BI for using e-textbooks.

> H4: The moderating variable, gender, influences EE of tertiary students' BI for using e-textbooks.

> H5: The moderating variable, experience, influences EE of tertiary students' BI for using e-textbooks.

In the scenario where the UTAUT model is applied for, the participants were all in the same social circle (Venkatesh et al., 2003), which means that peers and social groups can influence user adoption of certain technologies, such as e-textbooks and mobile phones. Since users of technologies are in the same social environment, others within that group can be a source of influence. While this aspect is likely to affect e-textbooks' users, they may belong to more than one social circle. For example, students interact with each other in the class, but they may interact with their family members or friends outside of school. Previous studies suggested that users are most influenced by those closest to them (Agarwal & Prasad, 1997; Karahanna, Straub, & Chervany, 1999; Venkatesh et al., 2003). Thus, social impact becomes a significant dimension when studying an individual's intention to use a new technology (Harrison, Mykytyn, & Riemenschneider, 1997; Mathieson, 1991; Moore & Benbasat, 1991; Thompson, Higgins, & Howell, 1991; Venkatesh & Davis, 2000), such as exploring students' intentions to use e-textbooks. Moreover, gender and experience are two moderating variables that may adjust the influence of social impact on intentions (Venkatesh et al., 2003; Venkatesh & Morris, 2000). Based on the above discussions, three hypotheses are proposed:

> H6: Social impact has a significant and positive effect on tertiary students' BI for using e-textbooks.

> H7: The moderating variable, gender, influences the social impact on tertiary students' BI for using e-textbooks.

> H8: The moderating variable, experience, influences the social impact on tertiary students' BI for using e-textbooks.

Venkatesh et al. (2003) discovered that, when both effort and PE appear in the model of personal computer utilization and the innovation diffusion theory model as antecedent variables, FC (the supports received for using e-textbooks) have no effect on intention. However, if EE is excluded from the theory of planned behavior or the decomposed theory of planned behavior models, then the FC becomes a predictor of intention. Therefore, Venkatesh et al. (2003) argued, for the UTAUT model, FC are not influential on the intention to use a technology. In researching Computer Aided Software Engineering, Dasgupta, Haddad, Weiss, and Bermudez (2007) found that FC had no effect on intentions. Other prior studies, in their research contexts, have verified the same result (Amoroso & Hunsinger, 2009; Liu & Tsai, 2011).

However, the literature indicates that users' Internet experiences can significantly moderate facilitation of user intentions; those displaying neuroticism are especially vulnerable and need to find security (Wang & Yang, 2005). Venkatesh Brown, Maruping, and Bala (2008) discussed this in terms of duration, frequency, and intensity, and found that intention is a better predictor of behavior for extended periods of use. Experienced users are likely to have formed habits for using a system, and thus their intentions become an automatic behavior (Venkatesh, Thong, & Xu, 2012). Based on the literature, the following hypotheses are proposed:

> H9: FC have no effect on tertiary students' BI for using e-textbooks.

> H10: The moderating variable, experience, influences FC on tertiary students' BI for using e-textbooks.

Previous studies have indicated that perceived enjoyment (PENJ) affects the use of technology (Agarwal & Karahanna, 2000; Chung & Tan, 2004; Davis, Bagozzi, & Warshaw, 1992). In Van der Heijden's (2004) study, PENJ represented a strong factor for intention, and was reported to be even stronger than perceived usefulness. As Venkatesh et al. (2003) stated, if computer users have intrinsic motivation, they will then feel more comfortable with utilizing the new technology because their interest overcomes their negative feelings of spending extra effort. In other words, if an individual finds e-textbooks fun and pleasant to use, the inclination to use them would be stronger (Lai & Ulhas, 2012; Maynard & Cheyne, 2005; Van der Heijden, 2004). Contrarily, for those who do not feel at ease in their use, a strong use intention may not exist. Based on the findings arising from the literature and the results of prior studies, the following hypothesis is proposed:

> H11: PENJ has a significant and positive effect on tertiary students' BI for using e-textbooks.

Chen and Hitt (2002) indicated that, when users switch to different products or services, they incur additional costs, such as equipment, access, and transmission costs. Researchers have suggested that new technology and service providers should search methods for reducing these costs to promote acceptance (Young, 2001). Currently, e-textbooks confront a user-transition situation, because users have other similar and familiar means to obtain the required information (Lai & Ulhas, 2012; Van der Heijden, 2004). Recent studies have shown that perceived cost is an influential factor that can create a negative impact on adoption intention (e.g., Boroughs, 2010; Wu & Wang, 2005). Therefore, the following hypothesis is proposed:

> H12: Perceived cost has a significant negative effect on tertiary students' BI for using e-textbooks.

Users' intentions increase when they perceive a high degree of TTF; contrarily, perceiving a relatively low degree of TTF decreases users' intentions (Lee, Cheung, & Chen, 2005; Lin & Huang, 2008). As previous studies identified, when users adopt a new technology, the TTF produces significant influences. Lin and Huang (2008) discovered that the PTTF affects an individual's intention to use the knowledge management system. In this study, despite the fact that e-textbooks have many advantages, such as ease of transport and multimedia, if these advantages are not sufficiently helpful for the user's task, e-textbooks may not be an alternative to traditional textbooks. Thus, a final hypothesis is proposed:

> H13: PTTF has a significant effect on the positive BI of tertiary students' toward the use of e-textbooks.

Questionnaire Design

A questionnaire was designed for testing the proposed research model, and a 5-point Likert scale was employed for the response. In order to avoid unreliable data produced from participants' carelessness or rushed responses, the questionnaire included several reverse questions. Three information systems academics and two industrial experts helped revisions of the questionnaire, specifically for correcting semantic errors and checking completeness of the questions, to ensure the overall design was valid and clear, and the questions were appropriate and representative.

Data Collection and Analysis

In order to study higher education students and their intentions toward using e-textbooks, this research invited students who were enrolled in tertiary studies (either colleges or universities) in Taiwan to participate. The participants included both graduate and undergraduate students. The final version of the completed questionnaire was distributed via websites and major forums in Taiwan. The distribution period was one month. After receiving the completed questionnaires, several functions of the statistical software, SPSS, were utilized to perform descriptive analysis, factor analysis, reliability and validity tests, and model verification.

Results and Discussions

Participants

A total of 1,140 questionnaires were collected. After eliminating invalid questionnaires, 912 valid ones remained, including 396 experienced users (had used the e-textbook) and 516 inexperienced users (had never used the e-textbook). For the 396 experienced users, most 235 (58.7%) were male and 161 (41.3%) were female. For the 516 inexperienced users, 311 (60.3%) were male and 205 (39.7%) were female. In terms of the participants' experience with e-textbooks, 220 (55.6%) subjects had less than one year's experience.

Reliability and Validity Testing

In terms of reliability, the composite reliability values of the models for exploring the inexperienced users' and experienced users' intentions were both over 0.7, indicating that each variable in both models reached an acceptable level of reliability. This study adopted the principal component analysis to test construct validity, and measured the factor loadings to determine if the questionnaire achieved both discriminant and convergent validities. According to Hair, Black, Babin, and Anderson (2010), when the number of samples surpasses 150, a factor loading over 0.45 achieves construct validity. This study used the varimax and equamaz of the orthogonal rotation method to perform adjustments in the factor analysis.

In terms of both experienced and inexperienced users, after conducting the factor analysis, this study deleted four questions. After the deletions, the FC construct had less than three items, resulting in deletion of the entire construct. The factor analysis results show that all items converged in the corresponding constructs, and that each construct was significantly different from the others. The factor loading values which the researchers obtained were all greater than 0.45, which indicates good construct validity. This study also tested the correlations among constructs via Pearson correlation analysis; Table 1 shows the results.

Table 1

Correlation Analysis

	PE	EE	SI	FC	PTTF	PENJ	PC	BI
PE	1	0.509**	0.568**	NA	0.764**	0.610**	-0.072	0.671**
EE	0.464**	1	0.339**	NA	0.633**	0.513**	-0.003	0.458**

SI	0.549**	0.192**	1	-	0.524**	0.401**	-0.078	0.484**
FC	0.385**	0.450**	0.293**	1	NA	NA	NA	NA
PTTF	0.716**	0.532**	0.508**	0.516**	1	0.683**	-0.097*	0.664**
PENJ	0.571**	0.509**	0.347**	0.393**	0.664**	1	-0.001	0.616**
PC	-0.027	-0.059	0.048	-0.204**	-0.025	0.075	1	-0.143**
BI	0.622**	0.415**	0.370**	0.394**	0.607**	0.551**	-0.073	1

*P<0.05 **P<0.01 ***P<0.001.

Note. Experienced users – numbers appear bottom left area of the table; inexperienced users - numbers appear top right area of the table.

Path Analysis Results

For the participants with experience of using e-textbooks, this study found that four (PE, PENJ, PTTF, and FC) out of seven independent variables have significant and predictive power on BI. These four and the dependent variable (i.e., BI) share 0.685 for the multiple correlation coefficient, 0.469 for the determination coefficient, and 86.454 (p = 0.000; <0.05) for the F value of the model's overall testing. Figure 2 presents the path analysis results of the participants with experience of using e-textbooks.

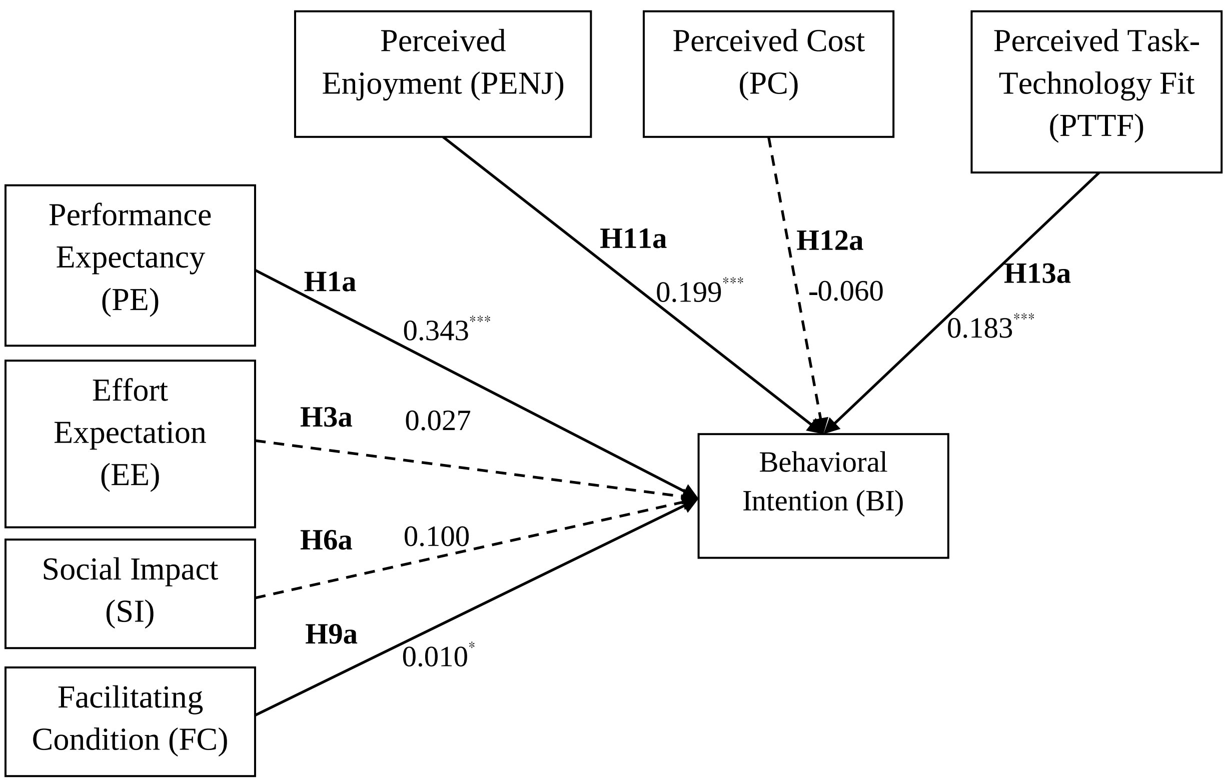


Figure 2. Path analysis of experienced users.

For the participants without experience of using e-textbooks, they do not have sense of how the e-textbooks provide FC. Thus, FC is not applicable in the model of inexperienced users. This study found that five (PE, PENJ, PTTF, PC, and SI) out of seven independent variables have significant predictive power on BI. These five predictors and the dependent variable (i.e., BI) share 0.744 for the multiple correlation coefficient, 0.553 for the determination coefficient, and 126.124 (p = 0.000; <0.05) for the F value of the model's overall testing. Figure 3 offers the path analysis results of the participants without experience using e-textbooks.

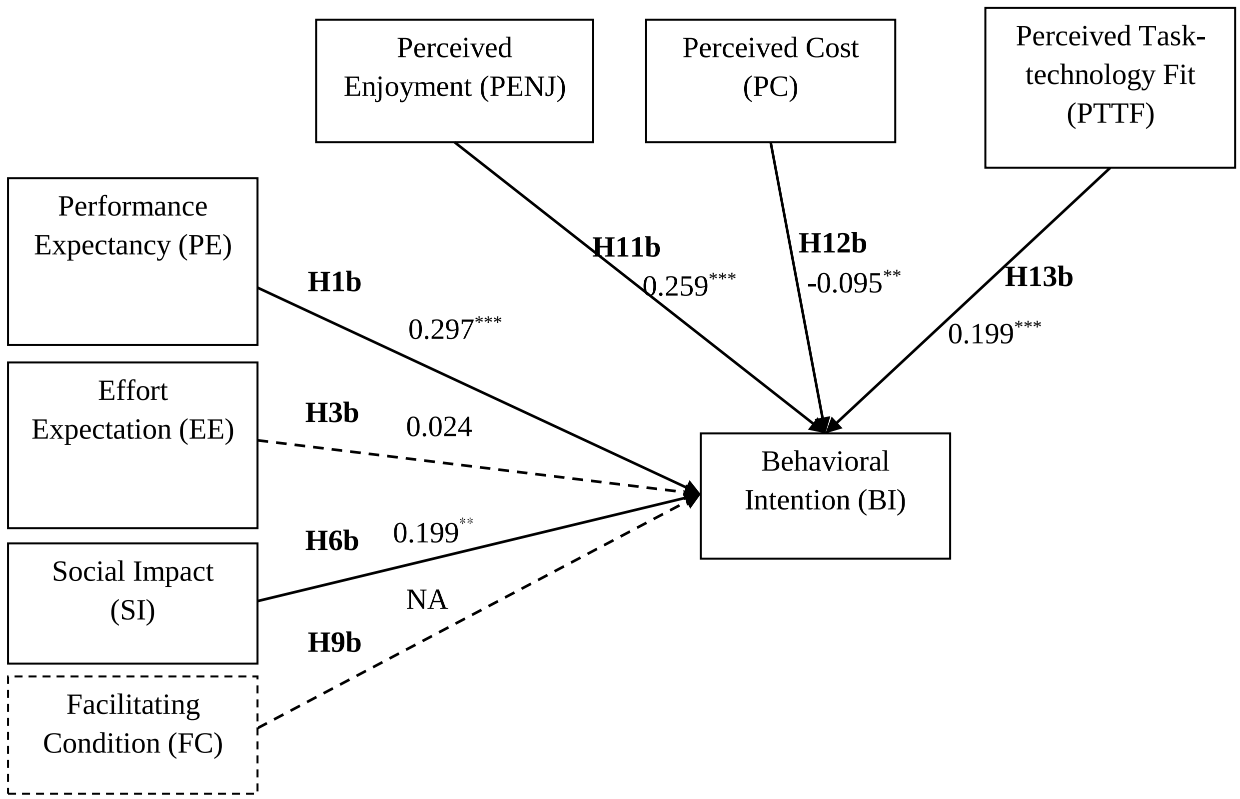


Figure 3. Path analysis of inexperienced users.

Testing of Moderating Effects

This study tested the effects of moderating variables (i.e., gender and experience) on the impacts of the four independent variables (PE, EE, SI, and FC) on BI, based on two levels of hierarchical regression analysis. Judging the existence of a moderating effect depends on the cross-multiplication p-value of the independent variable and moderating variable in the second-level hierarchical regression analysis, for which the p-value must be higher than 0.05 (p>0.05).

For the experienced participants, the standardized regression coefficients (β values) of the cross-multiplication of gender and the observed variable values are all insignificant (Gender x PE: β = 0.071; p = 0.642; Gender x EE: β = -0.177; p = 0.256; Gender x SI: β = 0.024; p = 0.914). This means that gender is not the moderating factor in the proposed model for experienced users. By contrast, for inexperienced participants, the standardized regression coefficients (β values) of the cross-multiplication of gender and the observed variable values are all significant (Gender x PE: $\beta = 0.295$; $p = 0.015$; Gender x SI: $\beta = 0.431$; $p = 0.023$), except for the EE variable (Gender x EE: $\beta = 0.018$; $p = 0.894$). These results indicate that gender is the moderating factor in the hypothesized model for inexperienced users, except for the influential path from EE to BI.

As the authors mentioned above, for inexperienced participants, gender is the moderating factor for two influential paths: From PE to BI and from SI to BI. This study further explored for which gender PE and SI produced the highest impact on BI by conducting a series of post hoc tests. In terms of the impact from PE to BI, the standardized regression coefficients (β values) of the gender's effect are 0.625 (male) and 0.738 (female), with $p = 0.000 < 0.001$, thereby reaching a significance level. Since both β values are positive (female > male), PE has a positive impact on the students' BI toward using e-textbooks, with gender being a definite influence.

In terms of the impact from SI to BI, the results show that the standardized regression coefficients (β values) of the gender effect are 0.464 (male) and 0.523 (female), with $p = 0.000 < 0.001$, thus reaching a significance level. Since both the β values are positive (female > male), this data indicate that SI has a positive impact on students' BI, with gender again having a definite effect.

Apart from gender effect, the questionnaires acquired from experienced users were utilized for testing the moderating effects of the experience variable on the hypothesized paths. As a result, the moderating effect of experience was found to be significant for the path of EE and BI (Experience x EE: $\beta = 0.094$; $p = 0.041$). However, the moderating effects of experience are insignificant for the paths of SI and BI, and FC and BI (Experience x SI: $\beta = -0.012$; $p = 0.804$; Experience x FC: $\beta = 0.027$; $p = 0.569$).

Accordingly, for the experienced participants, experience appears to be the moderating factor for the influential path of EE to BI. Thus, this study further explored which level of experience (high, medium, or low) produced the highest impact. As a result, the standardized regression coefficients (β values) of the effect of experience were 0.337 (low), 0.433 (medium), and 0.599 (high), with $p = 0.000 < 0.001$, thereby reaching a significance level of 0.05. Since all β values are positive (high > medium > low), EE has a positive impact on students' BI, with different levels of experience affecting the use intention. For students with high, medium, and low levels of experience, the explanatory power of EE to predict BI accounts for 35.9%, 18.7%, and 11.4% of the variance, respectively.

In summary, Table 2 provides the results for testing the direct and moderating effects as the authors hypothesized. If the result of the path is significant, it is denoted with "Yes".

Table 2

Results of Hypotheses Testing

Hypotheses	Path	Experienced users significant?	Inexperienced users significant?
H1	PE→BI	Yes	Yes
H3	EE→BI	No	No
H6	SI→BI	No	Yes
H9	FC→BI	Yes	NA
H11	PENJ→BI	Yes	Yes
H12	PC→BI	No	Yes, but negative
H13	PTTF→BI	Yes	Yes
H2	Gender mod (PE→BI)	No	Yes
H4	Gender mod (EE→BI)	No	No
H7	Gender mod (SI→BI)	No	Yes
H5	Experience mod (PE→BI)	Yes	NA
H8	Experience mod (SI→BI)	No	NA
H10	Experience mod (FC→BI)	No	NA

Discussions of Direct Effects

For both experienced and inexperienced users, PE has a positive impact on BI. This finding agrees with prior studies of technology acceptance, which contend that people accept technology through a belief that it is useful for improving their performance and efficiency in certain tasks (Agarwal & Karahanna, 2000; Fishbein & Ajzen, 1975; Karahanna, Straub, & Chervany, 1999).

In both usage models, EE has a positive, but insignificant impact on tertiary students' BI. However, this result differs from prior studies suggesting that EE should have a significant impact on BI. In this study, the insignificant impact may be due to e-textbooks requiring fundamental IT skills, rather than advance or high-level ones.

For tertiary students with experience of using e-textbooks, SI bears no significance for their BI. Contrarily, for those without experience using textbooks, SI has a positive impact on students' BI. The results imply that students may be influenced by others prior to gaining experience of using e-textbooks. Differing from the assumptions in the previous literature, after using e-textbooks, the opinions of others seem to be no longer influencing tertiary students' acceptance.

Venkatesh et al. (2003) suggested that FC does not affect BI; however, this study found that FC does have a significant impact on tertiary students' BI, albeit only in the experienced-student model. This implies that assistance from external sources does not influence the adoption intention of inexperienced users. Perhaps without experience of using e-textbook, users do not understand how these facilitations could be helpful in adopting the technology. After using it, however, and with the availability of external resources, tertiary students BI towards use increases.

PENJ has a positive and significant impact on tertiary students' BI for both usage models, which is in line with Venkatesh et al. (2003). E-textbooks provide students with a new form of learning and reading that allows them to remain in their own personal space and use interactive methods for studying in new and challenging ways. If students achieve greater enjoyment during the learning process, the sense of frustration with the difficulty of learning declines, and may in turn increase the willingness to use e-textbooks.

For the experienced students, PC bears no significant impact on their BI. The reason for this may be that e-textbooks remain in an early stage of promotion in Taiwanese tertiary institutions, and students can browse and read e-textbooks in Portable Document Format (PDF) without much additional cost as long as the displaying device has Adobe Reader installed. Contrarily, for those without experience, PC has a significant but negative impact among tertiary students' BI. These results may be due to their impressions that the use of e-textbooks incurs costs for purchasing hardware, accessing networks, and other expenses.

PTTF has a positive impact on tertiary students' BI in both models (with and without experience), which is consistent with Goodhue and Thompson (1995). This indicates that, when the e-textbook and its functions are compatible with students' learning styles and learning tasks, they tend to use it. Tertiary students are frequently required to prepare various kinds of written reports. In order to assist these complicated tasks and materials, e-textbooks provide advantages over traditional textbooks, such as keyword searches, built-in dictionaries, cross-references, and even interactive maps and charts. Moreover, these technical functions can meet the demands of tertiary students' learning tasks, and can, therefore, increase their willingness to use them.

Discussions of Moderating Effects

As Table 2 shows, gender has no moderating effect on the hypothesized interrelationships in the model of experienced users. However, for inexperienced female users, gender has a moderating effect on the hypothesized interrelationships between PE, SI, and BI. It seems that SI via recommendations from friends, newspapers, and magazines are more influential to female students than to males, when students expect e-textbooks to enhance their learning efficiency. Among experienced tertiary students, the level of experience moderates the relationship between EE and BI, indicating that the amount of effort required to use e-textbooks is more of a concern for experienced users. However, the level of experience does not moderate the impacts of SI or FC on BI. Perhaps, the use of e-textbooks may be influenced by other strong environmental factors, such as university policy and incentives.

Conclusion

This study discovered several critical factors in the UTAUT, the PTTF, and the PENJ models, which may help students accept e-textbooks. Several factors have rarely been discussed in the prior literature about e-textbooks. As such, findings from this study can serve as a guide for studying e-textbook acceptance in the future. Moreover, this study also found that both gender and usage experience influence the acceptance models of both experienced and inexperienced users of the technology.

Comparing the adoption models between experienced and inexperienced users, the great differences lie in whether social impact, facilitating condition, and perceived cost contribute significant influence on BI. In terms of social impact for experienced users, students tend to use e-textbooks based on their habits and learning styles, irrespective of peer influence. However, in the case of inexperienced users, friends and classmates can be influential to their intention of using e-textbooks. In terms of facilitating condition and perceived cost for inexperienced tertiary students, supportive resources from the institution would not affect their intention toward using e-textbooks, and they are concerned about using the technology due to costs. However, after actual usage, experienced students may discover that e-textbooks do not require much extra cost for continuous use, perhaps only networking fees. Experienced students also expect more supportive resources. As such, it is suggested that tertiary institutions provide resources, such as training tutorials, to resolve the difficulties and obstacles that may be encountered when using e-textbooks.

Regarding the moderating effects, gender does not induce any moderating effect in the proposed acceptance model, while experience can moderate the relationship between effort expectation and BI. Further, gender has moderating effects on the hypothesized interrelationships between PE, social impact, and BI for inexperienced users, and the effect is particularly high in the case of females. These findings indicate that female students' perception toward using e-textbooks to enhance learning efficiency is higher than male students. Also, for female students, the influence of friends' experiences and recommendations from newspapers and magazines are stronger than for males.

For practical implications, this study found that FC will affect experienced users' willingness to use e-textbooks. Therefore, if Taiwanese colleges and universities wish to promote the use of e-textbooks effectively, they should develop a long-term facilitating mechanism to support students in utilizing e-textbooks for learning. In a real world scenario, this study suggests that lecturers may play a mediating or supervisory role to guide students' use of e-textbooks during lectures. It is also possible to offer pre-class and after-class support during the processes of adoption for learning. Moreover, since the value chain in the textbook industry includes students, lecturers, and publishers, satisfying the needs of these three parties is necessary in the promotion of e-textbooks. Yet, the existing literature only focused on aspects associated with the industry's value chains and lecturers, and lacks student-related research. Hopefully, this study provided useful guidelines for marketing strategies on e-textbooks, and thus filled the literature gap.

Apparently, using e-textbooks for learning has become an efficient way to acquire knowledge, particularly in the scenarios of distributed and open learning. People can use e-textbooks to gain knowledge at any time and any place as long as the electronic reader is available. The factor of social impact has significant influence on inexperienced users' acceptance intention, which means that creating a strong social environment for the students and their social entities can stimulate the use of e-textbooks and thus shape an interactive and better distributed learning environment.

This study has several limitations and foresees future directions for research. First, the theoretical model of this study is focused on intention and tertiary students' feelings toward e-textbooks. Consequently, caution is necessary when interpreting the authors' results in order to predict actual behavior toward using e-textbooks in other contexts. Second, the participants in this study represented a selection of tertiary students without specifically targeting any department. Therefore, future research might focus on tertiary students in specific disciplines, such as science or liberal arts majors, to study the differences toward using e-textbooks among students of different fields. The differences among departments and the reasons for those differences could deepen our understanding of the use of technology. Third, after e-textbooks become more common, future research could test the factors in this study on their influences toward continuous use of e-textbooks.

References

Agarwal, R., & Prasad, J. (1997). The role of innovation characteristics and perceived voluntariness in the acceptance of information technologies. *Decision Sciences, 28*(3), 557-582.

Agarwal, R., & Karahanna, E. (2000). Time flies when you're having fun: Cognitive absorption and beliefs about information technology usage. *MIS Quarterly, 24*(4), 665-694.

Al-Ali, S., & Ahmed, A. (2015). E-textbooks in ESL classrooms: Are learners on board? *Learning and Teaching in Higher Education: Gulf Perspectives, 12*(2). Retrieved from http://lthe.zu.ac.ae/index.php/lthehome/issue/view/13

Amoroso, D. L., & Hunsinger, D. S. (2009). Understanding consumers' acceptance of online purchasing. *Journal of Information Technology Management, 10*(1), 15-41.

Baker, E. W., Al-Gahtani, S. S., & Hubona, G. S. (2010). Cultural impacts on acceptance and adoption of information technology in a developing country. *Journal of Global Information Management, 18*(3), 35-58.

Boroughs, D. (2010, April). *Bye the book: In educational publishing, the only certainty is change*. Retrieved from http://www.prism-magazine.org/apr10/feature_01.cfm

Bruner II, G. C., & Kumar, A. (2005). Explaining consumer acceptance of handheld internet devices. *Journal of Business Research, 58*(5), 553-558.

Chen, P. Y., & Hitt, L. M. (2002). Measuring switching costs and the determinants of customer retention in Internet-enabled businesses: A study of the online brokerage industry. *Information Systems Research, 13*(30), 255-274.

Chung, J., & Tan, F. B. (2004). Antecedents of perceived playfulness: An exploratory study on user acceptance of general information-searching websites. *Information & Management, 41*(7), 869-881.

Clough, G., Jones, A. C., McAndrew, P., & Scanlon, E. (2008). Informal learning with PDAs and smartphones. *Journal of Computer Assisted Learning, 24*(5), 359-371.

Dasgupta, S., Haddad, M., Weiss, P., & Bermudez, E. (2007). User acceptance of CASE tools in systems analysis and design: An empirical study. *Journal of Informatics Education Research, 9*(1), 51-78.

Davis, F. D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS Quarterly, 13*(3), 319-339.

Davis, F. D., Bagozzi, R. P., & Warshaw, P. R. (1992). Extrinsic and intrinsic motivation to use computers in the workplace. *Journal of Applied Social Psychology, 22*(1), 1111-1132.

Dennis, A. R., Abaci, S., Morrone, A. S., Plaskoff, J., & McNamara, K. (2016). Effects of e-textbook instructor annotations on learner performance. *Journal of Computing in Higher Education, 28*(2), 221-235.

Fischer, L., Hilton, J., Robinson, T. J., & Wiley, D. A. (2015). A multi-institutional study of the impact of open textbook adoption on the learning outcomes of post-secondary students. *Journal of Computing in Higher Education, 27*(3), 159-172.

Fishbein, M., & Ajzen, I. (1975). *Belief, attitude, intention, and behavior: An introduction to theory and research*. Reading, MA: Addison-Wesley Pub. Co.

Gerhart, N., Peak, D., & Prybutok, V. (2015). Searching for new answers: The application of task-technology fit to e-textbook usage. *Decision Sciences Journal of Innovative Education, 13*(1), 91-111.

Goodhue, D. L., & Thompson, R. L. (1995). Task-technology fit and individual performance. *MIS Quarterly, 19*(1), 213-236.

Gu, X., Wu, B., & Xu, X. (2015). Design, development, and learning in e-Textbooks: What we learned and where we are going. *Journal of Computers in Education, 2*(1), 25-41.

Gurung, R. A. R., & Daniel, D. (2005). Do text-based pedagogical features enhance student learning? In D. S. Dunn, & S. L. Chew (Eds.), *Best practices for teaching introduction to psychology* (pp. 41-55). New Jersey: Lawrence Erlbaum.

Hair, J. F., Black, W. C., Babin, B. J., & Anderson, R. E. (2010). *Multivariate data analysis – A global perspective*. New Jersey: Pearson Education.

Harrison, D. A., Mykytyn, P. P., & Riemenschneider, C. K. (1997). Executive decisions about adoption of information technology in small business: Theory and empirical tests. *Information Systems Research, 8*(2), 171-195.

Hsiao, C. H., Tang, K. Y., & Lin, C. H. (2015). Exploring college students' intention to adopt e-textbooks: A modified technology acceptance model. *Libri, 65*(2), 119-128.

Isa, S. M., & Wong, K. Y. (2015). Age differences in behavioral intention to use internet marketing: A comparative study between Malaysian and Taiwanese. *International Journal of Business & Society, 16*(3), 386-396.

Johnston, D., Berg, S., Pillon, K., & Williams, M. (2015). Ease of use and usefulness as measures of student experience in a multi-platform e-textbook pilot. *Library Hi Tech, 33*(1), 65-82.

Kaba, B., & Touré, B. (2014). Understanding information and communication technology behavioral intention to use: Applying the UTAUT model to social networking site adoption by young people in a least developed country. *Journal of the Association for Information Science & Technology, 65*(8), 1662-1674.

Karahanna, E., Straub, D. W., & Chervany, N. L. (1999). Information technology adoption across time: A cross-sectional comparison of pre-adoption and post-adoption beliefs. *MIS Quarterly, 23*(2), 183-213.

Kohnke, A., Cole, M., & Bush, R. (2014). Incorporating UTAUT predictors for understanding home care patients' and clinician's acceptance of healthcare telemedicine equipment. *Journal of Technology Management & Innovation, 9*(2), 29-41.

Kuo, R. Z. (2011). Knowledge management system adoption: Exploring the effects of empowering leadership, task-technology fit and compatibility. *Behaviour & Information Technology, 30*(1), 113-129.

Lai, J. Y., & Ulhas, K. R. (2012). Understanding acceptance of dedicated e-textbook applications for learning: Involving Taiwanese university students. *The Electronic Library, 30*(3), 321-338.

Lee, M. K. O., Cheung, C. M. K., & Chen, Z. (2005). Acceptance of Internet-based learning medium: The role of extrinsic and intrinsic motivation. *Information & Management, 42*(8), 1095-1104.

Lin, T. C., & Huang, C. C. (2008). Understanding knowledge management system usage antecedents: An integration of social cognitive theory and task technology fit. *Information & Management, 45*(6), 410-417.

Liu, W. Y., & Tsai, C. H. (2011). An application of the UTAUT model for understanding learning management systems adoption of college teachers. *Journal of Performance and Strategy Research, 8*(2), 49-60.

Marcolin, B. L., Compeau, D. R., Munro, M. C., & Huff, S. L. (2000). Assessing user competence: Conceptualization and measurement. *Information Systems Research, 11*(1), 37-60.

Mathieson, K. (1991). Predicting user intentions: Comparing the technology acceptance model with the theory of planned behavior. *Information Systems Research, 2*(3), 173-191.

Maynard, S., & Cheyne, E. (2005). Can electronic textbooks help children to learn? *The Electronic Library, 23*(1), 103-115.

Moon, J. W., & Kim, Y. G. (2001). Extending the TAM for a world-wide web context. *Information & Management, 38*(1), 217-230.

Moore, G. C., & Benbasat, I. (1991). Development of an instrument to measure the perceptions of adopting an information technology innovation. *Information Systems Research, 2*(3), 192-222.

Ngafeeson, M. N., & Sun, J. (2015). The effects of technology innovativeness and system exposure on student acceptance of e-textbooks. *Journal of Information Technology Education: Research, 14*, 55-71.

Pai, J. C., & Tu, F. M. (2011). The acceptance and use of customer relationship management (CRM) systems: An empirical study of distribution service industry in Taiwan. *Expert Systems with Applications, 38*(1), 579-584.

Shin, S., Chung, N., Hart, R. J., Joun, Y., & Koo, C. (2015). Examining technology perception and user competence on two types of smartphone usages. In *Proceedings of the Pacific Asia Conference on Information Systems (PACIS) 2015* (p. 105). Retrieved from http://aisel.aisnet.org/pacis2015/105/

Stone, R. W., & Baker-Eveleth, L. (2013). Students' expectation, confirmation, and continuance intention to use electronic textbooks. *Computers in Human Behavior, 29*(3), 984-990.

Szajna, B. (1996). Empirical evaluation of the revised technology acceptance model. *Management Science, 42*(1), 85-92.

Thompson, R. L., Higgins, C. A., & Howell, J. M. (1991). Personal computing: Toward a conceptual model of utilization. *MIS Quarterly, 15*(1), 124-143.

Van der Heijden, H. (2004). User acceptance of hedonic information systems. *MIS Quarterly, 28*(4), 695-704.

Venkatesh, V., Brown, S. A., Maruping, L. M., & Bala, H. (2008). Predicting different conceptualizations of system use: The competing roles of behavioral intention, facilitating conditions, and behavioral expectation. *MIS Quarterly, 32*(3), 483-502.

Venkatesh, V., & Davis, F. D. (2000). A theoretical extension of the technology acceptance model: Four longitudinal field studies. *Management Science, 46*(2), 186-204.

Venkatesh, V., & Morris, M. G. (2000). Why don't men ever stop to ask for directions? Gender, social influence, and their role in technology acceptance and usage behavior. *MIS Quarterly, 24*(1), 115-139.

Venkatesh,V., Morris, M. G., & Ackerman, P. L. (2000). A longitudinal field investigation of gender differences in individual technology adoption decision making processes. *Organizational Behavior and Human Decision Processes, 83*(1), 33-60.

Venkatesh, V., Morris, M. G., Davis, G. B., & Davis, F. D. (2003). User acceptance of information technology: Toward a unified view. *MIS Quarterly, 27*(1), 425-478.

Venkatesh, V., Thong, J. Y. L., & Xu, X. (2012). Consumer acceptance and use of information technology: Extending the unified theory of acceptance and use of technology. *MIS Quarterly, 36*(1), 157-178.

Vessey, I. (1991). Cognitive fit: A theory-based analysis of the graphs versus tables literature. *Decision Sciences, 22*(2), 219-240.

Wang, H. I., & Yang, H. L. (2005). The role of personality traits in UTAUT model under online stocking. *Contemporary Management Research, 1*(1), 69-82.

Woody, W. D., Daniel, D. B., & Baker, C. A. (2010). E-books or textbooks: Students prefer textbooks. *Computers & Education, 55*(3), 945-948.

Wu, J. H., & Wang, S. C. (2005). What drives mobile commerce? An empirical evaluation of the revised technology acceptance model. *Information & Management, 42*(5), 719-729.

Young, J. R. (2001). A university that reveres tradition experiments with e-books. *The Chronicle of Higher Education, 47*(36), 35-46.

Zhou, T., Lu, Y., & Wang, B. (2010). Integrating TTF and UTAUT to explain mobile banking user adoption. *Computers in Human Behavior, 26*(4), 760-767.

International **R**eview of **R**esearch in **O**pen and **D**istributed **L**earning
Volume 19, Number 4

September – 2018

"Doing the Courses Without Stopping my Life:" Time in a Professional Master's Program

Tami Oliphant and Jennifer Branch-Mueller
University of Alberta

Abstract

This study investigates how time intersects with student learning in Canada's first, and only, Master of Library and Information Studies (MLIS) in an online teaching and learning stream. Thirty-two students responded to a survey that asked about their experiences, perceptions, and challenges after their first year of the program. Descriptive statistics and NVIVO 10 were used to analyze survey responses and to develop themes through open coding. The findings indicate that time shapes students' decisions to pursue the MLIS online, their perception of what the degree might mean for their future, their experience in the program, the quality of their relationships, and their learning. The perceived flexibility of the MLIS program was incredibly important to students. However, the majority of students described themselves as "time poor" and many students underestimated the time commitment necessary to complete the program, to manage coursework, and to build and maintain relationships with others.

Keywords: online teaching and learning, time, graduate students, Master of Library and Information Studies (MLIS)

Introduction

The MLIS (Master of Library and Information Studies) program at the University of Alberta is a 16-course, 48-credit, ALA-accredited (American Library Association) program that offers online and on-campus teaching and learning streams. The American Library Association is the oldest and largest library association in the world and is responsible for program accreditation and promoting libraries around the world (American Library Association, 2018). While recent research (Consillium, 2015) suggests that 93.15% of Canadian universities offer online courses and programs, a country as large and diverse as Canada should be a leader in distance education for librarianship, but it is not. The School of Library and Information Studies (SLIS) at the University of Alberta offers Canada's first, and only, MLIS degree that students can opt to take completely online. To complete the degree, students in the program are required to take five core courses and two technology courses, nine course electives, and finish an ePortfolio capstone project. The online teaching and learning stream is asynchronous to accommodate a geographically dispersed cohort (Canada itself has six different time zones) and the learning management system (LMS) used in the program is eClass (Moodle).

The MLIS program is itself time bound. Students have six years to complete their degree in a semestered system. Courses are designed to be delivered sequentially with a number of electives requiring pre- and co-requisites. Furthermore, many of our students are already working in libraries, completing their MLIS as a second career, or to further their current career, while raising families or any combination thereof. How these students manage their time and strike a work/life balance is crucial to their success (however "success" is personally defined) in the program. Given that time is a critical, constitutive context in which students are situated, and that time permeates all aspects of lived experience, this research explores the following two questions:

1. How do students situate themselves in time as it pertains to the MLIS program and their future careers?

2. How does time shape online student experiences in the MLIS program?

Related Literature

Conceptualizations of Time and Space in Education

While standard dictionaries define time as a noun, adjective, and verb, Gourlay (2014) argues that time is neither "a thing unto itself" nor an entirely abstract concept and states that "time and how it is conceived of is a crucial constitutive dimension of human life, rather than a neutral and unchanging backdrop against which action takes place" (p. 141). Time permeates every aspect of education from learning experiences to pedagogical approaches, to relationships between and among students and teachers, to course structure and content (Allan, 2007; Cho & Tobias, 2016). The intersections of time and distance in education have been theorized for over three decades with Mardsen (1996) posing the question "How, given the spatial and temporal separation of teachers and learners, is education possible?" (p. 222). Evans, writing in 1989, argued that 'distance' in distance education results in the convergence of time and space in that distance education fosters new connections between disparate places and that time can measure this distance. For example, in the online environment, instructors and students must consider time in a very basic sense (time zones and the rhythms of night and day) when thinking about online education for students at a distance (Evans, 1989). In turn, delivery of distance education must take into account that various actors will have different perceptions of time, place, and distance (Evans, 1989). Increased offerings of online courses and programs of study have created what Barbera and Clara (2012) dub "new time conditions" (p. 3) which have prompted greater urgency in understanding the relationship between time and learning.

Temporal Aspects of Computer-Mediated Interaction

With advances in distance education and online delivery, time has become a salient element in relation to computer-mediated interaction (Allan, 2007; Barbera & Clara, 2012; Luppicini, 2007). Almost three decades ago, in 1988, Hesse, Werner and Altman presented a transactional framework for studying the temporal aspects of computer-mediated interaction. Hesse et al. (1988) suggested that educators need to consider both the linear dimension of time, which refers to past, present, and future, as well as the cyclical or spiraling dimension of time, which refers to recurring events such as when a "student regularly logs on to LMS discussion board but has varying purposes and experiences that make each event distinctive" (p. 150). Related to linear, spiraling, or cyclical dimensions of time in computer-mediated learning are synchronous and asynchronous interactions (Hesse, Werner, & Altman, 1988). Hesse, Werner, and Altman suggest that the "asynchronous modes of computer communication give considerable flexibility to temporal scale allowing the user almost unlimited time for editing, composing, sending, and retrieving messages" (p. 151). While asynchronous discussions might allow for temporal flexibility, there are implications and consequences for online learners. For example, Luppicini (2007) reports on research that found face-to-face students presented better counterarguments during class discussions (synchronous time) whereas online students outperformed face-to-face students in identifying different arguments and thinking of alternatives (asynchronous time). Other research indicates that students often perceive asynchronous discussion boards as goal and task oriented which can lead to feelings of isolation when students do not receive immediate feedback from instructors (Valenta, Therriault, Dieter, & Mrtek, 2001).

In addition, online discussion boards become not only the space and time where students and instructors interact, but also the locale whereby "each actor displays a hidden, direct or indirect influence on the others" (Kabat-Ryan, 2014, p. 165). For Kabat-Ryan (2014) "it is through these time and space coordinates that the life of the distance learner is organized and ultimately fixed" (p. 166) which underscores how temporal and spatial elements in computer-mediated interactions shape not only individual and collective learning, but also how they act as organizing principles for the learner. A final temporal aspect of computer-mediated interaction concerns the behaviours of learners themselves (Cavanaugh, Lamkin, & Hu, 2012; Lazaros & Flowers, 2014). Students who tend to complete online courses and enjoy online learning score higher on scales measuring self-regulation (Barnard-Brak, Lan, & Paton, 2011), tend to procrastinate less (Michinov, Brunot, Le Bohec, Juhel, & Delaval, 2011; Rakes, Dunn, & Rakes, 2013), and cite the structure of online courses as positive (Paechter & Maier, 2010). This research indicates the importance of understanding the temporal aspects and consequences of computer-mediated interaction of online learners. However, less attention has been paid to how temporal scales and cycles are related to other aspects of the situation such as overestimating and underestimating the time needed to complete course work, to update IT skills, and to communicate online (Winter, Cotton, Gavin, & Yorke, 2010).

Time and Pedagogical Approaches

Time also plays an important role in terms of course content and pedagogical approaches. The following section focuses on three types of pedagogical time as identified by Ihanainen and Moravec (2011): (1) temponormative, (2) pointillist, and (3) cyclical time. Temponormative pedagogy embraces a linear sense of time where "learning has a beginning and an end, with predictable and measurable waypoints between" and where temponormative knowledge is "typically encoded in predefined curricula, transmitted through 'banking' pedagogies, and transmits just-in-case information and knowledge (e.g., memorization of the world's capitals) that might be useful outside of the learning event's timeline" (Ihanainen & Moravec, 2011, pp. 28-29). The question for Ihanainen and Moravec is whether temponormative learning works in online learning environments. They suggest that dialogues mediated by information and communication technologies (ICTs) require the creation of new virtual conceptualizations of time as it relates to social interactions (Ihanainen & Moravec, 2011). These new concepts are

- pointillist (dot-like) time, which reveals "itself through discontinuous, separate acts that participants can return to;" and
- cyclical time, which is "illustrated by clusters of events in which intensive interactions occur for a period of time, and then cyclically reemerge as bursts of activity in the same or different forums after a certain amount of time has passed" (Ihanainen & Moravec, 2011, p. 28).

Pointillist learning is based on the idea that learning is made up of masses of fragments and pieces such as Twitter posts, YouTube clips, and blog posts, which "transmit separately beginnings, middle points, and endings of events in an order that may seem perceptibly vague. Among other things, they comprise experiences, opinions, perceptions, comments, and what-if scenarios" that are fragmented and unanticipated (Ihanainenn & Moravec, 2011, p. 29). Conversely, cyclical learning considers the participation in discussion forum threads where "learners experience both densification and diffusion of learning intensity" (Ihanainen & Moravec, 2011, p. 30). These authors suggest that there are phases of intense activity of discussion, usually around a specific theme or question, followed by periods of calm and that in cyclical learning students acquire the ability to learn within intensive time periods. Finally, Ihanainen and Moravec (2011) argue that these three types of learning (temponormative, pointillist, and cyclical) are not independent of each other and that they coexist within a course.

Time and Online Learners

Researchers have explored the intersections of time and the online student experience and suggested that time is not "a neutral and linear framework in which all students are equally positioned" (Burke, Bennett, Ramsay, Stevenson, & Clegg, 2016, p. 20) and that assumptions about "naturalised understandings of student temporality" must be interrogated (Henderson, 2016, p. 21). For example, McNeill (2014) argues that there has been an increase in the number of postsecondary students taking courses and programs online while at the same time, these very students are experiencing increasing demands on their time. McNeill highlights the three main dimensions of time in a student's life: home life, work life, and student life and argues that each dimension must be balanced for the student to be successful. He suggests that students create a "time budget" for online learning in order to make conscious decisions about how they are spending their time and how, when, and where they will study.. Furthermore, research by Romero and Barbera (2011) posited that the time demands of family, work, school, and other commitments affected learning in online programs. They explored the quality of time that students devoted to their studies and found that time flexibility and ability to learn in the morning were highly correlated to better grades (Romero & Barbera, 2011).

Method

In the fall of 2013, SLIS welcomed the first fully online cohort of students who were completing the MLIS degree part-time (one or two courses per term). After a full year in the program (fall 2014), students were given a survey that asked about their perceptions, experiences, and expectations of the program and the MLIS degree. To answer the research questions an online survey with 23 closed and open-ended questions was distributed to 39 students in our first online cohort. Thirty-two students responded for a response rate of 82%. Closed questions were used to collect demographic data such as age, gender, work experience, and last degree earned. Open questions centered on five separate areas with three open-ended questions in each area: Pursuing an online MLIS; Being an online MLIS student; Connecting in the online MLIS program; Building the online MLIS program; and Becoming an LIS professional. The questions posed in the survey examined the students' experiences in the online program and were analyzed to understand how time intersects with learning and student experiences in the MLIS program. The open-ended questions were designed to illicit student stories, thoughts, and reflections (Smyth, Dillman, Christian, & McBride, 2009). The closed question data were analyzed using frequency counts and descriptive statistics and open-ended data were analyzed for common themes and trends that emerged across questions and throughout the comments (Bogdan & Biklen, 1992; Miles & Huberman, 1998) using NVIVO 10. We used constant comparison to develop the codes and themes that are listed below.

Ethical Considerations

This research study received ethics approval from the University of Alberta's Research Ethics Board. The Research Ethics Board pays considerable attention to studies involving current students. In their ethics application, the researchers needed to clearly explain how participants could opt to participate or not to participate in the study, how anonymity and confidentiality was assured, and most importantly, how the researchers would guarantee the students that their decision to participate or not would in no way effect their program or courses. Because this was the first cohort in the online teaching and learning stream, the researchers consciously decided not to collect other forms of student-generated data such as discussion posts, time on eclass, or questions posed to various forums. While these data sources would have been useful to include to triangulate the findings, the researchers concluded that the first cohort had already experienced many firsts and that the focus of this study was on student perceptions and not on collecting data that may provide insight into their actual behaviour such as class participation or student work.

The Participants

MLIS students in the online teaching and learning stream differ from the face-to-face students in a number of ways. More students in the online stream have children compared to those in the face-to-face stream. Over 70% of SLIS online students are currently working in libraries while just two out of the 32 reported having no library-related work experience. Nine of the respondents had over ten years of experience in libraries in positions ranging from circulation assistant, children's programmer, and public service in a rural library system, to working at Library and Archives Canada. Sixteen percent of online students have a library technician diploma.

Study Limitations

This was the first cohort of students in the online teaching and learning stream and it is possible there were "novelty" effects whereby these students were different from others in terms of risk-taking, trying unknown or new things, and dealing with uncertainty. Furthermore, the online teaching and learning stream is new, the only one of its kind in Canada, and the students are part-time, graduate students. Consequently, application to other programs may be limited. Because this was the online stream's inaugural cohort, we expected to be alerted in some of the survey responses to specific issues that were problematic for students. Furthermore, we relied on a single data source (open-ended survey questions regarding students' perceived experiences) for reasons mentioned above. Lastly, there is a limitation in the survey instruments themselves: as people report their self-perceptions, such reports may or may not correspond to their actual behaviour.

Results

Situating the Self in Time

Students situated themselves in time to frame expectations, hopes, and planning for careers when asked "What factors led you to decide to pursue an online MLIS?" In the past, they "were unable to take the degree" for whatever reason (with four respondents citing timing and other obligations as a primary constraint). Other respondents reflected on their past by asking themselves what their likes and dislikes were when they considered their future careers. For two respondents a career in LIS made sense because they "have always loved libraries."

Respondents also considered the online MLIS teaching and learning stream by taking into account their self-knowledge. One participant stated that flexibility was important because "I tend to be a night owl, so I like doing my homework in the wee hours of the night" and another added "I did not have to be tied down attending classes at specific times." For several respondents the flexibility of the program was a primary factor in pursuing the MLIS because online delivery gave some agency in determining how and when respondents spent time on their courses.

Eleven of the 32 respondents chose the online MLIS teaching and learning stream because the online stream removed some of the time-related barriers such as commuting to a physical campus, relocating, or having to quit a job and then find a new one. These are incredibly important considerations in a country such as Canada where many people live in areas in which an MLIS program is unavailable. "I liked the flexibility of being able to stay and work in my home province while obtaining an MLIS." One respondent highlighted the connections they had already accrued in their city. "I really wanted to do the MLIS, but I was quite happy with my current living/life situation and my network of library contacts in the city." Online access to the MLIS enabled students to maintain some control over their current living, work, and social situations. Furthermore, maintaining jobs was a priority for a number of respondents and often provided reassurance. "Being able to continue living where I was and stay in my job meant that I felt less pressure going into the program to make it work."

External time commitments to their families were also a significant factor for many people when they were deciding whether to do the MLIS in the online teaching and learning stream. Spouses and significant others may not be in a position to move. For example, one military spouse reported that "we move every 2 years, often not to major cities." Twelve respondents out of 32 had children and major time commitments to their families: "As a parent and someone working full time, no other program type was really doable." When considering their expectations of the program, respondents indicated some control over their time and learning was critical: "My most positive experiences [in the program] have been the ability to work school around my shifts at a public library and also being able to work on school from my home." Similarly, the following respondent noted that "being able to do the courses without stopping the rest of my life, doing the work on my own time and still being able to work full-time" was the most positive aspect of the program. These findings support a large body of research that indicates that flexibility is one of the most positive aspects of any online learning endeavor (Collis & Moonen, 2011; Romero & Barbera, 2011).

Employment and finances constrained and expanded the possibilities of the present and future. One participant stated that "there are some retirements coming up in my library and I want to be qualified for the job. My work suggested I go now [take the MLIS] (as opposed to two years from now, when I wanted to go)." This respondent's supervisors have implied that an investment in the MLIS now will pay off in the future when the respondent is qualified to fill upcoming professional librarian positions due to retirements. In this case, time is a resource to be invested now in a necessary credential. Because the respondent's employer "suggested" that he or she enroll in the MLIS program now rather than the time that the respondent thought was more advantageous, the employer influenced not only how the employee spends his or her time at work but also how he or she spends their time outside of work. Others noted that lack of employer support for those already working and taking the MLIS was demoralizing with one respondent reporting that the biggest obstacle in the program was an "unsupportive employer." While fifteen respondents mentioned the advantage of maintaining employment due to online delivery, two respondents acknowledged their current financial situation as a constraint on making the time commitment to the MLIS. "I was hesitant to drop out of the workforce and pursue an MLIS degree full-time due to financial constraints."

When respondents considered their future, they focused on three primary issues: careers, self-improvement, and the process and benefits of professionalization. Respondents highlighted "better job prospects, better pay, wider and greater opportunities," "a desire to find a fulfilling career that matched my skills and interests," and "an MLIS degree would provide an entry into a field as well as lots of transferable skills for many fields." One respondent highlighted the benefits associated with full-time work: "the vacation time for full-time librarians was very tempting!" In terms of self-improvement, respondents spoke of wanting greater challenges, opportunities, responsibilities, and meaningful work with two respondents stating "I thought that the courses could enhance my knowledge and help me approach my job in new and better ways," and "I was in a job that was starting to feel stagnant and that wasn't going anywhere."

Professionalization, a process of enculturation that occurs over time, potentially offered many benefits, exemplified by statements such as "I would not be hired for my current position if I was applying today. . . I am looking for ways to access greater challenges in my work life," "I wanted to continue working at the library but in a capacity that would give me more responsibilities and more creative control," and "I wanted to know how to be a better professional in the library setting." Gaining knowledge and the professional credential were seen as time investments made now for greater autonomy, opportunity, and career advancement in the future.

Time and Student Experiences

Time management.

Twenty-eight respondents mentioned or referred to time management as a factor that shaped their experiences in the program in both positive and challenging ways. Time was perceived as a resource to be managed, experienced as psychological pressure, and related to course load, class participation, achieving a work/life balance, and the ability to develop relationships with others in the cohort.

> The biggest challenge has been time management ... on top of full-time work, readings and assignments, it can be difficult to actively participate. I often fall behind and feel intimidated, as a lot of classmates do not seem to struggle with this aspect whatsoever.

Four respondents, including the one above, viewed others in the program more favourably in terms of contributions to discussions, commitment to the program, and time management skills compared to themselves. Time management could affect motivation, commitment to learning, and have psychological effects such as "I feel like I'm never "off" when I'm in class, knowing that if I do take a day off of eClass I will have a lot to catch up on." These findings are consistent with those of Eriksen (2001) who argues that an unintended consequence of technological innovation mean that all of us are available all the time. Furthermore, time management was crucial in balancing work commitments with the MLIS program. On the one hand, work provided time constraints in terms of how much time students could devote to their studies (which could be both an advantage and a disadvantage) but on the other hand, some respondents remarked that working while taking the degree enabled them to make concrete connections between theory and practice with one participant stating a program highlight was "being able to apply what I'm learning to work."

Course content and structure.

Course structure, design, and course assignments mediated time in both positive and challenging ways. The temponormative aspects of the online program, particularly course structure and assignments, could assist students in managing their time and building knowledge. "I like how structured the courses are in terms of discussions and assignments. For me, this works as a safety net so I don't fall behind." Another respondent focused on scaffolding knowledge: "My most positive experience was completing a difficult paper…and receiving full marks for my effort…it was very challenging and satisfying." Others stated that they "have gained knowledge in some of the theoretical areas in the field" and that the "course material has been very good, learning has been the most positive experience." Conversely, one respondent wrote that:

> not having classes at a set time each week allows for flexibility, but also makes it more difficult to stay on schedule…it can be a challenge to learn difficult concepts on my own, without being in a class where the instructor may be able to better explain the topic.

This respondent raises a number of important issues. The first has to do with disciplining the self and the trade-off between program flexibility and maintaining a steady schedule. Some students are more successful with stricter structures. Second, the respondent highlights the relationship between students and instructors. Seven respondents mentioned the interaction with professors and instructors as positive, but this respondent clearly articulates his or her view of the instructor as having expertise and not merely as a support.

Over half of respondents (17) stated that their peers were the most positive aspect of the MLIS program thus far, with one student listing "diverse learning experiences of all of the students in my class," as a positive aspect, and another stating that it was "really interesting learning with other students who are from all over the world and have very different life and work experiences than I have." These relationships were built over time and often facilitated through discussions and group work. During the program as students are building expertise, the diverse lived experience of other members of the cohort made significant contributions to learning and discovery.

However, these positive perceptions were countered by many structural constraints such as keeping abreast of readings, participating in and monitoring discussions, and working with students across different time zones. "The volume of reading that has to be done is significant for anyone working full time, and I can't imagine what it's like for those with full time work and children." Another respondent confirmed this speculation. "I work full-time and have a family, so I have been finding the sheer volume of work that is expected to be quite overwhelming." Ten respondents discussed the time required for participation in the online courses. "The added time requirement of posting is not the same as doing the reading and having to participate in class, which is spontaneous." Another respondent commented that one of the greatest challenges is "keeping up with the discussions." One respondent reported that "it is time-consuming to read through 20+ comments and by not keeping up I feel isolated from my classmates." Conversely, Brown and Green (2009) found that students in online programs spent the same amount of time participating in online discussions (reading and writing) as what students did in face-to-face courses. If this is the case, the above responses suggest that class participation and the psychological pressure of time is experienced differently in online courses and in the above instance, has led to feelings of isolation. Others found the structure of class discussions challenging, with one respondent reporting: "I had the idea that it [the program] would be a bit less structured, in that I hadn't anticipated discussions each week being between certain days and times."

For others in the program, dealing with the long-distance aspect of the program, particularly assignments involving group work, was a major constraint. Group work required students to adjust to the different geographical time zones and other time commitments and schedules of each group member. Several respondents made comments similar to this one: "We are in different time zones, different work schedules, different work/life commitments. Group work should not be tied to major assignments." However, group work also facilitated relationships and learning.

Half of all respondents mentioned course load and time commitment as a challenge, with one respondent reporting that they "found this degree to be 'part-time' in name only." When providing advice for future students, the most common refrain was to recognize the intensity of the workload and time commitment, with comments such as "Takes much more time than I realized. I anticipated 15 hours/week per course, but is actually taking much more than that." Conversely, two respondents stated that they would gladly take more courses if the option were available. Another respondent expressed surprise at "just how self-directed it [the program] is while still having due dates and incredible interaction with classmates and professors."

Respondents noted that program structure impacted their free time, leisure, and sense of motivation. Because students in the online teaching and learning stream take courses year-round, four explicitly stated they wanted more breaks incorporated into the semester.

Furthermore, in the summer of 2014, compressed courses were offered. In response to these courses, one student reported that:

> Summer courses were killer. They were so intense that the few weeks off before this fall semester started in no way felt like enough so I felt a lot more tense than before and it took longer to get properly motivated.

This response supports Akyol, Vaughan, and Garrison's (2011) finding that duration of courses (6 weeks compared to 13 weeks) influenced students' critical thinking. In addition, technology was a double-edged sword in that it could facilitate communication with other students and instructors but also alienate students. Two students reported that the greatest challenge was computer-related: "HAVING to be on a computer so much of the day" and "having others understand what it means to be in grad school because you are just on your computer."

Finally, some respondents noted that they would like additional signposts and markers indicating their progress through the program:

> We're not terribly well advised as to where we are in the program, and what's to come. More touchpoints from an advisor, even to the group en masse would be welcome and make us feel less like we are just floating out there.

This respondent experiences time and space in the online program as being unmoored. Others mentioned wanting "more updates on long term plans (graduation dates, capping project expectations, etc.)" and "a regular check-in with students with how they're handling the program (I know I feel pretty overwhelmed right now) and I don't know who I would feel comfortable talking to about it." It was important for respondents to feel connected to the program, to SLIS faculty and staff, to the University of Alberta, and to each other to avoid feelings of isolation. These findings support Ross, Gallagher, and McLeod (2013) who argue that it is incumbent upon institutions of Higher Education to foster a sense of "nearness" in distance education, with "nearness" defined as a temporal assemblage of people, technology, and circumstances that serves to support online learning. Conversely, one respondent stated "even though the distances are large, we are made to feel like we matter."

Relationships.

Many of the positive experiences reported by students reflected relationship building that occurred over time with one respondent registering his or her surprise at "how well I've gotten to know some of the other participants. I figured because we're never actually in the same place at the same time, that it would be difficult to get to know each other." The structure of courses could also facilitate relationship building. "Discussion groups also helped create a sense of community because you're sharing with these 5-6 people week after week." A number of respondents mentioned the importance of meeting others in the cohort (where possible) who lived in the same, or nearby, community: "someone in my first course invited all the members in my area to meet for coffee...We have only met 2 times, yet I feel that helped me to feel a sense of community." One respondent stated that "Meeting local members of my cohort, forming bonds with cohort members outside of my geographic region" led to "reigniting my passion for libraries and validating my career change." In-person interactions were uniformly perceived as a positive time investment.

However, time also served as a constraint to building and maintaining relationships, not just with fellow students but also with families. Six respondents stated that they did not develop a sense of community due to time constraints. "I don't have time to really enjoy or develop a rapport with my fellow classmates." "I think it has been really difficult being so spread out and not actually seeing them [classmates] on a regular basis." Time played a crucial role in whether students felt disconnected from others in the program. "I work full-time. I often don't have the time to read each one [comments]. Because of this, I feel that I haven't been able to connect the way I want to with my classmates." Family relationships could also be affected by the time commitment necessary for studying:

> my schedule does not line up with my children's school schedule very well, and when they have time off, I am not able to devote as much time to them as I want as I have to do school projects...I hate saying no to them...but I just don't have the time.

Discussion

There are two contradictory findings that arise from these results. First, students seek an MLIS program that fits into their lives. By far, the most appealing factor in taking the MLIS in the online teaching and learning stream is the perceived flexibility of the program. However, perceived flexibility was tempered by students' various time commitments, having to conform to program structure, and underestimating how much time the courses require. How can (perceived) program flexibility be reconciled with students' lived experience of taking the program? The second contradictory finding relates to Brown and Green's (2009) conclusion that if face-to-face students and online students spend the same amount of time on reading and writing for courses, why do online students experience learning and class time differently?

To answer these questions the work of McNeill (2014) is particularly helpful. McNeil notes that part-time and distance students traditionally have families and "social and domestic demands on their time that the full-time student does not normally have" and while these students might be rich, "their job and other commitments make them time poor" (p. 28). The results of this study support McNeill's hypothesis but an important caveat must be acknowledged. Our data source consisted of self-reported perceptions and experiences and not actual behaviour. It is possible, and perhaps likely, that time rich students are the ones who struggle the most with time management. Future research that triangulates self-reported data with other data such as time spent in eClass may provide greater insight into how students think they spend their time versus how they actually spend their time. However, for these online students, balancing external commitments to family, work, and others with taking MLIS courses often led to stress and feelings of guilt and isolation. Furthermore, many participants noted financial constraints. McNeil has previously observed "many [students] are becoming increasingly time impoverished as term time employment is required to subsidise fees and living expenses" (p. 27). In the case of MLIS students working in libraries and information centres, this can be particularly problematic because employment not only enriches the student financially so that they can continue their program of study but work also enriches them professionally by enhancing the learning experience. MLIS students have a number of reasons to pursue employment while earning their degrees even though this may mean they have less time to devote to their studies. Finally, students conceptualized the MLIS as a time investment that would pay off in the future with improved opportunities, challenges, and meaningful work.

To answer the second question "Why do online students experience learning and class time differently?" a number of factors are at play. As Eriksen noted in 2001, in everyday life short time gaps such as a five-minute wait in the grocery line or time spent commuting are increasingly being filled. In many instances technological innovations have eradicated time and space, making an "off" switch unavailable. While the MLIS program is time bound, course work can be experienced psychologically as open-ended for students. At the same time, research indicates that deciding work hours in advance, deliberately stopping work, resting, and taking breaks are ways to activate an “off” switch (Newport, 2016). Furthermore, self-reported data does not indicate the quality of time spent on courses. Students who engage in “deliberate practice” when learning, for example, can be more productive despite spending less time studying (Romero & Barbera, 2011).

Other findings indicate that face-to-face meetings facilitated a sense of community among students, instructors, and SLIS staff. Furthermore, shared online space could also facilitate a sense of community even when students were in different time zones and separated by geographical space. Conversely, other respondents felt disconnected because of the perceived psychological distance and physical distance in the online teaching and learning stream. In response to these perceptions of time, online educators might consciously try different pedagogical approaches that draw upon different senses of time such as pointillist, cyclical, and temponormative time discussed by Ihanainen and Moravec (2011).

Implications

Findings from this research have implications for the School of Library and Information Studies’ MLIS online teaching and learning stream, for online program planning and course design, and for further research. Students in online programs need clear expectations in terms of the time commitment required for completing a degree online and suggestions for how to structure their time to include rest and breaks. This information should be included in promotional materials as well as on the SLIS website. To support students during the online program, tutorials should be created to help students harness technology for managing their time, organizing their course work, communicating with instructors and students, and staying connected. Students who have completed the program or who have found successful ways to manage their time while working and parenting could provide video and/or audio testimonials. It is important to create a repository of time management articles, suggestions, videos, as well as student testimonials.

Advisors also have a role to play in supporting students with time issues. They can facilitate small group get-togethers where students can connect, share strategies for connecting and communicating, and for building community to help students feel connected to the institution (the University and the School of Library and Information Studies).

When planning programs, faculty should consider ways for students to connect including mentoring, small group advising, regular cohort online get-togethers, face-to-face meetings when possible, Facebook groups, etc. Clear course schedules with planned breaks can also help students see times when they can “get away” from course work. Faculty might keep abreast of current research about students who are enrolled in programs part-time and who work full-time to better understand students’ experiences and to assist with course planning. In designing individual courses, instructors should provide experiences that build community (small group discussions and projects, for example), help students stay connected to each other, consider time in terms of online discussion expectations, consider time in terms of assignment deadlines (that meet the needs of students rather than preferences of instructors), and plan for natural breaks where students are not expected to be on discussion forums.

This study, while interesting and informative for the SLIS program, reminds us there is still much to learn about the experiences of online students. Further research should explore multiple data sources such as instructor interviews, student discussions, and statistics from eClass to better understand student time online. Individual interviews would allow students to tell their stories and may encourage a richer discussion about issues relating to how time is experienced by the part-time student who is also a full-time worker. Yearly exit surveys could also be used to help faculty see trends, patterns, and changes in the online student experience as new initiatives are undertaken.

Conclusion

This study explored two questions: "How do students situate themselves in time as it pertains to the MLIS program and their future careers?" and "How does time shape online student experiences in the MLIS program?" Findings indicate that students situate themselves in time and that time management, course content and structure, relationships, and feelings of connection or disconnection are time dependent. Further research is needed to better understand how time shapes the experiences and learning of online students. Finally, conceptions of time are embedded in ideas and notions about future plans and careers, which is another area of inquiry for future research. Through the process of enculturation both into the profession and into the online program, students are positioning and imagining themselves in time. Time is a useful lens to understand student experience in the MLIS online learning stream and to enrich online pedagogy.

References

Akyol, Z., Vaughan, N., & Garrison, R. (2011). The impact of course duration on the development of a community of inquiry. *Interactive Learning Environments, 19*(3), 231-246. doi: 10.1080/10494820902809147

Allan, B. (2007). Time to learn? E-learners' experience of time in virtual learning communities. *Management Learning, 38*(5), 557-572. doi: 10.1177/1350507607083207

American Library Association. (2018). About ALA. Retrieved from http://www.ala.org/aboutala/

Barbera, E., & Clara, M. (2012). Time in e-learning research: A qualitative review of the empirical consideration of time in research into e-learning. *International Scholarly Research Network, 2012*, 1-11. doi:10.5402/2012/640802

Barnard-Brak, L., Lan, W. Y., & Paton, V. O. (2011). Profiles in self-regulated learning in the online learning environment. *International Review of Research in Open and Distance Education, 11*(1), 61-80. http://dx.doi.org/10.19173/irrodl.v11i1.769.

Bogdan, R. C., & S. K. Biklen. (1992). *Qualitative research for education: An introduction to theory and methods* (2nd ed.). Boston, MA: Allyn and Bacon.

Brown, A. H., & Green, T. (2009). Time students spend reading threaded discussions in online graduate courses requiring asynchronous participation. *International Review of Research in Open and Distance Learning, 10*(6), 51-64. http://dx.doi.org/10.19173/irrodl.v10i6.760

Burke, P. J., Bennett, A., Ramsay, G., Stevenson, J., & Clegg, S. (2016, December). *It's about time: Working towards better understandings of unequal temporal resources and the impact of time for students in higher education*. Paper presented at the Society for Research into Higher Education Annual Research Conference, Newport, South Wales, UK. Retrieved from https://www.newcastle.edu.au/__data/assets/pdf_file/0004/279958/ITS-ABOUT-TIME.pdf

Cavanaugh, T., Lamkin, M. L., & Hu, H. (2012). Using a generalized checklist to improve student assignment submission in an online course. *Journal of Asynchronous Learning Networks, 16*(4), 39-44.

Cho, M., & Tobias, S. (2016). Should instructors require discussion in online courses? Effects of online discussion on community of inquiry, learner time, satisfaction, and achievement. *International Review of Research in Open and Distributed Learning, 17*(2), 124-140. http://dx.doi.org/10.19173/irrodl.v17i2.2342

Collis, B., & Moonen, J. (2011). Flexibility in higher education: Revisiting expectations. *Communicar,* 37(XIX), 15-24. http://dx.doi.org/10.3916/C37-2011-02-01

Consillium. (2015, December 4). *Online and distance education capacity of Canadian universities*. Retrieved from https://www.tonybates.ca/wp-content/uploads/ANALYSIS-AND-REVIEW-of-Canada-Distance-Education-2015-EN-final-1-1.pdf

Eriksen, T. H. (2001). *Tyranny of the moment: Fast and slow time in the information age*. London: Pluto Press.

Evans, T. (1989). Taking place: The social construction of place, time and space, and the (re)making of distances in distance education. *Distance Education 10*(2), 170-183. doi: 10.1080/0158790100203

Gourlay, L. (2014). Creating time: Students, technologies, and temporal practices in higher education. *E-Learning and Digital Media, 11*(2), 141-153. http://dx.doi.org/10.2304/elea.2014.11.2.141

Henderson, H. (2016, December). *Thinking about the future: Potential sociologies of higher education students possible selves*. Paper presented at the Society for Research into Higher Education Annual Research Conference, Newport, South Wales, UK. Retrieved from http://www.srhe.ac.uk/conference2016/downloads/SRHE_ARC_2016_Programme.pdf

Hesse, B. W., Werner, C. M., & Altman, I. (1988). Temporal aspects of computer-mediated communication. *Computers in Human Behaviour, 4*, 147-165.

Ihanainen, P., & Moravec, J. W. (2011). Pointillist, cyclical, and overlapping: Multidimensional facets of time in online education. *International Review of Research in Open and Distance Learning, 12*(7), 27-39. http://dx.doi.org/10.19173/irrodl.v12i7.1023

Kabat-Ryan, K. (2014). Fixed and manipulated temporal frames: Procedural analysis of students' perceptions of electronic time on the discussion board. In E. Barbera & P. Reimann (Eds.), *Assessment and evaluation of time factors in online teaching and learning* (pp. 163-197). Hershey, PA: Information Science Reference (IGI Global).

Lazaros, E., & Flowers, J. (2014). Keys to succeeding in a master's program. *Technology and Engineering Teacher, 73*(5), 34-39.

Luppicini, R. (2007). Review of computer mediated communication research for education. *Instructional Science, 35*, 141-185. doi: 10.1007/s11251-006-9001-6

Mardsen, R. (1996). Time, space, and distance education. *Distance Education, 17*(2), 222-246.

McNeill, W. (2014). Time and the working online learner. In E. Barbera & P. Reimann (Eds.), *Assessment and evaluation of time factors in online teaching and learning* (pp. 24-62). Hershey, PA: Information Science Reference (IGI Global).

Michinov, N., Brunot, S., Le Bohec, O., Juhel, J., & Delaval, M. (2011). Procrastination, participation, and performance in online learning environments. *Computers & Education, 56*(1), 243-252. https://doi.org/10.1016/j.compedu.2010.07.025

Miles, M. B., & Huberman, M. A. (1998). *Qualitative data analysis: An expanded sourcebook* (2nd ed.). Thousand Oaks, CA: Sage Publications.

Newport, C. (2016). *Deep work*. New York, NY: Grand Central Publishing.

Paechter, M., & Maier, B. (2010). Online or face-to-face? Students' experiences and preferences in e-learning. *The Internet and Higher Education, 13*(4), 292-297. https://doi.org/10.1016/j.iheduc.2010.09.004

Rakes, G. C., Dunn, K. E., & Rakes, T. A. (2013). Attribution as a predictor of procrastination in online graduate students. *Journal of Interactive Online Learning, 12*(3), 103-121.

Romero, M., & Barbera, E. (2011). Quality of learners' time and learning performance beyond quantitative time-on-task. *The International Review of Research in Open and Distance Learning, 12*(5), 125-137. http://dx.doi.org/10.19173/irrodl.v12i5.999

Ross, J., Gallagher, M. S., & Macleod, H. (2013). Making distance visible: Assembling nearness in an online program. *The International Review of Research in Open and Distance Learning, 14*(4), 51-67. http://dx.doi.org/10.19173/irrodl.v14i4.1545

Smyth, J. D., Dillman, D. A., Christian, L. M., & McBride, M. (2009). Open-ended questions in web surveys: Can increasing the size of answer boxes and providing extra verbal instructions improve response quality? *Public Opinion Quarterly, 73*(2), 325-337.

Valenta, A., Therriault, D., Dieter, M., & Mrtek, R. (2001). Identifying student attitudes and learning styles in distance education. *Journal of Asynchronous Learning Network*, *5*(2).

Winter, C., Cotton, D., Gavin, J., & J.D. Yorke. (2010). Effective e-learning? Multi-tasking, distractions, and boundary management by graduate students in an online environment. *ALT-J Research in Learning Technology, 18*(1), 71-83. doi: 10.1080/09687761003657598

International **R**eview of **R**esearch in **O**pen and **D**istributed **L**earning
Volume 19, Number 4

September – 2018

Developing a Mobile App for Learning English Vocabulary in an Open Distance Learning Context

Mpine Makoe and Thuli Shandu
University of South Africa (UNISA)

Abstract

Academic success depends on the comprehension of a language, which is linked to vocabulary learning. Many distance students in South Africa find it difficult to comprehend learning in a language other than their mother tongue. Finding effective strategies for enhancing English vocabulary of university students amidst the spatial, temporal, and pedagogic distance associated with Open Distance Learning (ODL) practices remains a challenge. To address the need for enhancing vocabulary development, mobile application systems (apps) were explored as the best vehicle for the delivery of the vocabulary learning. Mobile learning technologies are ideal in the ODL context because they are flexible, accessible, available, and cater for a myriad of interaction activities. The purpose of the study is to design and implement a mobile-based application aimed at enhancing English vocabulary teaching and learning. Using the Design-Based Research methodology, this study maps the steps taken to develop a vocabulary learning mobile app named VocUp; it describes the architecture, user interface, features of VocUp, and advocates for contextually-conscious and learning-driven app development.

Keywords: mobile apps, vocabulary teaching and learning, android app development, design-based research

Introduction

Mobile phones have proliferated our daily lives to an extent that many confess to not being able to live without them. Inasmuch as they were earlier touted as wireless communication devices that allowed for untethered, anytime, and anywhere calls, mobile phones are now complex instruments with multiple functions (Godwin-Jones, 2011). Within the language learning sphere, mobile application systems (apps) have transformed the mobile phone into mobile language laboratories where users can learn and practise languages wherever and whenever they find an opportunity (Kukulska-Hulme, 2009; Traxler, 2009). This flexibility in learning is especially critical in Open Distance Learning (ODL) contexts where students, often with limited time and resources, need a flexible mode of learning that allows them to study anywhere and anytime. The spatial and temporal distance in ODL often means that the students are separated from their peers, instructors, and even the institutional physical resources such as the library (Moore, 1993; Makoe, 2010). Therefore, there is a crucial need for support not only for learning, but also for language learning and use.

Supporting language learning is critical in South Africa given that students, whose first language is often not English, are expected to be proficient in English as an academic language. Many of these students struggle to meet the academic demands of higher education because their academic success is determined, mostly, by their proficiency in English. Academic success, according to Folse (2010) “depends on reading ability, and reading ability is in turn strongly linked to vocabulary” (p. 140). However, second language speakers find it difficult to comprehend learning in a language other than their mother tongue. Comprehension is linked to one’s vocabulary as Nation (2002) reported that an educated native speaker of English knows about 20,000 word families, or 70,000 words, but second or foreign language students of English know only a fraction of this number (Laufer & Yano, 2001). Studies have shown that increased vocabulary positively influences academic performance (Larsen-Freeman, 2003; Nation, 2002; Nation & Waring, 1997). Finding effective strategies for enhancing the vocabulary of university students amidst the spatial, temporal, and pedagogic distance is, therefore, a major challenge in ODL.

To address the distance students’ need for vocabulary learning, mobile application systems (apps) were explored as the best vehicle for the delivery of the vocabulary learning. Mobile learning technologies are ideal in the ODL context because they are flexible, available, and cater for a myriad of interaction activities. The idea is to harness the affordances of mobile technology that is synonymous to the students’ lifestyle by presenting a portable programme that is accessible to students anytime and anywhere. Therefore, the purpose of this study is to design and implement a mobile-based application aimed at enhancing vocabulary teaching and learning.

Vocabulary Teaching and Learning

For many years, vocabulary teaching was not considered a critical component of language learning as reading and grammar (de Groot, 2006). One school of thought has expressed that vocabulary can be picked up incidentally when learners are exposed to other activities such as reading (Ender, 2014), while others have supported the view that vocabulary should be purposefully and explicitly taught (Feldman & Kinsella, 2005). According to Nation’s (2002) multi-componential framework for teaching vocabulary, there are three dimensions of word knowledge: form, meaning, and use. Students need to learn the form of words, their meaning, and how to use them appropriately in various settings. The multi-componential nature of word knowledge was used to ground this study because it provides a much needed structure for how to teach vocabulary within a distance learning context.

The first principle of vocabulary development is the explicit teaching and learning of vocabulary, which refers to the "selection and presentation of words for learners" (Furneaux, 1999, p. 367). This also involves directly teaching learners how to internalise and use the vocabulary because "merely giving students lists of words to learn is certainly not effective vocabulary instruction." (Oxford & Scarcella, 1994, p. 231). The second principle of vocabulary teaching pertains to practice through repeated exposure to the vocabulary and opportunities for rehearsals. It was therefore important that the mobile app should facilitate repeated exposure to words used previously. The third principle relates to testing. According to Stockwell (2010) and Zimmerman (1997), incorporating exercises as part of vocabulary learning leads to effective vocabulary development. It is therefore important that assessment is incorporated in the proposed app so that distance students could demonstrate their grasp of the new words. The aim of using mobile apps is to facilitate interaction between student and a teacher, and among students themselves. Interaction plays a crucial role in education especially in vocabulary teaching and learning where students are expected to use the new vocabulary in real life, including interaction with the content, device, teacher, and other students.

The feasibility of interaction in its varied forms is difficult in an ODL context due to the physical as well as pedagogic distance between students and the learning environment. Throughout the history of distance education, different types of technologies have been explored to address the concept of interaction which is vital for success in education. There are different types of interaction in ODL, the main ones being student-student interaction and student-lecturer interaction, as well as student-content interaction (Moore, 1993). These interactions are all underpinned by the crucial role of technology in facilitating meaningful interaction (Garrison, 1989). Distance learning students need continuous interaction which is facilitated by the lecturer and, thus, requires technology that will be continuously accessible for students and lecturers (Makoe, 2010). The decision to use mobile phones to enhance interaction for teaching vocabulary was influenced by three factors: context, availability, and accessibility. Mobile phones were chosen because they offers space that makes interaction and attention to vocabulary possible, even in ODL contexts.

The context in which learning takes place is critical, according to Cole (2003), because it is located within a social environment that influences an individual in a various ways. Therefore, it is important that the pedagogical principles should be guided by the context of teaching and learning. In this context, learning will be guided by the principles of the ODL practice, the accessibility of mobile phones in the South African environment, and the students learning experiences. In an ODL context, there is a need to facilitate teaching to students who are learning at a distance. Therefore, the delivery of teaching should be flexible so that students can access them anytime and anywhere.

The lack of infrastructure to support Information Communication Technologies (ICTs) in most developing countries, has led to the proliferation of the wireless infrastructure. The use of mobile phones in Africa has increased at an alarming rate. In South Africa alone, the ownership of cellphones was just over 85 million, while the population is about 45 million in 2015 (Shezi, 2016). In this context, owning a mobile phone is not a luxury, but "a staple of day-to-day life" for all spheres of society (Pandey & Singh, 2015, p. 108). This shows that mobile phones are available and accessible to a large number of people and therefore can be used to facilitate teaching and learning. According to Keegan (2005), "It is not technologies with inherent pedagogical capabilities that are successful in distance education, but technologies that are generally available to citizens" (p. 3). Therefore, vocabulary learning through content and device interaction is best facilitated and augmented by mobile learning technologies because they are flexible, available, and cater for countless interaction activities (Traxler, 2009).

Design-Based Research Methodology

Since mobile phones have transcended the function of making and receiving calls and they are now a learning tool, they are used to support ODL students as they learn English vocabulary. The idea was to harness the affordances of mobile technologies that students were already familiar with to enhance their vocabulary. To address the objective of the study, the Design-Based Research (DBR) methodology was used because of its devotion to the development of interventions that solve problems in authentic contexts (Anderson & Shattuck, 2012). DBR is concerned with integrating known and hypothetical design principles with technological affordances towards practical solutions; conducting rigorous and reflective inquiry to test and refine innovative learning environments as well as to define new design principles (Anderson & Shattuck, 2012; Kolmos, 2015).

In developing the mobile app for teaching and learning vocabulary, the four-phased DBR methodology was followed. The first phase relied on the literature review and the analysis of context to identify and analyse the problem. The second phase involved the development of a solution using existing vocabulary teaching and learning principles. The third phase of the DBR is preoccupied with evaluation and testing of the solution in practice (McKenney & Reeves, 2013). Since DBR is concerned with improved interventions and principles for real educational environments, this phase involves a series of iterative cycles of testing and refinement. The iterations leads to the fourth stage of DBR in the form of a reflection to produce design principles and enhance solution implementation.

Once it was determined that a mobile vocabulary app would be the best intervention, a search for a relevant app that focused on vocabulary learning was done through surveying language learning apps. Some of the apps provided in-depth explicit teaching of vocabulary that included synonyms and antonyms. Other apps provided images and visual cues as part of vocabulary teaching and resources, such as pictures of the words taught. Yet other apps provided daily vocabulary delivered to the user together with definitions and examples of how that word had been used in literature, but they did not provide opportunities for testing understanding. Some apps were tailored in that they were aimed at providing preparation for specific standardised tests. Despite the myriad apps available in the market, none was considered appropriate for the purposes of vocabulary learning in ODL because they could not facilitate the principles which underpin the pedagogy of vocabulary teaching and learning. Given the limitations of the surveyed apps, a contextually relevant app was then developed to address the pedagogical (content) thrust and the technological (vehicle) delivery. The app had to conform to the vocabulary learning principles of explicit vocabulary teaching (Nation, 2002); rehearsal and practice as well as incorporating testing (Stockwell, 2010).

Developing the App

Using the benefits of the portability of the device; the different features in the device; the multimedia functionality of voice, text, and graphic-audio visual, had made it possible for mlearning to cater for innovative ways to teaching and learning especially in an ODL context. The mobile devices are not only accessible, they are also less expensive than computers and laptops and they are cheaper to charge so that students where electricity is scarce, can keep their phones operating. Its accessibility, availability, and flexibility are the underlying and foregrounding principles that makes mlearning to be considered as more beneficial over other delivery tools of learning.

Planning. The first step towards planning for the development of the mobile app meant to enhance vocabulary learning is to decide on the content that was to be taught. Research has emphasized the importance of developing a language learning environment before deciding on the role of mobile technologies and further emphasizes a focus on the learner ahead of the technology (Salaberry, 2001; Colpaert, 2004); therefore, there was a need for ensuring a match between pedagogy and technology (Sweeney & Moore, 2012). In this case, the mobile app was developed to enhance vocabulary learning. There was a need for increased vocabulary towards increased proficiency and better chances of success (Schmitt, Schmitt, & Clapham, 2001), thus it was decided that vocabulary would be taught in its multi-componential nature of form, meaning, and use (Larsen-Freeman, 2003; Nation & Waring, 1997). Further, the content had to conform to the vocabulary principles of explicit teaching, repeated exposure, as well as assessment practices. Based on the work of Thornton and Houser (2002), short lessons were created which were labelled Word Capsules. Each Word Capsule contains the word of the day, part of speech, definition, three sentences for different ways the word could be used in real contexts, and three exercises for further testing and application.

The second step was to identify the operating system for the envisaged mobile app. Three operating systems were considered for developing the native app including the IOS, Android, and Symbian. The Android Operating System was selected because, according to Joorabchi, Mesbah, and Kruchten (2013), there were about two million apps available with Android taking 52% of the market; Apple taking 38% of market share, and AppWorld and Windows with 6% and 3% respectively. The app was developed on the open source platform with a complete software stack for a mobile device.

The third step was to draw mockups of what the app was to look like on the phone. The app development software was then installed on the computer as part of setting up the environment for Android app development. Different programmes were installed for creating the app where all codes for instructions were entered and others were meant to enable the computer to understand and "speak" the language of the app. Other programmes were emulators, which enables the developer to see how the app will look like in a real android phone.

Coding. Following the planning stage was the coding process which focused on three main sections including developing the *User Interface (UI)*, creating *Activities*, as well as creating *Activity Life Cycles*. Developing the UI involved creating the packaging of the app, its view, and layout. The linear layout and card view were used because they displayed the different sections of the vocabulary in a logical and presentable flow. Other features such as background colours, font colours, and special characters, including bold and italic, were also coded.

The Activities of the app were sections which form part of the app and these were divided into four activities. The *Word of the Day* activity has subcategories of reflecting the word itself; part of speech and definition. The next Activity has the *Examples* which listed three sentences reflecting how a word can be used in real life. The third Activity is the *Exercises* which was a list of three questions giving the users an opportunity to test their grasp of the vocabulary and further allow for vocabulary use. Each exercise has the question itself, three options, one correct answer, and a check button. The last Activity contains *Past Words*, a list of words which have been covered in previous days so the users can go back and review them.

The Activity Life Cycle involved coding instructions for what the app had to do and when. The app was given instructions on what to do when a phone has been switched off and then on; when the app has been inactive; when the user closes the app (*onCreate*, *onStart*, *onResume- Running*, *Paused*, *Stopped*). These instructions included background activities for the app to connect periodically to the cloud to pull down updates such as new Word Capsules. Other programmes were used binding the Activities and keeping them in sync while testing if the instructions were being applied.

Adding vocabulary content. To develop Word Capsules, words were carefully selected from the two versions of the Vocabulary Levels Test (Schmitt et al., 2001). The 10,000 word levels from both versions of the test were used because language learners who have grasped the most frequent 10,000 words in English have a wide vocabulary and may be able to cope with the challenges of studying at university in English.

Short vocabulary lessons were created and labelled as *Word Capsules*. To illustrate the concept of a word capsule, the word "bask" is used. After detailing that this entry as a "verb," a definition is entered as "To sit or lie enjoying the warmth, usually exposed to the sun, for relaxation. Bask is also used to mean deriving pleasure especially from attention." Then three sentences exemplifying use are presented as:

1. Take care to wear sunscreen as you bask in the sun this summer.
2. My sister basked in the limelight as she received awards for sports excellence.
3. I've had it with her indolence; she spends her days basking in the sun when she should be helping me with chores.

The word usage examples are followed by exercises which provide more opportunities for using the new word and also to test understanding:

1. Which of the following songs would you most likely associate with bask?
    a. I'm gonna soak up the sun
    b. Ain't no sunshine when she's gone
    c. Crying in the sun
2. Choose a feeling that best goes together with basking.
    a. Irritation
    b. Fear
    c. Joy
3. Another word for bask could be
    a. Burn
    b. Sleep
    c. Revel

App testing. When the app looked and worked well, it was sent to external parties for testing. Feedback was received on the technical aspects of the app, such as ease of use as well as the content such as typos, options, and answers to exercises. The comments were used to revise the app through a series of testing and revisions.

VocUp overview. Once the app was developed, it was given the name VocUp as a play on "upping the vocabulary" which would sound a bit like "vocabulary app." A VocUp icon was then created that would make the app identifiable on the phone. After downloading and running the app, the user could click on the VocUp link to access the Word of the Day. Alternatively, if the user allows it, the app sends a notification to the user when the new word is delivered in the morning. This feature is meant to invite the busy ODL student to take some time and do some studying. The app was developed as self-sufficient to encourage independent study.

App evaluation and discussion. To inform the design principles, VocUp was evaluated in relation to its technological design and how it facilitated vocabulary learning as an intervention. Although the purpose of VocUp is vocabulary development, it is also important for the delivery tool to be of quality for it to fulfil the purpose for which it was created. According to Parsons, Ryu, and Cranshaw (2007), quality in a mobile learning system should focus on product quality and the quality of the user experience. They further assert that mobile learning environment issues pertain to user role and profile, mobility, interface design, media types, communication support, as well as the elimination of technical errors (Parsons et al., 2007). Pertinent to the issues of quality is the device aspect, the intersection of device usability, and social technology. To evaluate the technology aspects of VocUp, Sarrab, Elbasir, and Alnaeli's (2016) quality model was used because it has synthesised previous quality models and took into account the recent developments in mobile technologies. In the words of Sarrab et al. (2016), the model provides "developers with concrete actions that will reach the preferred quality level" (p. 101).

While it was developed based on the principles of vocabulary development, including the explicit teaching of form, meaning, and use; repeated exposure to learned words; as well as assessment practices (Folse, 2006; Nation, 2002), VocUp coheres to the technical qualities pertaining to mobile learning (Sarrab et al., 2016). The quality checks included availability, flexibility, quick response, connectivity, reliability, functionality, usability, and security. Table 1 presents the list of mobile technical aspects in relation to VocUp.

Table 1

Towards A Quality Model of Technical Aspects for Mobile Learning Services With Added VocUp Features

Technical aspect	**Short description**	**VocUp examples**
Availability	Accessibility associated with mlearning.	- Word capsules sent early in the morning. - Past words accessible in the app for revisiting and reviewing.
Quick response	Avoiding delays in response.	- Downloading and access prompt due to data size.

		- Exercises quickly alert user of incorrect answer.
Flexibility	Offering options for the user.	- Flexibility of time and place of use. - Content flexibility.
Scalability	Accommodating changes made to the system.	- Accommodated later changes on alarms and activities. - Migrated system to new hosting site.
Connectivity	Maintaining connectedness for collaboration through instant interactivity.	Learner-device interaction.
Reliability	Consistency and trusted functioning without system failure.	- Reliability affected by system error and bugs at the beginning. - System correction and bug clean-up improved reliability.
Functionality	Accuracy and suitability of the app based on the needs of the users and their contexts.	- VocUp teaches vocabulary explicitly. - The app functions such as notifications improve functionality.
Usability	Ease of use.	- Sliding screens between activities. - Accessing word of the day and past words.
Security	Achieving data confidentiality, integrity, and availability.	- VocUp does not carry high-risk confidential information such as student numbers and academic records or bank account details.

Note. The table illustrates the various technical aspects towards quality in mobile learning, qualified through VocUp features aligning to relevant quality markers. Adapted from "Towards a quality model of technical aspects for mobile learning services: An empirical investigation," by M. Sarrab, M. Elbasir, and S. Alnaeli, 2016, *Computers in Human Behavior, 55*(A), p. 101. Copyright 2015 by Elsevier Ltd.

Testing the App

Once the app was developed, tested, and piloted to a small number of people, VocUp was then disseminated to a group of first-year English students who had signed consent forms to participate in the study. The app, together with a set of instructions on how to download, was sent to the participants through WhatsApp. After downloading it onto their phones, the participants began to engage with the vocabulary immediately. The word of the day had different categories for the word on each screen. The main screen had the word of the day including the part of speech and definition. Sliding the screen showed the three example sentences. Another slide showed the exercises. On the second day, the app sent the new word with the different screens showing the various categories of the word. The previous day's word was available in the Past Words screen. After a few weeks of activity with VocUp, interview questions were sent to participants and their responses sent back to the researcher on WhatsApp. The interview questions were related to the participants' experiences of downloading and using VocUp with particular references to the technical aspects, as well as the pedagogical issues pertaining to the app. The interview questions were sent individually to all the participants and 18 out of 29 participants sent back their responses.

One of the characteristics of DBR is that it is situated in real educational contexts and therefore participants were asked to respond on their experiences on using VocUp and how it could be improved. Based on the virtual interviews, the results showed benefits related to ease of use, familiarity with phone systems, and vocabulary content. Participants appreciated the fact that the app was interactive in that the exercises helped them to get prompt feedback on assessing their understanding of the content. In the absence of human-human interaction, the app provided device-human interaction that facilitated feedback. Since most distance students have responsibilities besides studying, they said the app's notifications were helpful because it served as a constant reminder to engage in learning. Despite these benefits, the findings revealed that the challenges of VocUp related to phone problems, network and connectivity, as well as a lack of familiarity with phone use. Some participants were wary of downloading VocUp, as they feared it might be costly. Other participants were concerned about the security of the app. The one area of concern was that VocUp was downloaded through a link to a website where the app code was stored. Failure to pay attention to protection and security can hinder the adoption and use of a mobile app such as VocUp.

Although VocUp facilitated student-content and student-device interaction where the participants appreciated the privacy of working alone, other participants felt that they needed student-student and student-lecturer interaction. It was clear that the refinement needed to include an interaction component to it. VocUp was created with the purpose of assisting distance students to learn new words at their own pace. The exercises, as multiple-choice or sentence and paragraph writing, also was meant to facilitate the cognitive presence processes as some exercises prompted a sense of puzzlement, which necessitated cognitive engagement with the words. The exercises also played a socio-emotional role in that the participants were elated and had their confidence boosted, or were shy and sometimes dejected based on when and how they answered the exercises. Not only did this vocabulary app serve a reflective role of testing the grasp of learned vocabulary, but the assessment also served the role of facilitating interaction. The assessment was so important that the participants requested more exercises to be included as part of the intervention. The use of mobile phones meant that the participants could continue with their daily lives while they also caught up on vocabulary.

VocUp refinement. Since DBR is about refinement of the solution, the results from the first interviews assisted with the refinement of the app. The main refinement areas were technical and pedagogic in nature. Although some students were able to download the app easily and quickly, others who were not familiar with the phone and the app system struggled a bit. This indicated that the instructions for downloading the app needed refinement so that downloads would be easier since distance students work mostly on their own. In addition to refined instructions, the participants requested the inclusion of a word pronunciation feature. While the participants in this study had one word per day, with three main sections of the lesson focusing on form, meaning, and use, participants also wanted more exercises in addition to the activities they completed. This was a surprising given that distance students have to juggle their studies with personal, work, family, and social commitments. However, this finding reveals that distance students know what they want, aware of their vocabulary deficiencies, and want more support in developing their vocabulary. The need for more work may be that participants enjoyed accessing lessons from a medium that was not disruptive of their daily activities. The vocabulary learning technology was integrated into their lifestyle and they could conveniently access the content.

Reflection and Discussion

The final phase in design of the app began with what had to be taught, how it had to be taught, to whom, when, and how. The "what" question was lucidly responded to by the importance of vocabulary in language proficiency, especially for second language speakers. As to what exactly needed to be taught as part of the vocabulary, Larsen-Freeman (2003) provided guidance on teaching form, meaning, and use. There was also a need to teach students how to spell the word correctly, define it, and use it appropriately. Regarding the specific vocabulary to be taught, the Vocabulary Levels Test (Schmitt et al., 2001) were used because it had gone through stringent validity and reliability processes. From the Test, words were selected to form Word Capsules, which would explicitly teach vocabulary while the app facilitated repeated exposure to words and provided assessment opportunities. The interaction between user and device was one of the most useful and helpful features of the app, especially in the ODL context. The exercises provided student-device and student-content interaction where feedback was received immediately and prompted the users to attempt the question again, or opt to revisit the other sections as they became aware of gaps in understanding.

The appeal of mobile learning is the fact that one uses a tool with which most students are familiar. In this study, thus, the mobile phone proved to be both a resource and a source of frustration. It was a resource because it provided flexible and easy access to the content, but it was a frustration and barrier when the device seemed to hinder their ability to access content, such as when there was no network. Familiarity with technology or lack thereof, even after orientation, determined whether one would be able to access the content or participate successfully in the intervention. This study revealed that challenges and shortcomings associated with mlearning are actually related to the users' comfort and familiarity with the technology used. It is therefore important that practitioners consider developing context-appropriate apps that serve the needs of their students.

Conclusion

This paper has highlighted the importance of technological, as well pedagogical, aspects of mobile-app interventions for vocabulary teaching and learning. In planning to implement mobile learning, this study demonstrated a need for interventions to consider the teaching and learning context in addition to the students for whom the interventions are developed. In trying to implement mlearning, effort should be made to incorporate interventions that would not further exclude students from benefiting. In this study, the intervention for vocabulary development was developed within the contextual principles of ODL, which emphasise student-centredness, flexibility, and accessibility. There was a marked effort to create technologically-stable and pedagogically sound intervention that would benefit students. When developing mobile apps, however, we should be cautious of being presumptuous about student backgrounds by creating interventions as all-encompassing; instead, we should be prudent and offer options to students. Mobile apps that will work in ODL, therefore, are those that acknowledge contextual variables, provide options for independent study, and/or interaction. To facilitate student-centredness, interventions should be flexible and accessible.

References

Anderson, T., & Shattuck, J. (2012). Design-based research: A decade of progress in education research? *Educational Researcher, 41*(1), 1-17. **https://doi:10.3102/0013189X11428813**

Cole, M. (2003). *Vygotsky and context. Where did the connection come from and what difference does it make?* Istanbul: International Society for Theoretical Psychology. Retrieved from **http://lchc.ucsd.edu/People/MCole/lsvcontext.html**

Colpaert, J. (2004). From courseware to coursewear? *Computer Assisted Language Learning, 17*(3-4), 261-266. **https://doi/abs/10.1080/0958822042000319575**

De Groot, A. (2006). Effects of stimulus characteristics and background music on foreign language vocabulary learning and forgetting. *Language Learning, 56*(3), 463-506. **doi/abs/10.1111/j.1467-9922.2006.00374.x**

Ender, A. (2014). Implicit and explicit cognitive processes in incidental vocabulary acquisition. *Applied Linguistics, 37*(4), 536–560. **https://doi.org/10.1093/applin/amu051**

Feldman, K., & Kinsella, K. (2005). Narrowing the language gap: The case for explicit vocabulary instruction. *Scholastic*. Retrieved from **http://teacher.scholastic.com/products/authors/pdfs/Narrowing_the_Gap.pdf**

Folse, K. (2010). Is explicit vocabulary focus the reading teacher's job? *Reading in a Foreign Language, 22*(1), 139-160. Retrieved from http://files.eric.ed.gov/fulltext/EJ887885.pdf

Furneaux, C. (1999). Recent materials on teaching writing. *ELT Journal, 53*(1), 56-61. **https://doi.org/10.1093/elt/53.1.56**

Garrison, D. R. (1985). Three generations of technological innovations in distance education. *Distance Education, 6*(2), 235-241. **https://doi.org/10.1080/0158791850060208**

Godwin-Jones, R. (2011). Emerging technologies: Mobile apps for language learning. *Language Learning & Technology, 15*(2), 2-11.

Joorabchi, M. E., Mesbah, A., & Kruchten, P. (2013, October). Real challenges in mobile app development. In *The ACM/IEEE International Symposium on Empirical Software Engineering and Measurement* (pp. 15-24). IEEE. **https://doi.org/10.1109/ESEM.2013.9**

Keegan, D. (2005, October). The incorporation of mobile learning into mainstream education and training. In *Proceedings of the 4th World Conference on m-Learning*, Cape Town, (pp. 25-28). Retrieved from **keegan1.pdf?AWSAccessKeyId=AKIAIWOWYYGZ2Y53UL3A&Expires=1536935853&Signature_incorporation_of_mobile_learning_int.pdf**

Kolmos, A. (2015, July). Design-based research: Issues in connecting theory, research and practice. In *Research in Engineering Education Symposium* (pp. 13-15). Aungier St.: Dublin Institute of

Technology. Retrieved from http://vbn.aau.dk/en/publications/designbased-research--issues-in-connecting-theory-research-and-practice(d4a34757-95ba-4801-90e9-34468a56a844).html

Kukulska-Hulme, A. (2009). Will mobile learning change language learning? *ReCALL, 21*(2), 157-165. https://doi.org/10.1017/S0958344009000202

Larsen-Freeman, D. (2003). *Teaching language: From grammar to grammaring*. Boston: Heinle.

Laufer, B., & Yano, Y. (2001). Understanding unfamiliar words in a text: Do L2 learners understand how much they don't understand? *Reading in a Foreign Language, 13*(2), 549-566.

Makoe, M. (2010). Exploring the use of MXit: A cell-phone social network to facilitate learning in distance education. *Open Learning, 25*(3), 251-257. https://doi.org/10.1080/02680513.2010.512099

McKenney, S., & Reeves, T. (2013). Educational design research. In M. Spector, M. Merrill, J. Elen, & M. Bischop (Eds.), *Handbook of research on educational communications & technology*. London: Springer.

Moore, M. G. (1993). Theory of transactional distance. In D. Keegan (Ed.), *Theoretical principles of distance education* (pp. 22–38). Routledge: London.

Nation, P. (2002). Best Practice in Vocabulary Teaching and Learning. In J. Richards & W. Renandya (Eds.), *Methodology in Language Teaching: An Anthology of Current Practice*, (pp. 267-272). Cambridge: Cambridge University Press. https://doi.org/10.1017/CBO9780511667190.037

Nation, P., & Waring, R. (1997). Vocabulary size, text coverage and word lists. *Vocabulary: Description, Acquisition and Pedagogy, 14*, 6-19. Retrieved from http://catdir.loc.gov/catdir/samples/cam031/97042211.pdf

Oxford, R. L., & Scarcella, R. C. (1994). Second language vocabulary learning among adults: State of the art in vocabulary instruction. *System, 22*(2), 231-243. https://doi.org/10.1016/0346-251X(94)90059-0

Pandey, K., & Singh, N. (2015). Mobile learning: Critical pedagogy to education for all. In Y. Zhang (Ed.), *Handbook of Mobile Teaching and Learning,* (pp. 107-132). Heidelberg, Berlin: Springer. https://doi:10.1007/978-3-642-54146-9_6

Parsons, D., Ryu, H., & Cranshaw, M. (2007). A design requirements framework for mobile learning environments. *Journal of Computers, 2*(4), 96-100. DOI: 10.4304/jcp.2.4.1-8

Salaberry, M. R. (2001). The use of technology for second language learning and teaching: A retrospective. *The Modern Language Journal, 85*(1), 39-56. https://doi.org/10.1111/0026-7902.00096

Sarrab, M., Elbasir, M., & Alnaeli, S. (2016). Towards a quality model of technical aspects for mobile learning services: An empirical investigation. *Computers in Human Behavior, 55*, 100-112. https://doi.org/10.1016/j.chb.2015.09.003

Schmitt, N., Schmitt, D., & Clapham, C. (2001). Developing and exploring the behaviour of two new versions of the Vocabulary Levels Test. *Language Testing, 18*(1), 55-88. DOI: 10.1177/026553220101800103

Shezi, L. (2016, April 29). SA's 26.8 million internet users spend almost three hours a day on social media. *HXT*. Retrieved from http://www.htxt.co.za/2016/04/29/the-stuff-south-africa-26-8-mil-internet-users-spend-most-their-time-doing-online/

Stockwell, G. (2010). Using mobile phones for vocabulary activities: examining the effect of the platform. *Language Learning & Technology, 14*(2), 95-110.

Sweeney, P., & Moore, C. (2012). Mobile apps for learning vocabulary: Categories, evaluation and design criteria for teachers and developers. *International Journal of Computer-Assisted Language Learning and Teaching (IJCALLT), 2*(4), 1-16. DOI: 10.4018/ijcallt.2012100101

Thornton, P., & Houser, C. (2002). M-learning in transit. In P. Lewis (Ed.), *The changing face of CALL* (pp. 229-243). Lisse, The Netherlands: Swets and Zeitlinger.

Traxler, J. (2009). Current state of mLearning. In M. Ally (Ed.), *mLearning: Transforming the delivery of education and training* (pp. 9-24). Edmonton, Alberta: Athabasca University Press.

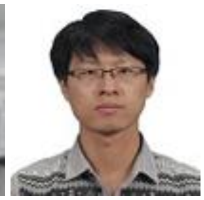
Zimmerman, C. B. (1997). Do reading and interactive vocabulary instruction make a difference? An empirical study. *TESOL Quarterly, 31*(1), 121-140. https://doi.org/10.2307/3587978

International **R**eview of **R**esearch in **O**pen and **D**istributed **L**earning
Volume 19, Number 4

September – 2018

Parents' and Students' Attitudes Toward Tablet Integration in Schools




Sha Zhu[1, 2], Harrison Hao Yang[3, 4], Jason MacLeod[3], Yinghui Shi[1], and Di Wu[1]
[1]National Engineering Research Center For E-Learning, Central China Normal University, China; [2]Wuhan Huada National E-learning Technologies Co. Ltd., China; [3]School of Educational Information Technology, Central China Normal University, China; [4]School of Education, State University of New York at Oswego, USA

Abstract

This study explored parents' and students' attitudes toward tablet usage in a formal educational setting. A total of 212 students from four 7th-grade classes, along with 145 of their parents, responded to the Tablet Acceptance Questionnaire. Quantitative methods including a t-test and partial least square (PLS) analyses were employed to examine students' and parents' attitudes toward tablet integration in schools, and to investigate factors influencing students' and parents' attitudes toward tablet usage, respectively. The results indicated significant differences between students' and parents' attitudes. Empirical findings suggested students hold more positive views than their parents with regard to tablet usage, tablet benefits for learning, and technical advantages and ease of use. Conversely, parents expressed greater concern over potential negative effects of tablet usage in education than do their children. This study also suggested educational benefits of tablet usage were the key factor influencing both students' and parents' attitudes. Based on the cross-examined understanding of parents' and students' attitudes, suggestions for large scale tablet initiatives are proposed.

Keywords: parent, student; attitude, tablet, technology integration, partial least square

Introduction

Tablet integration into K-12 education is a steadily increasing global phenomenon. Despite the prevalence of attitudinal studies from students' and teachers' perspectives (e.g., Uzoğlu & Bozdoğan, 2015; Ifenthaler & Schweinbenz, 2013; Shih, Chu, Hwang, & Kinshuk, 2011), few studies have examined parents' perception of personalized tablet usage in K-12 education. Meanwhile, it is well known that successful educational technology implementation is a complex process (Robertson, Grady, Fluck, & Webb, 2006) and regardless of the type or generation of educational technology, teachers', students', and parents' perspectives must all be considered.

Despite students' and teachers' positive attitudes toward tablet usability, effectiveness, and satisfaction (Chen, 2013), among large scale tablet initiatives, a global pattern of unexpected integration outcomes has emerged in schools. From the Los Angeles Unified School District in the United States (Blume, 2014) to the Shenzhen FuTian School District in China (Zhang & He, 2013), large scale tablet initiatives have been receiving negative publicity due to parental concerns. General parental concerns have often emphasized potential threats to academic performance (Soykan, 2015), however, parents' concerns regarding personalized tablet usage and comparative analysis between students and parents have not yet been the target of peer-reviewed research.

To further support the demand for research, Kiger and Herro (2015) regarded parental support as the key to successful tablet integration and Khan, Al-Shihi, Al-Khanjari, and Sarrab (2015) stated parents' trust in tablet benefits for learning is critical to tablet acceptance in schools. Additionally, it is believed that parents and students may influence each other's attitudes toward tablet initiatives in education.

Failure to recognize parental concerns has hindered the progress of tablet initiatives on a global scale. Therefore, deep analysis regarding parental attitudes is of great importance. The exploration of parental attitudes and inter-relationships between parents' and students' perspectives are necessary to complete the foundation of knowledge surrounding tablet integration in schools. This study was expected to expand literature and inform strategic planning processes for large-scale tablet initiatives' design and implementation.

Related Works and Theoretical Framework

Educational Technology Implementation in Schools

The guiding theoretical framework of this study was based on Davis's (1989) Technology Acceptance Model (TAM), which has been utilized across a broad range of tasks and settings (Fathema, Shannon, & Ross, 2015; Wixom & Todd, 2005) to assist understanding of human acceptance and the usage of technology. Figure 1 illustrates the proposed TAM-based framework for educational technology implementation in schools.

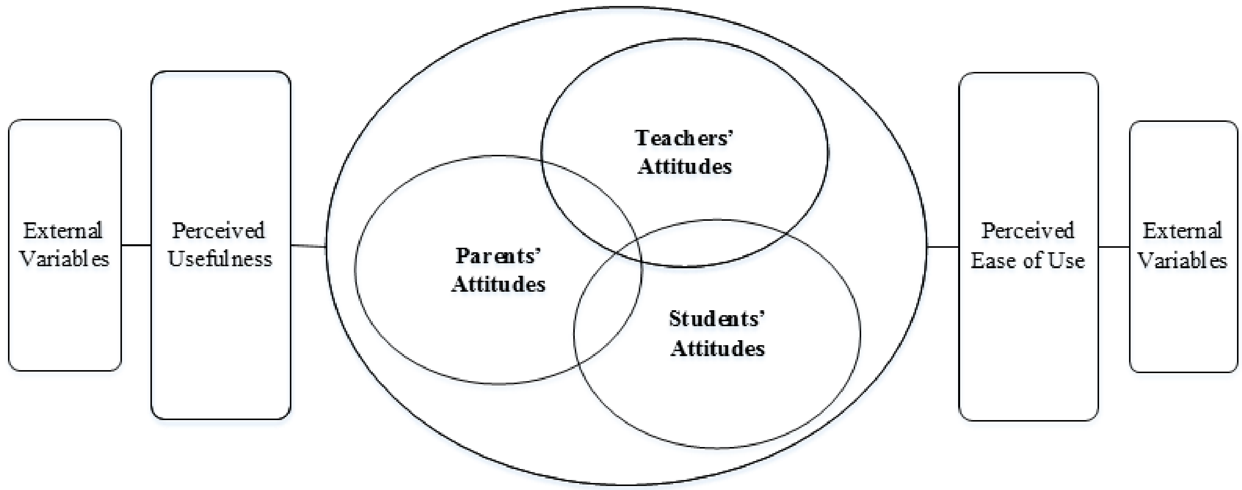


Figure 1. Framework for educational technology implementation in schools.

Among the many factors that influence technology integration, Davis (1989) stated that users' attitudes toward computer technology were directly related to Perceived Usefulness (PU) and Perceived Ease of Use (PEOU). PU is the degree to which a person believes using a system enhances their performance; while PEOU is the degree to which a person believes usage would be free from effort. It was also discovered that, "usefulness is significantly more strongly linked to usage than is ease of use" (Davis, 1989, p. 333). All stakeholders in Figure 1 are affected by PU and PEOU. However, it is believed that PEOU will typically be of greater importance to teachers and students, since parents may not directly engage with educational technologies. Thus, parents are likely to focus more heavily toward PU. The external variables influencing PU and PEOU may vary based on the specific technology being implemented in schools. Therefore, a thorough literature review will always be necessary to identify relevant external variables for the specific technology being implemented.

Proposed Research Model for Tablet Implementation in Schools

Specifically relating to tablets, prior research has utilized a technology acceptance model and findings supported PU and PEOU as key determinants of human attitudes toward tablets (Park & Pobil, 2013). All external variables influencing PU and PEOU in this study were aligned to a core psychological construct which includes three widely recognized components: cognitive, affective, and behavioral. Table 1 defines psychological construct terms used in this framework.

Table 1

Psychological Construct of External Variables

Attitude	Definitions
Cognitive	Attitude stimulants relating to factual knowledge and object capabilities.
Affective	Attitude stimulants relating to personal opinions, feelings, and object aesthetics.
Behavioral	Attitude stimulants relating to past experiences and personal capabilities.

Figure 2 illustrates the proposed research model used for analyzing attitudes toward tablet usage in this study. This model consists of five variables: (1) tablets' potential negative effects (Negative Potential, NP), (2) tablets' benefits for learning (Educational Benefits, EB), (3) individuals' related awareness and understanding of tablets (Technical Awareness, TA), (4) individuals' prior computer-related experiences (Prior Experiences, PE), and (5) general attitudes toward tablets (Attitudes, AT). Literary support for the five variables is provided in the following section.

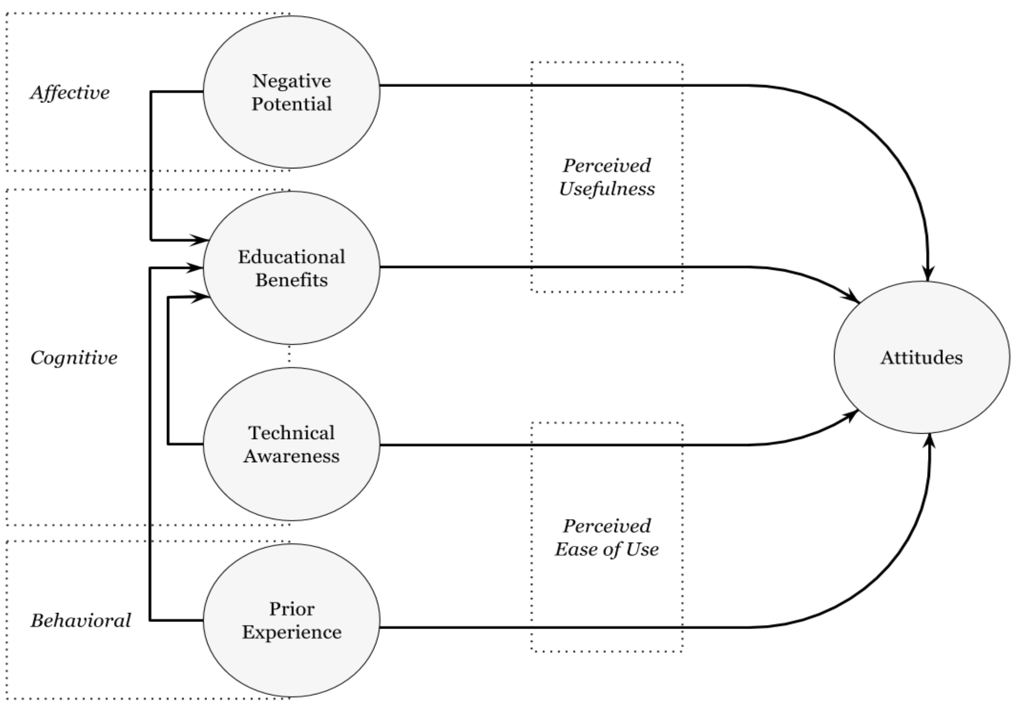


Figure 2. Proposed research model for attitudes toward tablet usage in schools.

PU - Educational Benefits and Negative Potential. Educational Benefits is a cognitive attitude stimulant because it relates to proven facts about technology attributes and capabilities. Prior research has shown tablets' mobility and connectivity enables students to become active participants, rather than passive receivers in learning activities (Pegrum, Howitt, & Striepe, 2013). Additionally, tablets have been stated capable of facilitating students' academic performance (Boticki, Baksa, Seow, & Looi, 2015), increasing motivation to learn, supporting interactive collaboration (Chen, 2013), and promoting teachers' and students' engagement (Valstad, 2011).

Negative Potential is an affective attitude stimulant because it reflects personal opinion and human emotions. Prior research suggested concern among parents in educational settings are due to potential distraction from studies and internet game addictions (Soykan, 2015). However, other Negative Potential may include eye strain from reading words on small screens (Kraut, 2013), prevention of physical exercise, and reduction of face-to-face interaction (Takeuchi, 2011). Additionally, a variety of socioeconomic variables have attracted considerable attention (Billon, Lera-Lopez, & Marco, 2010). These literary-supported Educational Benefits and Negative Potential attributes are appropriate external variables for generalizing PU attitudes toward tablet usage in schools.

PEOU - Prior Experience and Technical Awareness. Prior Experience is a behavioral attitude stimulant, as it relates to things done in the past; while Technical Awareness is a cognitive attitude stimulant, as it relates to knowledge of the subject matter. Specifically regarding tablets, human attitudes have strongly aligned with attitudes toward computers, as tablets are regarded as a form of portable computer (Dündar & Akçayır, 2014). Additionally, researchers have found users' prior experience and usage frequency the most closely related influential factors of attitudes toward computers (Schumacher & Morahan-Martin, 2001). Although experience is tough to measure and some controversy over this topic exists (Garland & Noyes, 2004), large bodies of evidence suggest computer experience is positively correlated to computer attitudes (Adebowale, Adediwura, & Bada, 2009; Kumar & Kumar, 2003; Gobbo & Girardi, 2001). Furthermore, lack of adequate knowledge and experience has been found to negatively affect attitudes toward tablets' PEOU (Çuhadar, 2014). Therefore, these literary-supported Prior Experience and Technical Awareness attributes are appropriate external variables for generalizing PEOU attitudes toward tablets in schools.

Methodology

Research Questions

This study analyzed attitudes toward tablet usage in education to investigate influential factors and relationships between parents and students. The three research questions guiding this study and seven hypotheses are listed below.

1. What major factors influence parents' and students' attitudes toward tablets in schools?
2. Are there significant differences between parents' and students' attitudes?
3. Are there relationships between parents' and students' attitudes?

Specifically, seven hypotheses have been formed in alignment with the proposed research model.

1. Negative Potential is negatively related to Educational Benefits.
2. Prior Experience is positively related to Educational Benefits.
3. Technical Awareness is positively related to Educational Benefits.
4. Educational Benefits is positively related to Attitudes.
5. Negative Potential is negatively related to Attitudes.
6. Prior Experience is positively related to Attitudes.
7. Technical Awareness is positively related to Attitudes.

Participants

A sample of seventh grade students (n=228) from a school located in central China was used. Students were distributed across four different classes and selection included all students participating in a new large scale tablet initiative. All participants were informed of a parallel research initiative and were required to sign a consent form to participate in the study.

Parent participants (n=171) were all directly related (one generation prior) to student participants. Age ranged from 35 to 42 with a mean of 38. A single response was collected from each family. For a variety of reasons (i.e., work schedules, family living arrangements, or personal issues), some parents were unable to participate. Prior to participation in the tablet initiative, the school provided all parents with basic tablet information regarding usage in educational settings. Additionally, demographic surveys suggested 80% of the parents reported accessing the internet almost every day and claimed basic ICT skills. Over the durations of this study, parents were asked to supervise their children's tablet usage at home to the best of their ability.

Students belonged to two types of classes (two classes for Chinese language, two classes for mathematics). Chinese language and mathematics were purposefully selected due to their critical significance in China's K-12 education system. It was believed that tablet acceptance in these disciplines could predict attitudes toward using tablets in all other curricula. Prior to study initiation, all teachers received training from the software provider for general usage and specific pedagogical techniques. The software provider also cooperated with administrators to co-design the tablets being implemented in this study. The resulting tablets being implemented had software accessibility controls to support only specific functions. Figure 3 provides a diagram to explain the tablets' three functional components.

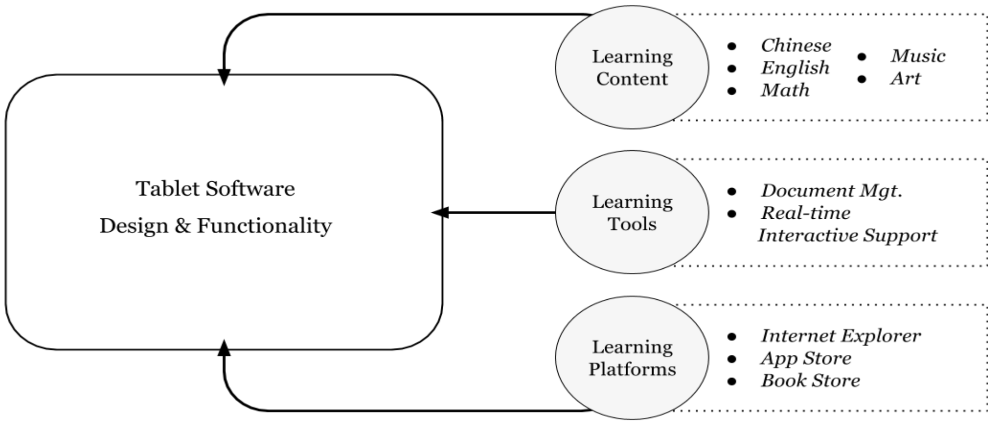


Figure 3. Overview of tablets' software design and functionality.

Instrumentation

The completed Tablet Acceptance Questionnaire (TAQ) was based on the theoretical framework and proposed research model for determining attitudes toward tablets in schools. The TAQ contained five dimensions (Negative Potential, Educational Benefits, Technical Awareness, Prior Experience, and Attitudes) and aligned to the proposed research model. Two versions of the TAQ were designed, with the only difference being language for sentence subjects to represent a parent or student perspective. The TAQ contained 13 items evaluated on a 5-point Likert scale from strongly disagree (1) to strongly agree (5). Each item referred specifically to a TAQ dimension and was supported by relevant literature. An example item from the Technical Awareness dimension was "Tablets provide great mobility and flexibility for connectivity." Appendix A presents the full 13 items included in the TAQ. The content validity of TAQ was validated by three educational technology researchers prior being administered.

Data Collection and Analysis

After one month of tablet usage, all students and their parents were invited to complete a questionnaire aimed at measuring attitudes toward tablet usage. A total of 357 valid questionnaires were collected, including 212 (93%) students and 145 (85%) parent submissions.

Results

Overview and Comparison of Responses

T-test was conducted to compare parents' and students' responses. As indicated in Table 2, parents reported significantly lower scores than students in four of the five dimensions (Attitudes, Educational Benefits, Negative Potential, and Technical Awareness). The only exception was the Prior Experience dimension, which assessed individuals' exposure to ICT. Parents scored highest on Technical Awareness and lowest on Negative Potential. Meanwhile, students scored highest on Attitudes and lowest on Prior Experience. The findings revealed parents held less positive views than students with regard to tablet usage in schools despite having had more Prior Experience than their children. Parents also displayed greater concerns over the Negative Potential of tablet usage than students, while students expressed greater recognition of Technical Awareness.

Table 2

T-Test of TAQ Responses

Category	Parents		Students		*t*
	Mean	SD	Mean	SD	
Attitudes	3.32	0.94	4.18	.79	9.02*
Educational benefits	3.22	0.84	3.85	.78	7.17*
Negative potential	2.45	0.69	2.91	.87	5.59*
Technical awareness	3.68	0.64	4.08	.71	5.52*
Prior experience	3.13	1.04	2.81	.75	-3.26*

Note: *p<.001

PLS Analysis of Factors Influencing Attitudes

PLS method was used to verify the proposed research model and to investigate influential attitudinal factors of attitudes. PLS was appropriate for the sample size of this study (Chin, 1998; Gefen, Straub, & Boudreau, 2000) and well-suited for testing theories in early stages of development (Fornell & Bookstein, 1982). SmartPLS 3 software was used to assess the measurement and structural models.

Measurement model. The measurement model was assessed by convergent validity, reliability of measures, and discriminant validity. The convergent validity was measured by the average variance extracted (AVE). Results showed the AVE values were over 0.6, which was satisfactory (Segars, 1997). The reliability of the measurement model was examined using the composite reliability and Cronbach's alpha. Findings indicated that the composite reliability (CR) coefficients were over 0.8, which demonstrated satisfactory reliability (Nunnally & Bernstein, 1994). Cronbach's alpha were all over 0.58 and within acceptable limits (Helmstadter, 1964). Furthermore, to evaluate the discriminant validity, the square roots of AVE were compared to correlations among latent variables (Fornell & Larcker, 1981), in which all latent correlations were less than the corresponding AVE square roots. Table 3 shows the results of the measurement model.

Table 3

Results of the Measurement Model

	Convergent validity	Reliability of measures		Discriminant validity				
	AVE	CR	Cronbach's α	AT	EB	NP	TA	PE
AT	0.70	0.87	0.78	0.84				
EB	0.62	0.83	0.70	0.76	0.79			
NP	0.60	0.82	0.67	0.33	0.34	0.78		
TA	0.70	0.82	0.58	0.59	0.67	0.22	0.83	
PE	0.74	0.85	0.66	-0.07	0.03	-0.14	-0.02	0.86

Structural model. The structural model was used to test hypothesized paths using path coefficients (γand β), R^2 value, and *t*-value bootstrapping (500 resamples; Cohen, 1988). When comparing influential factors of attitudes toward tablet usage in education, structural model tests were conducted twice using parent and student data respectively.

Structural model test for parents. As seen in Table 4, Hypothesis 3 and 4 were supported. Negative Potential and Prior Experience had no significant influence on Educational Benefits and Attitudes. However, Technical Awareness significantly influenced Educational Benefits, and accounted for 57% of the variance. In addition, Educational Benefits exhibited a significant relationship with Attitudes, accounting for 36% of the variance. Figure 4 shows results of the structural model test using PLS analysis. Path coefficients along with the associated *t*-values are provided and explained the variance given.

Table 4

Structural Model Test for Parents

Hypothesis	Independent variable	Dependent variable	γ	β	*t*	*p*	Result	R^2
H1	NP	EB	0.16		11.14*	0.25	Rejected	0.57
H2	PE	EB	0.11		11.26*	0.17	Rejected	
H3	TA	EB	0.57		15.72*	0.00	Supported	
H4	EB	AT		-0.68	10.62*	0.00	Supported	0.36
H5	NP	AT		-0.02	10.22*	0.82	Rejected	
H6	PE	AT		-0.11	11.51*	0.05	Rejected	
H7	TA	AT		-0.13	11.30*	0.09	Rejected	

Note: *p<.001

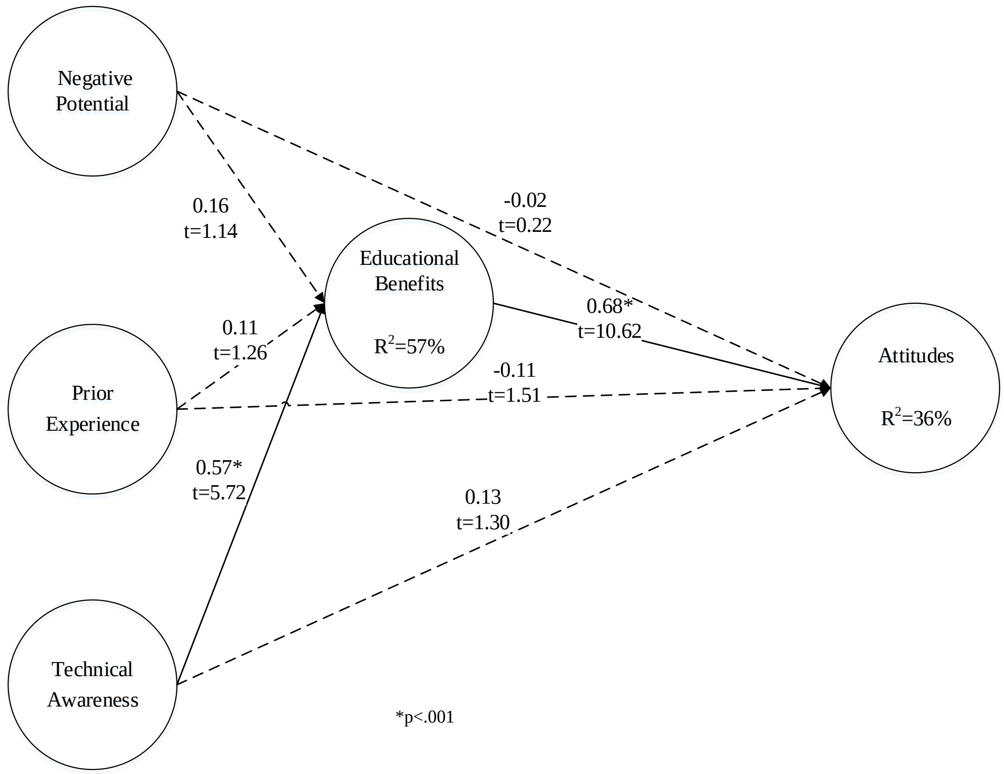


Figure 4. Results of structural model test for parents.

Structural model test for students. As seen in Table 5, Hypothesis 1, 3, and 4 were supported. The significant predictors of Educational Benefits included both Technical Awareness, and Negative Potential, which collectively explained 51% of the variance. Moreover, Educational Benefits was the significant predictor of Attitudes, accounting for 53% of the variance. Figure 5 shows results of the structural model test using PLS analysis. Path coefficients and associated *t*-values are provided and explained the variance given.

Table 5

Structural Model Test for Students

Hypothesis	Independent variable	Dependent variable	γ	β	*t*	*p*	Result	R^2
H1	NP	EB	0.23		13.32*	0.00	Supported	0.51
H2	PE	EB	0.14		11.32*	0.19	Rejected	
H3	TA	EB	0.60		9.73*	0.00	Supported	
H4	EB	AT		0.59	18.62*	0.00	Supported	0.53
H5	NP	AT		0.07	11.53*	0.12	Rejected	
H6	PE	AT		0.01	10.13*	0.90	Rejected	
H7	TA	AT		0.15	11.51*	0.02	Rejected	

Note: *p<.001

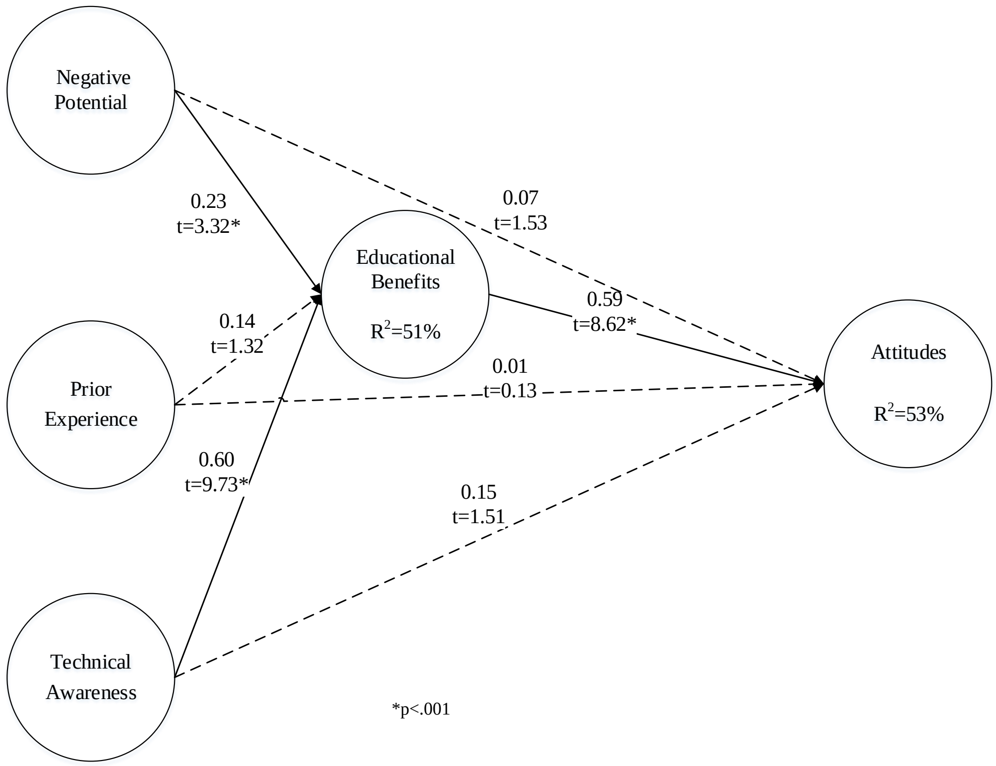


Figure 5. Results of structural model test for students.

Mediation Analysis of Factors Influencing Attitudes

Mediation analysis has been employed to better understand the relationship between independent and dependent variables both in the absence of the mediating variable(s) and in their presence (Chin, 2010). In this study, by adopting the bootstrapping procedures in SmartPLS 3, mediation tests of parents' and students' responses were conducted according to Baron and Kenny's (1986) four step recommendation.

Mediation analysis for parents. As shown in Table 6, Educational Benefits acted as a mediator. That is, parents only perceived tablet usage positively when they perceive a tablet was useful in enhancing their children's learning experience. Technical Awareness did not directly predict Attitudes, but instead relied on mediating effects of Educational Benefits.

Table 6

Parent Results for Technical Awareness, Educational Benefits, and Attitudes

Step	Path			Path coefficient	*t*-value
1	Technical Awareness	→	Attitudes	0.52	05.46*
2	Technical Awareness	→	Educational Benefits	0.57	06.85*
3	Educational Benefits	→	Attitudes	0.75	14.96*
4	Technical Awareness	→	Attitudes	0.13*	01.30
4	Technical Awareness	→	Educational Benefits	0.57	05.72*
4	Educational Benefits	→	Attitudes	0.68	10.62*

Note: *p < .001

Mediation analysis for students. As shown in Table 7 and Table 8, Educational Benefits played a full role in mediating two relationships: Technical Awareness to Attitudes, and Negative Potential to Attitudes. The direct path coefficients of these relationships were 0.51 and 0.22 when the links were direct, and they became non-significant when Educational Benefits was included as a mediator. The mediation analysis indicated Technical Awareness and Negative Effects do not directly predict Attitudes, but instead rely on mediating effect of Educational Benefits. Unless students perceive tablet usage beneficial to learning, any level of Technical Awareness or perception of Negative Potential may not greatly affect their Attitudes.

Table 7

Student Results for Technical Awareness, Educational Benefits, and Attitudes

Step	Path			Path coefficient	*t*-value
1	Technical Awareness	→	Attitudes	0.51	7.67*
2	Technical Awareness	→	Educational Benefits	0.60	8.65*
3	Educational Benefits	→	Attitudes	0.69	7.97*
4	Technical Awareness	→	Attitudes	0.15	1.51*
4	Technical Awareness	→	Educational Benefits	0.60	9.73*
4	Educational Benefits	→	Attitudes	0.59	8.62*

Note: *p < .001

Table 8

Student Results for Negative Potential, Educational Benefits, and Attitudes

Step	Path			Path coefficient	*t*-value
1	Negative Potential	→	Attitudes	-0.22	2.97*
2	Negative Potential	→	Educational Benefits	-0.23	3.56*
3	Educational Benefits	→	Attitudes	-0.62	5.41*
4	Negative Potential	→	Attitudes	0.07*	1.53*
4	Negative Potential	→	Educational Benefits	-0.23	3.32*
4	Educational Benefits	→	Attitudes	-0.59	8.62*

Note: *p < .001

Discussion and Conclusion

The results of this study strengthened understanding of parents' and students' attitudes toward tablet usage in educational settings. Overall, parents hold less positive attitudes than students regarding tablet usage in schools. This finding may be driven by China's exam-oriented education system (Hill, 2013), whereby Chinese parents generally prioritize assessment in K-12 schools. Additionally, prior research has suggested inter-generational difference regarding attitudes, PU, and PEOU of mobile technologies in educational settings (Salajan, Schonwetter, & Cleghorn, 2010). Therefore, parents may simply be more comfortable with traditional teaching methods and opt against emerging technology integration into schools.

This study indicated parents have greater concerns than students regarding tablet usage in schools. Findings aligned with recent parent protests against tablet usage in formal education settings (Zhang & He, 2013). Among the potential negative effects of tablet usage examined in this study, problems associated with video game addiction and distractions were the most serious issues for parents. Furthermore, in China, this concern appears to be reasonable, as a recent survey involving a nationally representative sample of elementary and middle school students reported the percentage of internet addicts has increased with increasing frequency of internet use per week (Li, Zhang, Lu, Zhang, & Wang, 2013).

Perhaps the most important finding of this study is the identification of tablets' educational benefits as the key factor determining both parents' and students' attitudes toward tablet usage in schools. From the parents' perspective, as long as tablet usage was perceived beneficial for learning, tablets were accepted despite potential of negative effects. From the students' perspective, having a technical awareness of tablet usage is critical to determining perception of educational benefits.

Empirical findings cross-examined parents' and students' attitudes toward the use of tablets in an educational environment. These findings indicated the following strategies may be effective in promoting large-scale tablet initiatives in educational settings:

1. Build awareness among parents before implementation**.** Clear and open information communication can provide a foundation for deepening parents' understanding of tablet usage in education. If large scale tablet usage is a school priority, then strategic planning must incorporate a buffer period for educational outreach to gain parental support. In order to avoid problematic issues, transparent communication channels must be established to keep parents updated on usage trends and to be assured that devices are being used appropriately.

2. Implementation is an interconnected partnership**.** Opportunities for parental involvement can support understanding and comfort with large scale tablet initiatives. Accordingly, rules of usage must be an open discussion between all stakeholders to ensure responsible tablet usage in home and school environments. In order to minimize potential negative effects of tablets (Stevenson, 2011), stakeholders must have the proper capabilities and confidence in each other's ability to monitor tablet usage in their respective environments. Additionally, communication between stakeholders must be maintained throughout the duration of tablet usage.

3. Parents require training too**.** Teachers play a critical role in tablet integration because the responsibility for implementation largely happens in the classroom (Bebell & O'Dwyer, 2010). However, these devices span multiple environments, which is different than many other stationary educational technologies. Thus, the discussion cannot only focus professional development toward teachers, as parents play an equal role in ensuring positive integration. Parents should be trained in a similar manner to teachers so they are capable of understanding, monitoring, and supporting home usage.

This study focused on attitudes toward tablet usage in schools among seventh grade students and their parents participating in a large scale tablet initiative in central China. However, one study cannot completely capture the dynamics of educational tablet usage. Further research should extend to differing cultures and education levels. Additionally, mixed method studies combining quantitative and qualitative data may be beneficial for cross-sectional comparisons between parents' and students' perspectives.

Acknowledgements

This work was supported by the Key Projects of Philosophy and Social Research, Ministry of Education of China under grant #14JDZ044.

References

Adebowale, O. F., Adediwura, A. A., & Bada, T. A. (2009). Correlates of Computer attitude among secondary school students in Lagos State, Nigeria. *International Journal of Computing and ICT Research, 3*(2), 20-30.

Baron, R. M., & Kenny, D. A. (1986). The moderator-mediator variable distinction in social psychological research: Conceptual, Strategic, and statistical considerations. *Journal of Personality and Social Psychology Bulletin, 51*(6), 1173-1182. doi: 10.1037/0022-3514.51.6.1173

Bebell, D., & O'Dwyer, L. M. (2010). Educational Outcomes and research from 1:1 Computing settings. *Journal of Technology, Learning, and Assessment, 9*(1), 5-15.

Billon, M., Lera-Lopez, F., & Marco, R. (2010). Differences in digitalization levels: A multivariate analysis studying the global digital divide. *Review of World Economics, 146*(1), 39-73. doi: 10.1007/s10290-009-0045-y

Blume, H. (2014). L.A. parents must give OK before iPads sent home with students. *Los Angeles Times*. Retrieved from http://www.latimes.com/local/lanow/la-me-ln-la-parents-ipads-20140425-story.html

Boticki, I., Baksa, J., Seow, P., & Looi, C. K. (2015). Usage of a Mobile social learning platform with virtual badges in a primary school. *Computers & Education, 86*, 120-136. doi: 10.1016/j.compedu.2015.02.015

Chen, X. B. (2013). Tablets for informal language learning: Student usage and attitudes. *Language Learning & Technology, 17*(1), 20-36. doi: 10125/24503

Chin, W. W. (1998). The partial least squares approach to structural equation modeling. In G. A. Marcoulides (Ed.), *Modern methods for business research* (pp. 295-336). New Jersey: Lawrence Erlbaum Associates.

Chin, W. W. (2010). How to write up and report PLS analyses. In V. Esposito Vinzi, W. W. Chin, J. Henseler, & H. Wang (Eds.), *Handbook of partial least squares: Concepts, methods and applications* (pp. 655-690). Heidelberg, Dordrecht, London, New York: Springer.

Chu, H. C., Hwang, G. J., Huang, S. X., & Wu, T. T. (2008). A knowledge engineering approach to developing e-libraries for mobile learning. *The Electronic Library, 26*(3), 303-317. doi: 10.1108/02640470810879464

Cohen, J. (1988). *Statistical power analysis for the behavioural sciences*. Hillsdale, New Jersey: Erlbaum.

Çuhadar, C. (2014). Information technology pre-service teachers' acceptance of tablet PCs as an innovative learning tool. *Educational Sciences: Theory & Practice, 14*(2), 741-753. doi: 10.12738/estp.2014.2.2038

Davis, F. D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS Quarterly, 13*(3), 319-340. doi: 10.2307/249008

Dündar, H., & Akçayır, M. (2014). Implementing tablet PCs in schools: Students' attitudes and opinions. *Computers in Human Behavior, 32*, 40-46. doi: 10.1016/j.chb.2013.11.020

Fathema, N., Shannon, D., & Ross, M. (2015). Expanding the technology acceptance model (TAM) to examine faculty use of learning management systems (LMS). *Journal of Online Learning and Teaching, 11*(2), 210-233.

Fornell, C., & Bookstein, F. L. (1982). Two structural equation models: LISREL and PLS applied to consumer exit-voice theory. *Journal of Marketing Research, 19*(4), 440-452. doi: 10.2307/3151718

Fornell, C., & Larcker, D. F. (1981). Evaluating structural equation models with unobservable variables and measurement error. *Journal of Marketing Research, 18*(1), 39-50. doi: 10.2307/3151312

Garland, K. J., & Noyes, J. M. (2004). Computer experience: A poor predictor of computer attitudes. *Computers in Human Behavior, 20*(6), 823-840. doi: 10.1016/j.chb.2003.11.010

Gefen, D., Straub, D. W., & Boudreau, M. C. (2000). Structural equation modeling and regression: Guidelines for research practice. *Communications of the Association for Information Systems, 4*(1), 7.

Gobbo, C., & Girardi, M. (2001). Teachers' beliefs and integration of information and communications technology in Italian schools. *Journal of Information Technology for Teacher Education, 10*(1-2), 63-86. doi: 10.1080/14759390100200103

Helmstadter, G. C. (1964). *Principles of psychological measurement*. New York: Appleton-Century-Crofts.

Hill, P. (2013). *Examination systems: Asia-Pacific secondary education system review series No. 1*. Bangkok, Thailand: UNESCO.

Ifenthaler, D., & Schweinbenz, V. (2013). The acceptance of tablet-PCs in classroom instruction: The teachers' perspectives. *Computers in Human Behavior, 29*(3), 525-534. doi: 10.1016/j.chb.2012.11.004

Khan, A. I., Al-Shihi, H., Al-khanjari, Z. A. & Sarrab, M. (2015). Mobile learning (M-learning) adoption in the Middle East: Lessons learned from the educationally advanced countries. *Telematics and Informatics, 32*(4), 909-920. doi: 10.1016/j.tele.2015.04.005

Kiger, D., & Herro, D. (2015). Bring your own device: Parental guidance (PG) suggested. *TechTrends, 59*(5), 51-61. doi: 10.1007/s11528-015-0891-5

Kraut, R. (2013). Policy guidelines for mobile learning. *United Nations Educational, Scientific and Cultural Organization*, Retrieved from http://unesdoc.unesco.org/images/0021/002196/219641e.pdf

Kumar, P., & Kumar, A. (2003). Effect of a web-based project on pre-service and in-service teachers attitudes toward computers and technology skills. *Journal of Computing in Teacher Education, 19*(3), 87-92.

Li, Y., Zhang, Y., Lu, F., Zhang, Q., & Wang, Y. (2013). Internet addiction among elementary and middle school students in China: A nationally representative sample study. *Cyberpsychology, Behavior, and Social Networking, 17*(2), 111-116. doi: 10.1089/cyber.2012.0482

Nunnally, J. C., & Bernstein, I. H. (1994). *Psychometric theory*. New York: McGraw-Hill.

Park, E., & Pobil, A. (2013). Technology acceptance model for the use of tablet PCs. *Wireless Personal Communications, 73*(4), 1561-1672. doi: 10.1007/s11277-013-1266-x

Pegrum, M., Howitt, C., & Striepe, M. (2013). Learning to take the tablet: How pre-service teachers use iPads to facilitate their learning. *Australasian Journal of Educational Technology, 29*(4), 464-479.

Robertson, M., Grady, N., Fluck, A., & Webb, I. (2006). Conversations toward effective implementation of information communication technologies in Australian schools. *Journal of Educational Administration, 44*(1), 71-85. doi: 10.1108/09578230610642665

Salajan, F. D., Schonwetter, D. J., & Cleghorn, B. M. (2010). Student and faculty inter-generational digital divide: Fact or fiction?. *Computers & Education, 55*(3), 1393-1403. doi: 10.1016/j.compedu.2010.06.017

Schumacher, P., & Morahan-Martin, J. (2001). Gender, internet and computer attitudes and experiences. *Computers in Human Behavior, 17*(1), 95-110. doi: 10.1016/S0747-5632(00)00032-7

Segars, A. H. (1997). Assessing the unidimensionality of measurement: A paradigm and illustration within the context of information systems research. *Omega International Journal of Management Science, 25*(1), 107-121. doi: 10.1016/S0305-0483(96)00051-5

Shih, J. L., Chu, H. C., Hwang, G. J., & Kinshuk. (2011). An investigation of attitudes of students and teachers about participating in a context-aware ubiquitous learning activity. *British Journal of Educational Technology, 42*(3), 373-394. doi: 10.1111/j.1467-8535.2009.01020.x

Soykan, E. (2015). Views of students', teachers' and parents' on the tablet computer usage in education. *Cypriot Journal of Educational Sciences, 10*(3), 228-244. doi: 10.18844/cjes.v1i1.68

Stevenson, O. (2011). From public policy to family practices: Researching the everyday realities of families' technology use at home. *Journal of Computer Assisted Learning, 27*(4), 336-346. doi: 10.1111/j.1365-2729.2011.00430.x

Takeuchi, L. M. (2011). *Families matter: Designing media for a digital age*. New York: The Joan Ganz Cooney Center at Sesame Workshop.

Uzoğlu, M., & Bozdoğan, A. E. (2015). Investigation of primary school students' attitudes toward tablet computers according to different variables. *International Journal of Human Sciences, 12*(1), 539-553. doi: 10.14687/ijhs.v12i1.2738

Valstad, H. (2011). Introducing The iPad in A Norwegian high school: How do students and teachers react to this technology. Norwegion University of Science and Technology. Retrieved from http://www.diva-portal.org/smash/get/diva2:450284/FULLTEXT01.pdf

Wixom, B. H., & Todd, P. A. (2005). A theoretical integration of user satisfaction and technology acceptance. *Information Systems Research, 16*(1), 85-102. doi: 10.1287/isre.1050.0042

Zhang, X. L., & He, W. (2013, September 4). E-schoolbag promotion meet the strongest blocking. *Southern Metropolis Daily*. Retrieved from http://epaper.oeeee.com/epaper/H/html/2013-09/04/content_2362713.htm?div=-1

Appendix A

Tablet Acceptance Questionnaire

Dimension	Code	Questionnaire Item
Attitudes	AT1	I would recommend using tablets for learning to other friends. (Shih, Chu, Hwang, & Kinshuk, 2011; Chu, Hwang, Huang, & Wu, 2008)
	AT2	I would be happy if tablet usage was continued in education. (Shih, Chu, Hwang, & Kinshuk, 2011; Chu, Hwang, Huang, & Wu, 2008)
	AT3	Using tablets in class is much more interesting than traditional classes. (Shih, Chu, Hwang, & Kinshuk, 2011; Chu, Hwang, Huang, & Wu, 2008)
Educational Benefits	EB1	[Subject's] learning interest and motivation improved after using tablets. (Chen, 2013)
	EB2	Tablets can facilitate [subject's] academic performance. (Boticki, Baksa, Seow, & Looi, 2015)
	EB3	Tablets have a positive impact on [subject's] learning. (Chen, 2013)
Negative Potential	NP1	Tablets may damage eyesight, reduce face-to-face time or deprive [subject] of exercise. * (Kraut, 2013; Takeuchi, 2011)
	NP2	The use of tablets may cause video game addictions or result in distraction. * (Soykan, 2015)
	NP3	Tablet usage may cause imbalanced access to educational resources. * (Billon, Lera-Lopez, & Marco, 2010)
Technical Awareness	TA1	Tablet attributes can enhance engagement and improve communication. (Valstad, 2011)
	TA2	Tablets provide great mobility and flexibility for connectivity. (Pegrum, Howitt, & Striepe, 2013)
Prior Experience	PE1	I have used computers for a long time. (Schumacher & Morahan-Martin, 2001)
	PE2	I use the internet almost every day. (Schumacher & Morahan-Martin, 2001)

Note: *Scored in a reverse manner.

International **R**eview of **R**esearch in **O**pen and **D**istributed **L**earning
Volume 19, Number 4

September – 2018

The Expansion of Higher Education and the Returns of Distance Education in China

Fengliang Li†
Tsinghua University

Abstract

The returns of traditional face-to-face education are widely analyzed, but there is a need for empirical studies on the returns of distance education. Further, comparative studies on returns of both traditional and distance education using high-quality data are rare. Since 1999, continuous and rapid expansions have occurred in the whole Higher Education system in China. Given this background, what are the changes in returns of both traditional face-to-face education and distance education? This study analyzes the returns of both of these formats from 2003 to 2006 using the data from the China General Social Survey Open Database (Chinese General Social Survey [CGSS], 2018), adding educational background as a dummy variable to the Mincerian income equation. The empirical results show that Distance Higher Education can significantly increase the income of learners, the returns of distance education are lower than those of traditional face-to-face education and that from 2003 to 2006, the returns of distance education decrease dramatically.

Keywords: distance higher education, returns of education, expansion of education, China

Introduction

Human capital theory sees education as an investment in human capital and regards that education can bring economic benefits to learners as well as promote national economic growth (Becker, 1964; Schultz, 1961). Since the 1950s there have been many studies on the private benefits of education, covering almost every nation and area (Daly, Lewis, Lewis, & Heaslip, 2015; Hartog & Gerritsen, 2016; Heckman, Lochner, & Todd, 2003; Psacharopoulos & Patrinos, 2004). These studies test the statement in human capital theory that education improves individual productivity. Further, private returns of education have become a main factor for individuals and families to make decisions in education investment. For example, comparing the returns of education and returns of other forms of capital investment can indicate whether education is a worthy investment (Psacharopoulos & Patrinos, 2004).

There are two prevalent methods for measuring the private returns of education (Psacharopoulos & Patrinos, 2004). One is the Mincerian rate of return, namely marginal returns to education, which reflects the increased benefit caused by one more year of education. The other method for measuring private returns of education is the internal rate of return, which calculates the discount rate that equalizes the real costs of education during the period of study to the real gains made as a consequence of this study period. Due to the availability of the cost data, most empirical studies estimate the Mincerian rate of return to education.

One important reason for establishing distance education institutes and providing distance education programs is to promote the development and investment of human capital. There is enough evidence which shows that distance education can improve professional skills and promote learners' employment in both developed countries and developing countries (Azeiteiro, Bacelar-Nicolaua, Caetano, & Caeiro, 2015; Siaciwena, 2008). Distance education, with face-to-face schooling, has become an important sub-system of the whole educational system. However, the studies of private returns of education still focus on traditional schooling and training. There are few empirical studies into the private returns of distance education. Although there are many studies on the costs of distance education, there are relatively fewer studies on the benefits or returns of distance education (Bramble & Panda, 2008; Moore, 2013; Rumble, 2001, 2004). The content of two books illustrates this point, namely Rumble's (2004) book titled *Papers and Debates on the Economics and Costs of Distance and Online Learning* and Bramble and Panda's (2008) book titled *Economics of Distance and Online Learning*. Both books contain many chapters on the costs of distance education but only two chapters focus on the benefits. Although some scholars have discussed the benefits (Bartolic-Zlomislic & Bates, 1999a, 1999b; Bates, 1995; Cukier, 1997; Hülsmann, 1997), empirical studies are lacking, as most of the existing studies do not measure the real benefits or returns of distance education. They lack in comparing the real income between those who have received distance education and those who have not received distance education. This situation is not in accordance with the current development of distance education, since the differences of real income after receiving distance education will be a good index for learners to decide whether to invest in distance education.

There are three empirical studies on the returns of distance education, all based on distance education in Mainland China. Li, Xia, Zhao, and Zhang (2009), Ni, Xu, Liang, and Zhu (2011), and Zheng, Chen, and Zhang (2009) reached similar conclusions that distance education can bring positive economic benefits.

These three studies used the Mincerian income equation to estimate the return of distance education according to a learner's income, educational background, and working experience (Li, Xia, Zhao, & Zhang, 2009; Ni, Xu, Liang, & Zhu, 2011; Zheng, Chen, & Zhang, 2009). All three studies, however, have the same three shortcomings. First, the sample cases are in-school learners in distance education institutes and the data are not the real cross-section data, which thereby does not meet the assumption of the Mincerian income equation. Second, the sample cases are from one or two Distance Higher Education institutes, and there are problems with generalizability. Third, only sample cases from Distance Higher Education are used, which therefore does not provide a credible comparison. Thus, data of higher quality, wider coverage, and more representation needs to be studied.

Since 1999, the whole Higher Education system in China has been in continuous and rapid state of expansion (Li, Morgan, & Ding, 2008). The scale of this expansion is likely to lead to changes in the returns of education (Psacharopoulos & Patrinos, 2004). Thus, with the expansion, what are the changes of returns of Distance Higher Education? This is important information that individuals and institutions should know.

Given these considerations, this study uses representative data, with wide coverage and rigorous sampling methods to analyze the change trend of private returns of Distance Higher Education. Further, this study compares the changing trend of returns of Distance Higher Education and Traditional Higher Education. Hence this study aims to make two main contributions. First, it is the first study (to our knowledge) to use high-quality and representative data to estimate the private returns of Distance Higher Education. That is, it is the first to measure the real income benefits of distance education. As such it will improve academic understanding of distance education as human capital and promote the study of the economics of distance education. Second, under the background of Higher Education expansion, the study will uncover trends in the changing returns of Distance Higher Education. This has the potential to guide investments regarding distance education, and help institutes plan how to develop and implement programs.

The next section of this paper introduces the expansion of Higher Education in China and the development of Distance Higher Education. The third section introduces the research methods and data. The fourth section presents the empirical results. The fifth section discusses the findings, and the final section offers a brief conclusion.

Literature Review: The Expansion of Higher Education and the Development of Distance Higher Education in China

At the beginning of the 1950s in Mainland China, distance education developed from correspondence education. In need of more high-quality human resources after the reform and opening up in 1978, Deng Xiaoping, who was the core of the "second generation" of Chinese leadership, put forward the idea that "planning for the development of modern educational instruments such as television and broadcast is an important way of rapidly developing China's education" (MOE, China, 1999). This initiated the establishment of Radio and Television Universities and the rapid growth of Distance Higher Education (MOE, China, 1999). From 1983, Radio and Television Universities started to enroll students from junior college education (Ding, 2001). By 1985, the number of junior college students attending Radio and Television Universities reached 674,000, accounting for 40% of Higher Education students in China (Ding, 2001).

In 1999, the Chinese Government decided to expand Higher Education drastically, and in 2003, the enrolment ratio of Higher Education reached 17% (Li, Zhou, & Fan). According to Martin Trow's theory of Higher Education Massification (1973), Chinese Higher Education had thereby surpassed the 15% threshold for characterization as Mass Higher Education.

Since 1999 in China, the expansion of Higher Education included both Traditional and Distance Higher Education. In order to promote the expansion of Distance Higher Education in 1998, China's Ministry of Education decided to allow some traditional universities to provide Distance Higher Education, and further to permit Tsinghua University [i], Zhejiang University, Beijing University of Posts and Telecommunications, and Hunan University to launch Distance Higher Education. In 2000, the Ministry of Education decided to take advantage of information network technology and infrastructure construction to further expand the traditional universities to launch distance education, and thirty more traditional universities were qualified to provide Distance Higher Education (Ding, 2001). Until 2008, the Ministry of Education qualified sixty-eight traditional universities to provide academic credentials education in the form of distance education (MOE, China, 2009). As a result of these reforms, the number of distance education students increased rapidly to 2,723,715 (MOE, China, 2009).

In 2011 the Ministry of Education eventually decided to establish the Open University of China based on Radio and Television Universities (Open University of China, 2016). The Open University of China engages in promoting education innovation, sharing high-quality education resources, and enhancing educational equity (http://en.ouchn.edu.cn/index.php/about-v2/new-style-university). In 2012, the number of registered students reached 3.59 million, including 1.05 million undergraduates, 2.54 million junior college students, 200,000 peasants, 100,000 soldiers, and 6,000 disabled students (http://en.ouchn.edu.cn/index.php/about-v2/new-style-university).

Today, China's Distance Higher Education system is mainly made up of the Open University of China (originally the Radio and Television University system) and the online education programs of traditional research universities. In addition, a few independent correspondence institutions also provide small-scale Distance Higher Education.

Given such background, what are the changes of the returns of Traditional Higher Education and Distance Higher Education? The following analyses will estimate the returns using the Mincerian income equation based on large-scale and high-quality individual cross-section data from different years.

Method and Data

This study mainly uses the Mincerian income equation to estimate the returns of distance and traditional education. The Mincerian income equation was proposed by an economist, Jacob Mincer, one of the founders of human capital theory (Mincer, 1974) as:

$$LnY = \alpha + \beta * S + \gamma_1 * EX + \gamma_2 * EX^2 + \xi$$

Figure 1. In this, Y is individual's income, LnY is the natural logarithms of individual's income, α is a constant term, S is the years of schooling of individual, EX is the years of working experience of individual worker in the labour market, and ξ is the error term.

Calculating the partial derivative of the equation above gives:

$$\beta = \frac{\partial \ln Y}{\partial S} = \frac{\partial Y / \partial S}{Y} \approx \frac{\Delta Y / Y}{\Delta S}$$

Figure 2. In this, β is individual's increasing rate caused by one more year's education. In economic studies, β stands for the percentage increase of an individual worker's income by taking one more year of education, which is named Mincerian rate of return.

Some scholars add the educational degree instead of educational years as a dummy variable in the Mincerian income equation (Carnoy, 1995). With this formulation, the coefficient difference of the educational degree is used to estimate the increasing rate of the individual's income (Carnoy, 1995). This method can only get the approximate value of return of education, which is not exactly equal to the value calculated by the Mincerian income equation[ii].

This study uses sample cases' income, educational background, and working years to estimate returns, by adding the dummy variables of educational degree to the standard Mincerian income equation.

All the data are from the China General Social Survey (CGSS; http://www.chinagss.org/). The first general social survey was conducted in China with the cooperation of the Sociology Department of Renmin University of China and the Social Research Center of Hong Kong University of Science and Technology. The survey adopts strict sampling technologies, and it is the first nationwide, comprehensive, continuous, and non-governmental social research survey, with 125 county units, 559 neighborhood committees, 5,900 interviewees, and 5,894 valid sample cases. Since 2005, the survey project team issued CGSS via Internet, and the data of CGSS in 2003 are public and free worldwide. The data of CGSS have gradually become public including the data of 2003, 2005, 2006, and 2008. The sampling of the year 2003, 2005, and 2006 are identical and there is a dramatic change in the sample size in 2008. In order to guarantee the comparability of the empirical results, this study uses the data in 2003, 2005, and 2006 for analyses.

In the studies by Zheng, Chen, and Zhang (2008), Li et al. (2009) and Ni et al. (2011), the data used includes only in-school Distance Higher Education learners. Compared with these studies, this study has an advantage that the data used includes adults of in-school learners and individuals in the labor market with various educational levels. In order to make the return of distance education more precise, this study analyzes only those individuals in the labor market.

Since the late 1970s, distance education in China has mainly focused on junior college education and undergraduate education, and rarely focused on post-graduate education (Li & Fu, 2015). Thus, Distance Higher Education is restricted to distance junior college and undergraduate education in this study. In order to estimate the return of Distance Higher Education, the laborers with the highest degree of senior secondary education should be the reference group. Therefore, the sample cases selected for this study were individual laborers with the educational level of senior secondary education, junior college education, and undergraduate education respectively.

Junior college education can be divided into full-time and part-time, similar to undergraduate education. In the SPSS data files provided by CGSS, “part-time” is defined as “The learners receive education from adult university, correspondence university, Radio and Television University. Most learners are still in the labor market and they take the courses in the evenings and weekends and face-to-face is not the main teaching method.” Obviously, the “part-time” can be deemed as distance education.

Table 1

Educational Backgrounds of Sample Cases

Educational Background	2003	2005	2006
Senior secondary education	1362	1640	1284
Distance college	364	243	271
Traditional college	262	355	203
Distance undergraduate	85	73	80
Traditional undergraduate	204	209	176
Total	2277	2520	2014

Table 2

The Simple Statistical Description of Variables

Variables	2003		2005		2006	
	Mean	Standard Deviation	Mean	Standard Deviation	Mean	Standard Deviation
Ln (income)	9.001	0.853	9.129	0.873	9.258	0.823
Distance college	0.089	0.284	0.050	0.218	0.073	0.260
Traditional college	0.064	0.244	0.073	0.260	0.055	0.227
Distance undergraduate	0.021	0.142	0.015	0.121	0.021	0.145
Traditional undergraduate	0.050	0.217	0.043	0.202	0.047	0.212
Working experience	24.954	12.702	26.640	15.124	24.821	13.592
Working experience square	783.989	685.149	938.396	911.329	800.786	719.777
N	2277		2520		2014	

The sample cases can be categorized into five kinds, including senior secondary education, distance college, face-to-face/traditional college, distance undergraduate, and face-to-face/traditional undergraduate. The sample cases with no information of annual income and working experience are excluded. Table 1 shows the distribution of the educational background of the sample cases.

The study deems those with senior secondary education as the reference group, and the other four educational levels as the dummy variables added to the Mincerian income equation. Table 2 is the simple statistical description of various variables.

Empirical Results

Table 3 depicts the regression of the Mincerian income equation in each year. Figure 3 shows the tendency of returns of distance education and traditional education of different educational levels from 2003 to 2006.

Table 3

The Regression of Mincerian Income Equation

	2003	2005	2006
Distance college	0.396***	0.331***	0.310***
	(0.044)	(0.050)	(0.048)
Traditional college	0.400***	0.446***	0.407***
	(0.050)	(0.043)	(0.056)
Distance undergraduate	0.568***	0.586***	0.489***
	(0.083)	(0.086)	(0.083)
Traditional undergraduate	0.873***	0.749***	0.680***
	(0.056)	(0.054)	(0.060)
Adjusted R square	0.134	0.110	0.102
N	2277	2520	2014

Note. The dependent variable is the natural logarithms of an individual's annual income. Standard errors are presented in parentheses. "***": significant at the 1% level. The coefficient information of the variables of constant, working experience, and its square are omitted.

From Table 3 and Figure 3 it can be seen, first, that the coefficients of the four education dummy variables are positive and significant, irrespective of distance education or traditional education, junior college education, or undergraduate education. The significance level is $p<0.01$. This reveals that both Distance Higher Education and Traditional Higher Education can significantly improve learners' income.

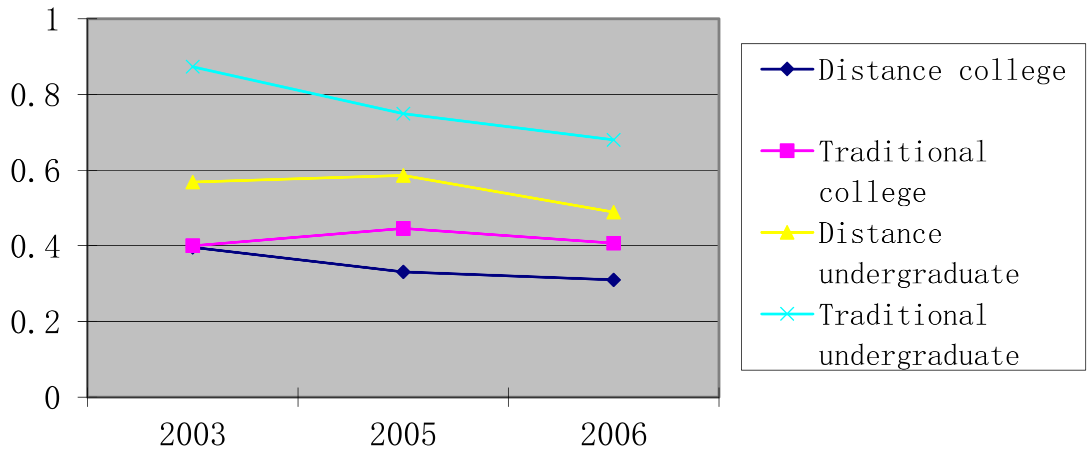


Figure 3. The change of returns of distance and traditional education from different educational degrees.

Secondly, the returns of distance education are lower than that of traditional education. It reveals that although both distance and traditional education can increase learners' income significantly, compared to face-to-face education, distance education has a smaller effect on increasing learners' income.

There are many possible explanations why the economic benefit of distance education is lower than that of face-to-face education. For example, distance education provides more flexibility and convenience for the learner, thus potentially attracting students who may be unable (due to work or life commitments) to study full-time at a campus university. With this, the lower economic returns of distance education may not be due to distance education itself but the result of the learners' extracurricular work or life commitments/inability to study full time. Such explanations are beyond the focus of this paper, but it would be helpful for follow-up research to investigate.

Thirdly, the difference of returns of distance education versus traditional education can be determined at different educational levels by dividing the coefficient of traditional education by that of distance education. Both in 2003 and 2006, the difference of undergraduate education is bigger than that of junior college education. This means that the return of distance education is lower than that of traditional education, and the disparity is more apparent at the level of the bachelor's degree.

Lastly, when looking to Figure 3, the returns of distance college, distance undergraduate, and traditional undergraduate education appears to decline each year, suggesting that the returns of these forms of education have a declining tendency. This tendency is consistent with another empirical study (Ding, Yu, & Yu, 2012). This tendency also contrasts the dramatic increase of returns of Higher Education between 1990 and the early 21st century (Chen, Chen, & Xia, 2003; He, 2009; PKU GSE, 2005). This shows that the expansion of Higher Education is accompanied by declined returns of Higher Education.

Discussion

This paper has found that Distance Higher Education can apparently increase learners' income. The coefficients of distance junior college education are about 31% to 40% and the coefficients of distance undergraduate education are about 49% to 59%. These results suggest that investing in Distance Higher Education is a sound choice. However, the returns of Distance Higher Education have declined, and fall behind that of Traditional Higher Education. The whole Higher Education system in China, especially post-graduate education, is in a continuous state of expansion. (Li, Yuan, & Liu, 2008; Yang & Li, 2012). Thus, the returns of junior college education and undergraduate education are likely to decline, and the Distance Higher Education system currently is not qualified to provide post-graduate education. Thus, the reformation of Distance Higher Education might be expected.

Currently, Distance Higher Education in China does not have a positive reputation. The *People's Daily*, the most authoritative official newspaper, once published several articles criticizing Distance Higher Education in China[iii]. This is a fraught situation for Distance Higher Education. With the expansion of Higher Education, it is rather easier for people to access Traditional Higher Education. Once the return of Distance Higher Education loses its charm, Distance Higher Education it is likely to face further threats and the need to find new rationales, methods, and markets. This should be recognized by the related administrative sectors and providers in the Distance Higher Education system. While Distance Higher Education has continued to flourish in more mature Higher Education systems in Europe and North America, it has done so by embracing new teaching technologies, new "mature age" (non-school-leaver) students, and professional development markets.

Conclusion

There are plenty of studies on returns of traditional education. Although the economic targets of distance education are to improve learners' skills and to promote their employment (Azeiteiro et al., 2015; Siaciwena, 2008) studies on returns of distance education are fewer, due to the difficulties to obtain data, and the ease of the economic target to be neglected. To fill this gap this study has used large-scale and high-quality data spanning several years to estimate the returns of Traditional and Distance Higher Education from 2003 to 2006, adding education background as a dummy variable to the standard Mincerian income equation.

The empirical results show that as with Traditional Higher Education, Distance Higher Education can significantly improve learners' income. For distance junior college learners, the increase is about 30% to 40%, and for distance undergraduate learners the increase is about 50% to 60%. This reveals that Distance Higher Education is a thoroughly valuable human capital investment. Although the returns of Distance Higher Education are impressive, these returns are apparently lower than those of traditional education, especially in the level of undergraduate education. With the expansion of Higher Education, the returns of Distance Higher Education have a declining tendency.

Based on the empirical results above, this paper suggests that the Distance Higher Education system in China should address this potential looming crisis, especially given that the changing population structures and lowering birth rates are likely to convey further decline (Yang & Li, 2012).

In further research, more attention should be paid to the following three areas. First, the returns of different majors of distance education can be estimated to better guide learners in how to choose majors. Second, the impact of educational quality on the returns of Distance Higher Education can be analyzed since many empirical studies show that quality will increase the returns of traditional face-to-face

Higher Education (Hanushek, Ruhose, & Woessmann, 2015; Hanushek & Woessmann, 2012; Jackson, Johnsonand, & Persico, 2016). Third, there are few empirical studies on the private returns of distance education and fewer empirical studies on the social returns of distance education. Distance education helps learners gain private benefits, and more importantly, it can improve the development of society with high social benefits. Thus, further studies should be conducted to estimate the social returns of distance education.

Acknowledgements

This article was supported by “The basic research project of young teachers of independent research program of Tsinghua University” (NO.: 20151080456). It is also supported by “An empirical study on improving the equity by online education in China” project (NO.: 2016YB103) and was sponsored by The Online Education Research Fund of Ministry of Education Online Education Center (Quantong Education Fund).

The author wishes to thank Professor Tony Bates, Sir John Daniel, Professor Rory McGreal, Professor Geraint Johnes, Professor Hamish Coates and two anonymous reviewers for their helpful comments on earlier drafts.

References

Azeiteiro, U. M., Bacelar-Nicolaua, P., Caetano, F., & Caeiro, S. (2015). Education for sustainable development through e-learning in higher education: Experiences from Portugal. *Journal of Cleaner Production, 106*(1), 308–319. Retrieved from https://www.sciencedirect.com/science/article/pii/S0959652614012505

Bates, T. (1995). *Technology, open learning and distance education*. London & New York: Routledge.

Bartolic-Zlomislic, S., & Bates, T. (1999a). Investing in on-line learning: Potential benefits and limitations. *Canadian Journal of Communication, 24*(3), 349-366. Retrieved from https://www.cjc-online.ca/index.php/journal/article/view/1111/1017

Bartolic-Zlomislic, S., & Bates, T. (1999b). *Assessing the costs and benefits of telelearning: A case study from the University of British Columbia*. Developing and Applying a Cost-Benefit Model for Assessing Telelearning Project Report. Retrieved from http://www.c3l.unioldenburg.de/cde/econ/readings/bates99.pdf

Becker, G. S. (1964). *Human capital: A theoretical and empirical analysis, with special reference to education*. New York, NY: Columbia University Press.

Bramble, W. B., & Panda, S. (2008). *Economics of distance and online learning: Theory, practice and research*. London, UK: Routledge.

Carnoy, M. (1995). Rates of return to education. In M. Carnoy (Ed.), *International encyclopedia of economics of education* (2nd ed.; pp.364-369). Oxford, UK: Pergamon Press and Elsevier Science.

Chinese General Social Survey. (2018). *Overview*. Retrieved from http://www.chinagss.org/index.php?r=index/introduce

Chen, X. Y., Chen, L. K., & Xia, C. (2003). Rates of return to schooling in urban China: Changes in the 1990s. *Peking University Education Review, 1*(2), 65-72. DOI: 10.19355/j.cnki.1671-9468.2003.02.011.

Cukier, J. (1997). Cost-benefit analysis of telelearning: Developing a methodology framework. *Distance Education, 18*(1), 137-152. Retrieved from https://www.tandfonline.com/doi/pdf/10.1080/0158791970180110

Daly, A., Lewis, P., Lewis, M., & Heaslip, T. (2015). The private rate of return to a university degree in Australia. *Australian Journal of Education, 59*(1), 97-112. DOI:10.1177/0004944114565117.

Ding, X. F. (2001). The Stages of Development, Prosperity And Adjustment of Distance Education in China. *Modern Distance Education, 17*(2), 6-9.

Ding, X. H., Yu, H. X., & Yu, Q. M. (2012). Private returns to different educational levels in urban China: 2002-2009. *Peking University Education Review, 9*(3), 73-84. DOI: 10.19355/j.cnki.1671-9468.2012.03.008.

Hanushek, E. A., Ruhose, J., & Woessmann, L. (2015). *Human capital quality and aggregate income differences: Development accounting for U.S. states* (National Bureau of Economic Research Working Paper No. 21295). Retrieved from http://www.nber.org/papers/w21295

Hanushek, E. A., & Woessmann, L. (2012). Do better schools lead to more growth? Cognitive skills, economic outcomes, and causation. *Journal of Economic Growth, 17*(4), 267-321. Retrieved from http://hdl.handle.net/10.1007/s10887-012-9081-x

Hartog, J., & Gerritsen, S. (2016). *Mincer earnings functions for the Netherlands 1962-2012. De Economist*, *164*(3), 235–253. DOI: 10.1007/s10645-016-9279-y

He, Y. M. (2009). The changes of the rate of return to education: An empirical study based on the data of CHNS. *Chinese Journal of Population Science, 22*(2), 44-54.

Heckman, J. J., Lochner, L. J., & Todd, P. E. (2003). *Fifty years of Mincer earnings regressions* (National Bureau of Economic Research Working Paper No. 9732). Retrieved from http://www.nber.org/papers/w9732

Hülsmann, T. (1997). *Literature review on cost-effectiveness in ODL systems*. International Research Foundation for Open Learning. Retrieved from http://isg.urv.es/publicity/isg/projects/2002-2005_bff/litrevrpt.pdf

Jackson, C. K., Johnson, R. C., & Persico, C. (2016). The effects of school spending on educational and economic outcomes: Evidence from school finance reforms. *Quarterly Journal of Economics, 131*(1), 157-218. https://academic.oup.com/qje/article/131/1/157/2461148

Li, F. L., & Fu, X. Y. (2015). Is China's online graduate education ready: Based on the analysis of "Online Graduate Education" in USA? *Open Educational Research*, *21*(2), 49-54. DOI: 1007 — 2179(2015) 02 — 0049 — 07.

Li, F. L., Morgan, W.J., & Ding, X. H. (2008). The expansion of higher education, employment and over-education in China. *International Journal of Educational Development*, *28*(6), 687-697. DOI: 10.1016/j.ijedudev.2007.10.002.

Li, F. L., Xia, G. S., Zhao, X. H., & Zhang, S. G. (2009). An empirical study on the rates of return to distance higher education: Evidence from students in Nanjing Radio & TV University and Haerbing Radio & TV University. *Open Educational Research, 15*(3), 10-15. DOI: 100722179 (2009) 0320010206

Li, F. L., Yuan, B. T., & Liu, H. Q. (2008). The forecast of the scale of post-graduate enrolment in China: From an international comparative perspective. *Journal of Higher Education*, *29*(5), 50-56. DOI: 100024203 (2008) 0520050207

Li, F. L., Zhou, M. Y., & Fan, B. L. (2014). Can distance education increase educational equality?—— Evidence from the expansion of Chinese Higher Education. *Studies in Higher Education, 39(10),* 1811-1822. DOI: 10.1080/03075079.2013.806462

Mincer, J. (1974). *Schooling, experience and earnings*. New York, NY: Columbia University Press.

MOE, China. (1999). *The opinion on the development of China's modern distance education*. MOE. Retrieved from http://www.xrtvu.com/office/oldfile/2002/01/04/AA480822-F067-4174-9821-2760D5A258FC/Index.htm

MOE, China. (2009). *The notice on the academic credentials education enrolment work for distance education pilot universities in 2009*. MOE. Retrieved from http://www.moe.gov.cn/srcsite/A07/moe_743/200903/t20090328_110176.html

Moore, M. D. (2013). *Handbook of distance education (3rd ed.).* London & New York: Routledge.

Ni, Q. R., Xu, H. J., Liang, Z. G., & Zhu, M. L. (2011). An empirical study of mincerian rate of return to higher distance education: An example of undergraduates in Ningbo Radio & TV University. *Journal of Ningbo Radio & TV University, 8*(2), 73-76.

Open University of China. (2016). "13th five-year plan" reform and construction of the open university of China. Retrieved from http://www.ouchn.edu.cn/News/ArticleDetail.aspx?ArticleId=9c549df3-f111-43c8-aad0-f6352f179033&ArticleType=2

PKU GSE. (2005). Education and employment survey of Chinese urban residents in 2004 (a). *PKU GSE Newsletter 092*.

Psacharopoulos, G., & Patrinos, H. A. (2004). Returns to investment in education: A further update. *Education Economics, 12*(2), 111-134. Retrieved from https://www.tandfonline.com/doi/abs/10.1080/0964529042000239140

Rumble, G. (2001). The costs and costing of networked learning. *Journal of Asynchronous Learning Networks, 5*(2), 75-96. Retrieved from http://www.c3l.uni-oldenburg.de/cde/media/readings/rumb01d.pdf

Rumble, G. (2004). *Papers and debates on the economics and costs of distance and online learning*. Oldenburg: Bibliotheks- und Informationssystem der Carl von Ossietzky University. Retrieved from http://www.c3l.uni-oldenburg.de/cde/rumble.pdf

Schultz, T. W. (1961). Investment in human capital. *American Economic Review*, *51*(1), 1-17. Retrieved from https://www.jstor.org/stable/1818907

Siaciwena, R. (2008). Distance education/learning. In McCulloch, G., & Crook, D. (Eds.), *The routledge international encyclopedia of education* (pp.175-178). London, UK: Routledge.

Trow, M. (1973). *Problems in the transition from elite to mass higher education*. California, USA: Carnegie Commission on Higher Education.

Yang, Z. J., & Li, F. L. (2012). The forecast of the scale of distance higher education in China. *China Educational Technology, 32*(8), 35-39. DOI: 1006—9860（2012）08—0035—05.

Zheng, Q. H., Chen, G, & Zhang, X. D. (2009). Individual return ratio of education investment for distance education. *Journal of Beijing Normal University (Social Sciences)*, *46*(02), 99-105.

† Dr. Li Fengliang, Associate Professor (Tenure), Institute of Education, Tsinghua University, Beijing, China. Postcode: 100084; email: dagger@tsinghua.edu.cn. Dr. Li Fengliang, a 2015 CCSEP (CANADA-CHINA SCHOLAR EXCHANGE PROGRAMME) visiting scholar at Athabasca University, with the support of Foreign Affairs, Trade and Development Canada.
[i] In 2004, Tsinghua University announced that it would stop providing academic credentials education via distance education.
[ii] The reader who are interested in the rate of return to education can read Carnoy (1995) to understand the difference between the two different methods.
[iii] Those reader who have interests can read the two review articles on the chaos on the distance higher education in the "People"s Daily" May-2-2013 (Chinese version). Although some of arguments from these two articles are debatable, but the worrying of Chinese distance higher education's quality is a consensus for many people.

International **R**eview of **R**esearch in **O**pen and **D**istributed **L**earning
Volume 19, Number 4

September – 2018

Book Review: Open: The Philosophy and Practices that are Revolutionizing Education and Science

Editors: Rajiv S. Jhangiani and Robert Biswas-Diener (London: Ubiquity Press, 2017, 304 pages. https://www.ubiquitypress.com/site/books/10.5334/bbc/)


Reviewed by: Nelson R. Jorge, *IHE Delft Institute for Water Education*, and Martijn Ouwehand, *Delft University of Technology*

When exploring the idea of Open, presenting different perspectives and covering various interconnected domains is a meaningful effort to provide a comprehensive overview of this multidimensional concept. Open education, open pedagogy, open science, open access, open textbooks, open educational resources, open-source, and open practices are all concepts related to the common idea of removing barriers, providing access, and stimulating progress.

The book Open: The Philosophy and Practices that are Revolutionizing Education and Science, edited by Rajiv Jhangiani and Robert Biswas-Diener, presents a combination of interesting viewpoints and developments related to various dimensions of the open movement: open education, open science, open access, and open pedagogy.

The introductory part of the book explores the concept of open education with a focus on open educational resources (OER). The chapters here included provide an explanation of the history of OER, its development and distribution, with David Wiley's 5R activities in mind - retain, reuse, revise, remix, redistribute - and the role of Creative Commons licensing, allowing easy access and editing with common tools, generally available.

In fact, Creative Commons played a critical role in the evolution of OER, contributing to its proliferation and leading to the possibility of reducing costs in higher education, for example with the adoption of open textbooks as opposed to expensive Big Publisher Books (BPBs), a curious term used in this book by Regan Gurung. Nevertheless, benefits for OER shouldn't be limited to cost savings. Other benefits include the contextualization and enhancement of OER, and the freedom learners have to access trial subjects, complement, and enrich their formal study.

The quality of OER is also an interesting topic brought up to the discussion. While some may consider price as a way to reveal quality (the more expensive the better), this judgement doesn't make sense when talking about OER. Just like with any other educational resource, faculty have the responsibility to analyse and review it before it's added to the teaching and learning process. Knowing the author of a certain OER and that it has been reviewed by peers makes it easier, with the advantage of knowing which parts could be improved and having the freedom to actually improve it. Therefore, the quality of OER can be understood as something dynamic since its content can continuously be revised and optimized.

The second part of the book is about Open Practices, including chapters about Open Science and Open Pedagogy.

The transition towards Open Science is an ongoing effort that is dependent on a profound cultural change - in researchers' behaviour, in the infrastructure that supports their research, and in the commercial business models that dominate the sector. The Center for Open Science (COS) is a meaningful initiative to encourage open science practices and accelerate a change process. The COS aims to improve the quality of research by increasing its openness, integrity, and reproducibility. Strategies to achieve their mission include the evaluation of empirical evidence, appropriate training of academic researchers, and incentives that promote the sharing of research output.

As reviewers working in the open education field, we see the addition of an Open Pedagogy chapter as a very relevant and important one, since it goes beyond reusing OER. Open Pedagogy entails an educational transformation where more interactive and meaningful contact time replaces traditional lectures. OER is critical in this pedagogical change but as something to critique and further develop, something to revise and add-on to, instead of an end product that is simply found and adopted. A truly student-centred approach can then be fostered, offering students the possibility to curate and create.

The third part of the book contains several case studies that describe practical examples of open initiatives, reinforcing the first two parts of the book.

David Wiley's chapter has, however, a different approach. In "Iterating toward openness: Lessons learned on a personal journey," Wiley shares insights and reflections on his work in open education. After almost 20 years of contributions to the field, Wiley concludes that it's time to move beyond narrow conceptions of OER to a more comprehensive Open Education Infrastructure, with four interdependent components: Open Competencies, Open Educational Resources, Open Assessments, and Open Credentials.

The book ends with a conclusion by the editors, where challenges and the future of the open movement are discussed.

In sum, this book provides insight into most of the currently relevant authors and developments in the open domain, offering a comprehensive overview. Although the idea of this book initiated with a focus on open psychology, it managed to gather a broader collection of different chapters that can be read separately. Due to this variety, we see it as a good starting point for people new to the concept of Open, while some chapters are definitely interesting for people who are already in the field.

Independent of the readers' background, we come to conclude that there's still a lot to be done and that a socio-cultural change is necessary to realize Open as a default practice in the coming future. We believe that reading this book can definitely contribute to the necessary change.

International **R**eview of **R**esearch in **O**pen and **D**istributed **L**earning
Volume 19, Number 4

September – 2018

Hearables for Online Learning

Rory McGreal
Athabasca University

Hearables, a term first coined by Hunn (2014), are wireless, smart, micro-computers with artificial intelligence that incorporate both speakers and microphones. They fit in the ears and can connect to the Internet and to other devices; they are designed to be worn daily. These devices, such as the *Bragi Dash*, *Vinci*, and *Bose Hearphone* are now appearing on the market, which is expected to exceed $40 billion in the USA by 2020 (Omnicom, 2018). Hearables are not headphones, nor hearing aids, nor ear plugs, although they could take on the affordances of any of these devices (Banks, 2018). Headphones are designed for listening to music. Hearing aids are designed as an aid for the hearing impaired. Ear plugs reduce unwanted sounds by cancelling noise. Hearables offer comparable features and additionally provide users with a microphone and connectivity to the Internet, thus supporting telephony and personal digital assistant (PDA) services (Computational Thinkers, n.d.). Prior to 2017, in the USA, such devices required the approval of the Food and Drug Administration. This approval is no longer required for hearables, as they are no longer considered to be medical hearing aids (Over the Counter Hearing Aid Act, 2017). This paves the way for the expansion in the market of significantly lower-priced hearables, undercutting the expensively-priced hearing aid market.

Hearables stream music or audio content wirelessly using Bluetooth. Phone calls can be taken hands-free. Noises can be filtered out and speech amplified and filtered. And, with augmented audio, hearables can transform the user experience with sound controls and special effects (Traynor, 2017)

Hearables can be also used to simply enhance the listening experience; Hunn (2014) refers to them as the "new wearables." As such, they represent a subset of wearable computers, which now includes wrist bands like *Fitbit*, eye wear such as *Google Glass*, intelligent garments such as *CoolShirt,* or shoes such as *Nike+*. Hearables must be distinguished from audibles such as Amazon's *Alexa*, Apple's *Siri,* Microsoft's *Cortana* and *Google Assistant*. The difference is that of mobility – hearables can go anywhere with the user, whereas audibles are place-based.

To date, hearable companies have focused on either music, because of its wide popularity, or the health and sports markets, because of the devices' ability to monitor and track body performance such as the heart-rate, energy, oxygen saturation, etc., or physical activity such as, speed, time, counting steps, etc. The ear is one of the best places to accurately measure biometrics and physical activities. In addition, the newest hearables can now provide as-needed advice on request by users. A PDA can instantly access various web applications, such as news and weather reports or route planning. Another form of specialised hearables are the earphone language translators such as *Waverly Labs Pilot* and to a lesser extent *Google Pixel Bud* that rely on *Google Translate*. This translation feature, along with others, opens up the possibility of taking full advantage of these devices to support mobile learning and other forms of both traditional and distance education.

Distance learning has been evolving at a rapid pace since the arrival of the ubiquitous Internet at the end of the last century. The old correspondence school model based on the postal system was ported to the Internet, increasing response times. Then the affordances of the Internet allowed for greater interactivity, first through simple email, then with social networking, audio and video conferencing, and Voice-Over-IP using desktop computers. Mobile devices including smart phones, tablets, and laptops are now ubiquitous. They allow users to access the Internet from wherever they are. More people today access the Internet using these mobile devices than by any other means (International Telecommunication Union, 2017). Students are taking full advantage by accessing their lessons online. Both formal and informal learners are also accessing instructional videos, audio books and manuals, podcasts, personal recordings, and accessible training, explaining, and skill enhancing websites.

More recently, place-based audible technologies have demonstrated the convenience of using these PDAs in the home and office. Their capability for intelligent voice recognition (IVR) and natural language understanding (NLU) enables these devices to serve as powerful interactive digital advisers. In fact, these interactions could become the principal means for spontaneous queries (Burrows, 2018). This has opened the possibilities for using IVR and NLU to support learning.

Place-based audibles can be used in the administration of education. Ellis (2018), reported on a campus-wide distribution of Echo *Dot* audible devices with *Alexa* to all the students. She noted how the devices are being used to relay information from the institution to students, alerting them to deadlines or dates on the academic calendar, as well as faculty office hours or even the cafeteria menus. She also noted that students were using their devices as PDAs, advising them on a wide range of campus and other activities. Hearables could be used in a similar manner, while allowing students more flexibility, because they can remain connected wherever they are, and so, not be confined to their residences in accessing *Alexa* and the broader Internet.

Now, with the availability of hearable devices, one can begin to explore in what ways, they can be advantageous. Hearing is a private and personal activity. This should be kept in mind when designing applications and tasks. Perhaps the most significant advantage for hearables comes with their ability to provide features that exceed the capabilities of the basic hearing aid. Hearables can augment the ability of the user to hear and discriminate sounds, helping them to focus on those sounds that are the most important – super hearing. For example, an emergency respondent could be alerted to the slightest sound in a burning building. Hearables also facilitate switching from one function to another seamlessly, while providing useful advice as needed. With the growth of augmented reality and other forms of multimedia, users will need to have audio input, so hearables could become essential in these alternative environments. As we know from the user experience with the home-based audible devices, the voice interactions can be natural and personal. In a mobile environment, perhaps the most important application will be the ability of users to instantly access the information they need in real time; in the workplace; the added advantage of being hands-free cannot be underestimated.

Brown (2016) noted several advantages of hearables. Notably, they can be used for most, if not all, of the traditional sound-related applications, such as listening to music, and mitigating hearing loss. In addition, hearables can augment sounds; this benefit improves hearing above the norm by empowering users to apply selective noise cancellation (removing extraneous noise) and focus on specific sounds, such as a baby crying. Instant replay and recording of words is also possible, so users can check for understanding or file a recording as a record of an agreement. Another important feature is the ability to instantly translate from many languages. The biometric capabilities allow for measuring health and fitness variables, providing users with a health record and even sound an alert for a sudden medical emergency. Biometrics can also be used for security authentication.

For educators, the information/communications functions can be effectively exploited. These support the delivery of lectures, educational podcasts, notifications, and reminders through a wide variety of applications, while supporting interactivity. Intelligent hearables can determine the context and choose the right time and place to deliver the best content. These PDAs can become one of the principal ways we interact in learning.

There are significant challenges in using hearable devices. There are major concerns related to the social acceptability of people talking out loud in a public space or office. There has also been a stigma attached to hearing aids, with many people considering them to be unfashionable and only for the elderly. Manufacturers are addressing the stigma by designing devices that are unobtrusive, sitting securely inside the ear. Hunn (2015) suggests that the comfort of these new lightweight devices will help to destigmatise their use. Of course, another approach is to create more fashionable devices – the earrings of the future (Lumen Couture, 2018).

Security of personal information is always an important consideration, especially when one considers that the microphone is always on. Users must be advised on exactly what is recorded and where it is stored, not to mention who controls access to it? As most companies are now adhering to European privacy regulations allowing personal control of information, we can hope that this does not remain a major issue.

There are several technical challenges for hearables. The need to reduce power usage and increase battery life has been identified, along with more reliable connectivity. High bandwidth connections are essential to support natural language communications, particularly those that require translation. These calculations require very fast processing speeds and so must be processed in the Cloud, as even the most modern devices do not have the computing power or memory capacity to perform required calculations. Blue Tooth 5 capability, which allows for a major reduction in power consumption, is also needed to support extended battery life. Fortunately, it is now incorporated in the latest mobile and hearable devices.

On the other hand, the benefits of hearable devices are significant. They are easy to use and highly portable; learners can use them almost anywhere with Internet connectivity to communicate with teachers and other students. It is available at any time the learner wants to study. It can be highly personalised to suit the learner's abilities and learning environment. Moreover, the devices will be well-integrated into the normal life and activities of the learners and not used only for learning.

Smart mobile devices are now ubiquitous among students and so we can assume that they will have one. This cannot be said for hearable devices yet, and it could take some time before they achieve the same level of ubiquity, if ever. On the other hand, lessons designed for hearable device use can be easily accessed by students on their mobile devices or other computers.

Learning using Hearable devices (H-Learning) is a subset of mobile learning, which itself is a subset of elearning. Therefore many of the lessons learnt from these implementations can be applied to H-Learning. Jones, Issroff, and Scanlon (2007) noted that mobile learning facilitated personal control and ownership in a fun environment, while supporting learning-in-context. As a specific instance of mobile devices, hearables share these characteristics. In online learning, hearables can be used in a similar fashion, providing student services and appropriate feedback to off-campus students as well as course content. Hearables can also be used (augmented or not) to improve personal voice-based contact between the students and their instructor, and among themselves, whether remotely or even when together in a classroom. Like other mobile devices, hearables, being easy to use, available and highly portable can also be accessed to provide course content, feedback to off-campus students, links to relevant resources, and more interactivity. (Mehdipour & Zerehkafi, 2013).

There are several different approaches to learning. Educators will need to experiment with different hearable devices, while piloting a variety of approaches to see what can be adapted to promote learning with or without hearable devices. In the beginning stage, it might be best to see hearables, not as stand-alone media for the transfer or construction of all the relevant knowledge or skills in a course, but rather as one of many aides in promoting learning. Today, blended learning is becoming the norm as more and more classroom-based courses integrate online components, whether that be a simple website or email exchanges. Online lectures and podcasts, as well as the audio from videos, can be easily accessed using hearables. Online text can also be made available on hearables as they are becoming much better in text-to-speech conversion. Textual content can now be accessed in this manner, whether the course is classroom-based, blended, or fully online. One can envision students following their courses while on the move and using their hearables while walking, running, or while riding on the plane, train, car, or bus. Visual information (texts, videos, pictures, graphs, tables, etc.) can be accessed using other devices. Learners can make use of their hearables to master at least some, if not most of the content and/or skills presented in a course.

While hearables can be successfully used in this manner, there are several learning scenarios where they can arguably be the most effective medium for instruction. Certainly in music education and language teaching, they are poised to play a significant role. Listening, lies at the heart of both music and language comprehension (Vandergrift, 2007). Yet, other subject areas could also benefit, especially when considering different learning approaches. Among them are just-in-time/context-based learning, self-directed learning, and personal/connectivist learning.

Just-in-Time Learning/Context-Based-Learning

With ubiquitous access to the Internet and its plethora of educational/training content, hearables are well-placed to play a significant, if not the most important role in supporting just-in-time learning. Using hearables, learners can now access important training whenever and wherever it is needed. In any mobile workplace, continuous training can be integrated into every workday using hearables. For example, when faced with faulty new machinery, a machinist can access instructions on how to fix the problem or even contact the manufacturer directly using hearables, while leaving his hands-free to follow instructions in real time. Sales people, while driving on their way to meet clients can use their hearables to brush up their knowledge of the customer, of their product line or even their presentation skills. To facilitate these training opportunities, designers should organize the content into bite-sized chunks as there are few workers who can spend an hour or even a half hour away from the job. People learn faster when the learning is immediately needed and in a meaningful context.

Self-Directed Learning

Hearables can play a key role in independent study. They can serve to detach learners from formal institutional education, expanding the variety of places, times, and ways their learning can be supported. They can serve as an important tool, helping a learner to become more independent, autonomous, motivated, organized, and disciplined. A PDA can help with identifying the learning resources needed, providing constructive feedback, monitoring progress, and aiding in the process of self-assessment and setting personal goals. In addition, hearables can be used to help structure study plans and create reasonable timelines. Having an advisor available with relevant information whenever needed also helps to instill in the learners the confidence to succeed.

Personal Learning/Connectivism

Hearables are well-placed to support context-aware, adaptive personal learning tailored to each individual learner's personal characteristics and situation. In this way, they can help learners to make their own decisions about what, where, when, and how to learn. Learners can take maximum advantage of the continuous connectivity afforded via hearables to achieve their learning objectives, and in the creation of a personal learning network. Immediate access, filtering knowledge domains for the most relevant information distributed on the Internet can be facilitated with the help of a PLA.

Conclusion

So, hearables are coming here to stay both in the wider society and the educational community. There is a need for educators to conduct research using these new devices to support learning in different contexts (online, workplace, classroom) using a variety of approaches. Also, hearables should be tested in a variety of subject areas, (but I would suggest particularly in language learning) to determine not only their optimal uses, but also the challenges. Piers Fawkes has commented on one negative effect from using hearables. "Maybe instead of people staring at their screens, they are going to be staring off into the distance. What's it called? The thousand-yard stare" (Glazer, 2014). On a more positive note, perhaps hearables will be helpful in bringing users down to earth, like the slave of Augustus Caesar, who rode with him in his chariot, reminding him that he was not a god, repeatedly whispering in his ear “Memento homo” (Remember you are a man).

References

Banks, L. (2018, June 13). The complete guide to hearable technology in 2018 (Blog post). Retrieved from https://www.everydayhearing.com/hearing-technology/articles/hearables/

Brown, S. (2016, November 3). Hearables: The next big wearable platform (Blog post). Retrieved from http://www.baldfuturist.com/blog/2016/11/1/hearables-the-next-big-platform

Burrows, P. (2018, August 2). The future is ear: Why "hearables" are finally tech's next big thing (Blog post). *Fast Company*. Retrieved from https://www.fastcompany.com/90212065/the-future-is-ear-why-hearables-are-finally-techs-next-big-thing

Computational Thinkers. (n.d.). Hearables no longer whispering wearables (Blog post). Retrieved from https://www.computationalthinkers.com/hearables-no-longer-whispering-wearables/

Ellis, L. (2018, August 2). Hey, Alexa, Should we bring assistants to campus? These colleges gave them a shot. *The Chronicle of Higher Education*. Retrieved from https://www.chronicle.com/article/Hey-Alexa-Should-We-Bring/244129

Glazer, J. (2014, April 29). Psst! Wearable devices could make big tech leaps, into your ear (Blog post). Retrieved from https://www.npr.org/sections/alltechconsidered/2014/04/23/306171641/psst-wearable-devices-could-make-big-tech-leaps-into-your-ear

Hunn, N. (2014). Hearables - the new wearables (Blog post). Retrieved from http://www.wearable-technologies.com/2014/04/hearables-the-new-wearables/

Hunn, N. (2015, February). The market for smart wearable technology: A Consumer centric approach. Retrieved from http://www.nickhunn.com/wp-content/uploads/downloads/2014/08/The-Market-for-Smart-Wearables.pdf

International Telecommunication Union. (2017). ICT facts and figures 2017 Retrieved from https://www.itu.int/en/ITU-D/Statistics/Documents/facts/ICTFactsFigures2017.pdf

Jones, A., Issroff, K., & Scanlon, E. (2007). Affective factors in learning with mobile devices. In M. Sharples (Ed.*), Big issues in mobile learning*. *Report of a workshop* (pp. 15-20). Nottingham: Learning Sciences Research Institute, University of Nottingham. Retrieved from https://telearn.archives-ouvertes.fr/hal-00190254/document

Lumen Couture. (2018, July 9). "Hearable" fashion techhearables: Wearable tech for your ears (Video). Retrieved from https://www.youtube.com/watch?v=GsBRKr1jQG8

Mehdipour, Y., & Zerehkafi, H. (2013, June). Mobile learning for education: Benefits and challenges. *International Journal of Computational Engineering Research, 03*(6). Retrieved from https://pdfs.semanticscholar.org/4ff6/1a4dc3de4c53c1d7ec4d417d1a319467d38b.pdf#page=251

Omnicom Health Group. (2017, March). SXSW interactive trends Retrieved from http://www.omnicomhealthgroup.com/pdfs/SXSW%202017%20Interactive%20Trends%20Paper_FINAL_041717.pdf

Over the Counter Hearing Aid Act, S.670 Stat. (2017). Retrieved from https://www.congress.gov/bill/115th-congress/senate-bill/670?q=%7B%22search%22%3A%5B%22Over+the+Counter+Hearing+Aid+Act+of+2017%22%5D%7D&r=2

Traynor, R. (2017). Headphones: They have come a long way, baby. *Canadian Audiologist, 4*(1). Retrieved from http://www.canadianaudiologist.ca/issue/volume-4-issue-1-2017/column/stories-from-our-past/

Vandergrift, L. (2007, July). Recent developments in second and foreign language listening comprehension research. *Language Teaching, 40*(3), pp. 101 - 210. Retrieved from https://doi.org/10.1017/S0261444807004338