Editorial for Volume 14 issue 1 ECEL 2015

Guest editors
Amanda Jefferies and Marija Cubric
University of Hertfordshire, UK

Introduction
Welcome to this special edition of EJEL, which shares a selection of extended papers initially presented at the 14th European Conference on E-Learning (ECEL), which was held in October 2015 at the University of Hertfordshire, UK. In this edition six papers are presented which discuss and reflect on research into multiple aspects of introducing digital technologies to enhance learning from Chile, New Zealand, Japan, Singapore, Malaysia, Denmark and the UK. This range of author nationalities is indicative of the value and reach of this European conference which now draws a global audience.

The focus of much e-learning research in recent years has concentrated on understanding how student users of digital technologies can enhance their learning whether at school, university level or in professional learning. Charbonneau-Gowdy and colleagues consider the important role of teacher identity in the embracing of technology-mediated learning in Teacher Education. They explore the development of teacher skills in using digital technologies for both research and learning, with initial teacher training and also experienced teachers. Their findings from a 16-month study of guided e-reading and technology-supported mentoring to prepare pre-service teachers are discussed in the context of the reflections of teachers who have been in service for a while. Their primary consideration is the importance of supportive mentoring especially where trainee teachers’ ‘lack confidence in using technology’ and in a context where they face complex barriers – infrastructural, pedagogical and human - in their engagement with and use of technology. Paradoxically, the authors conclude that for pre-service teachers it was the affordances of the technology that were crucial in providing the context of enriching opportunities for good mentoring.

In-service training of teachers is also the theme in the study from the Center for Teaching and Learning, University College Zealand (UCS), Denmark, in a paper entitled ‘Design framework for an adaptive MOOC enhanced by blended learning’. In the light of the Danish government’s requirement for all primary school teachers to be educated to Bachelor’s degree level in their specialist subject by 2020 a radical approach of offering in-service training to teachers via a MOOC has been adopted by UCS. This is in order to support the demands of the additional in-service training required. Gynther and colleagues explore the design and development of a MOOC by means of a design framework to guide the development of instructional designs. This has been adapted for the different training needs of experienced teachers. In the light of the literature they reflect on their rationale for the MOOC design framework which allows the users to have a unique personal curriculum based on their prior experience, skills and competencies. Early evaluation of participants of this ambitious project indicate that it is the external factors such as the lack of time off for in-service training which can be a barrier to progression and completion for mature students in full-time employment.

Schoolteachers’ use of technology is discussed in the three year longitudinal study reported by Parsons and Adhikari in ‘Bring Your Own Device (BYOD) to Secondary School: The Perceptions of Teachers, Students and Parents’. The authors explore how a school in Auckland, New Zealand has adopted a policy of using personally owned computers and the impact this has had on the primary stakeholders – the teachers, the students and their parents. The length of the study enabled them to take a longer view of how the BYOD classroom has developed and matured as they considered the importance of including the parental view in addition to the student and teaching staff users in the context of BYOD. The teachers commented positively on the changing classroom environment because it offered a more student-centred learning focus as the classrooms became ‘more devolved, collaborative, group based and student centric’. Overall the authors considered that the analysis of the qualitative data from teachers was substantially
positive, whereas responses from parents and students were more mixed. They suggest that the impact of agency has an important role to play, in this context, teachers had the greatest agency, but parents the least.

University students’ digital and information literacy skills are the focus of Tang and Chaw’s paper ‘Digital Literacy: A Prerequisite for Effective Learning in a Blended Learning Environment?’ They postulate that while it is generally accepted nowadays that students ‘face no difficulties in using technology for everyday social and entertainment activities’ they query how far ‘students can make effective use of technology for learning as well’, since in order to make most effective use of technology for learning, they need to display a certain level of digital literacy. Digital literacies have been the source of a number of recent research studies and it is widely acknowledged from UK and US-based studies across tertiary and further education that the possession of effective information management and critical thinking skills and online behaviours leads to a positive contribution to student achievement. This study asks ‘Do students require digital literacy to be effective in learning in a blended learning environment? The authors conclude their detailed literature review and the analysis of their own data by asserting that a ‘good fit of digital literacy level to course expectations is indeed necessary for successful blended learning.’

Nakayma and colleagues share their work into researching course participants’ participation and self-efficacy as a way to understand barriers to student achievement, in a detailed study considering aspects of student participation in a blended course. Their hypothesis was that increased note-taking activity may positively affect student’s emotional aspects, such as self-reflection. They gathered students’ reflections on their participation in their studies through the students’ own note-taking activities during a semester. The full statistical analysis led to the authors confirming that the level of information literacy and student’s learning experience contributed positively to factors of student’s reflection.

In ‘Introducing Open Educational Practices (OEP) to a large research-intensive university (RIU)’ Masterman first explores the current situation where sharing of knowledge is now globally possible through digital technologies, noting that “Open sharing of knowledge is at the heart of the academic process. For many faculty, it is an intrinsic value, convincingly demonstrated in their teaching and research” (Lerman, Miyagawa and Margulies, 2008, 214). She considers the literature on both OEP and RIU in the light of a study which included detailed interviews with 14 academics at the University of Oxford. Her own findings indicate that open educational approaches can be accommodated within a university’s prevailing pedagogic model without compromising its integrity and that the practice of openness can enhance the specifics of that pedagogy. She discusses how this can occur through aligning research-informed teaching with emergent open practices in research and equipping students with the skills necessary for living and working in an open world. She considers the motivating factors for the academic sharing their materials whether ‘altruism, enhancement of reputation or knowledge self-efficacy’, the academic or researcher reusing materials and the role of the institution in supporting the practice. She acknowledges that ultimately the spread of open practices in both pedagogy and outreach hinges on issues of governance, which in RIUs is historically characterised by academic autonomy. Important questions raised include whether examples of practice from the University of Oxford with its almost unique tutoring approach might be applied in other research-intensive universities and how those HE institutions which focus primarily on teaching can benefit from OEP.

The selection of papers for this Special Issue demonstrates the breadth and depth of e-learning research and the interdisciplinary nature of the e-learning field, which can be positioned within the intersection of Education, Information Systems, and Business subject areas. We commend the diversity of research strategies, methods and techniques and the diversity of the stakeholders’ perspectives and hope you enjoy reading this issue.
Brave Forms of Mentoring Supported by Technology in Teacher Education

Paula Charbonneu-Gowdy, Rosana Capredoni, Sebastian Gonzalez, María José Jayo and Pablo Raby
Universidad Andres Bello, Santiago, Chile
paula.charbonneu@unab.cl
rosanacapredoni@gmail.com
s.unabgonzalez@gmail.com
cotejayo@gmail.com
alejoraby@hotmail.com

Abstract: Quality education is undoubtedly a global concern, tied closely to preoccupations with economic and social development. Increasingly, the adoption and effective use of current technology tools are being recognized as visible signs of that quality. Scholars are providing increasing evidence of the kinds of empowered teacher identities that will adopt the effective use of technology tools in teaching. Less is being discussed about how technology can support the processes needed to mediate such identities. The context of Teacher Education is a strategic place to begin to initiate such processes. Our aim in this article is twofold: 1) to describe two recent examples of innovative, technology – supported mentoring processes that were conducted in the context of an EFL Teacher Education program in Chile; 2) to revisit the findings of these studies in light of new evidence from participants who have moved on in their careers. This evidence is viewed in the framework of recent scholarship on the responsibilities that Teacher Education plays in their development. The first 16-month study examined the influences of a guided reading program involving e-readers on the identities and literacy skills of pre-service teachers. The second was a student-conceived study. That inquiry sought to determine the influence of upper year students’ peer mentoring, made available partly through a social media site (SMS), on the identities and investment in learning of 12 first-year students in the pedagogy program. The initial evidence from ethnographic tools used in both studies indicated that the participants were struggling with confidence and doubting themselves as knowledgeable, effective future teachers – not predictive of a potential for quality teaching. Positive signs at the end of both studies and more recent reports from participants suggest that the mentoring had longitudinal benefits for some, although not uniformly. The potential of apprenticeship and mentoring in a technology-supported environment requires rethinking Teacher Education mandates if we are to empower emerging teachers to be quality teachers.

Keywords: teacher education, social communication technology support for mentoring, identity and investment, TPAK, e-readers

1 Introduction

It is difficult to ignore the extent to which information and social media technologies are infiltrating almost every area in our daily lives. Along with this movement, they are supporting a calling into question of established ways of doing on many levels. Media reports of the new social economy, for example, such as Airbnb accommodations and Uber taxi transportation, are revealing how technology is, as Kress (2004) puts it, “unmaking social frames of power” (p. 8). Resistance by the established elite that has controlled these economies is understandable given the high stakes that are involved. In each of these examples, however, the insight of brave and creative individuals have capitalized on the capacity of information and social communication technologies to support the power of human beings collectively to mediate the infrastructure and changes that they need and want.

New emerging technologies, as semiotic resources, i.e. resources of and for constructing new meanings (Kress, 2004, p. 9) are not being used by human beings solely for breaking down power structures like transportation or accommodation institutions. Similar struggles are clearly being played out in the field of education. The advent of massive online open courseware (MOOCs), (Seiman, 2012a; Alario-Hoyos et al., 2014) and the now world-renowned mathematical tutorials of the Khan Academy (Noer, 2012) are two examples of this phenomenon. In our own field of study of language learning, Language Learning Social Network Sites (LLSNs) where millions of learners choose to meet informally to practice a foreign language with native speakers, is yet another (Lin et al., 2016). These programs, made possible by increasingly powerful technologies, are serving connected groups of individuals to usurp the services of sacred institutions of learning and their well-
established economies and policymakers. Indeed, so powerful have these alternatives become that the institutions themselves are jumping on board (Murphy et al., 2014).

While scholars continue to debate how to break down resistance to technology in formal learning settings (Daniels et al., 2013, Husbye & Elsner, 2013, Wetzel et al. 2014, Lindstrom et al., 2015), it seems a counter movement is actually replacing the traditional offerings of these educational sites (Scott et al. 2016). Two recent studies we describe in this paper were conducted within the context of an EFL Teacher Education program and reflect a move in that direction. Our previous research (Charbonneau-Gowdy, 2012, Charbonneau-Gowdy, 2015) has been aimed at unravelling some of the complex infrastructural, pedagogical and human barriers we face in this teaching context with respect to the use of technology. Confronted by these barriers, our current work could be seen as efforts by a few maverick individuals to break away from the established system and, as stated above, to mediate the changes we want and need.

Much of the work that is looking into infusing technology in learning sites has led to the conclusion that identity is a major factor in whether or not learners, and more significantly teachers, adapt these emerging tools. For example, Wetzel et al. (2014) found that adopting a Technological Pedagogical Content (TPAK) model (Mishra & Koehler, 2006) as a framework for technology integration into pre-teachers’ teaching practices had less encouraging results due to reported lack of confidence on the part of the teachers-in-training. Similarly, Lindstrom et al. (2015), in reviewing the work in the area of digital learning in teacher education, point to pre and in-service teachers’ lack of confidence as an indication that still more work is needed before teachers uniformly will actively adopt technology-supported practices in their teaching.

Confidence, or the lack of it, is a dimension of one of our multiple identities, our sense of ourselves that we assume or that are assigned to us in various contexts. The subject of identity has been the focus of a cross section of research in education for over a decade. Indeed, in the TPAK model (See Figure 1), that we have adapted to explain more broadly the integration of technology into learning sites, we have conceptualized identity as a major determinant in the success of this process. Individuals, as well as communities, cultures and institutions, have multiple and dynamic identities (Norton, 2013). Norton has tied identity closely to the construct of investment as a commitment to change, or learn. We believe that it is in this area that drivers of change in the uptake of technology should be putting their efforts.

Figure 2: Adapted TPACK Model for Fostering ICT in Teacher Education

(Charbonneau-Gowdy 2014, adapted from Misha & Koehler, 2006)

In the next sections, we describe the studies that we conducted based on this belief. Ostensibly these studies were aimed at providing enriched technology-supported opportunities for pre-service teachers to construct empowered identities as learners and future teachers. Yet, we were well aware that the modelling that was happening in these mentoring sessions also had the potential to impact the participants teaching and learning practices as well (Figure 1). In the findings section, we report on our analysis of more recent data that supports this prediction. Along with the scholarly work of Norton and others studying identity and investment issues, we frame this latest analysis on the adapted TPAK model as well as current literature that examines effective modelling or mentoring practices to explain these recent developments.
2 Background and rationale

Part of our preoccupation with the role of identity in e-learning or change of any kind, is based on the experiences and insights we have gained using technology for teaching/learning practices and projects in diverse settings – North America, Europe and South America. In each of these settings, we have witnessed firsthand how various material and social conditions within these learning sites that are grounded in pedagogical, political, social cultural and personal contextual factors, determine the positions/identities that learners assume in these sites. We have concluded that it is the nature of the kinds of identities that learners mediate within occasions for learning that dictates how or whether they invest, or engage, in the learning practices that take place therein (Darvin & Norton, 2015). We have also learned how these conditions have an influence on multiple and often unequal ways that learners are positioned in these settings, and how this positioning can lead to different outcomes in learning. We have observed for example how the various learning outcomes that result in these situations are often dependent on structures of power that are invisibly intertwined in such contextual conditions. Our work in these sites has focussed on how, or indeed if, technology tools can serve to break down such power structures. In doing so, we have asked ourselves whether technology could provide opportunities for a different scenario in terms of identity construction for learners - one that alters the course of learning outcomes and transform learners' visions of the future.

To understand the personal, cultural and institutional identity factors involved in these studies, it is important to understand the context. The two studies took place at a large, private university in Santiago, Chile. Chile distinguishes itself economically among other countries in South America by being the only country on the continent to be a member of the OECD. Indeed, it's economy is the strongest in Latin America at time of writing. On the other hand, within its borders, it has struggled with a socio-economic divide that is reflected all too vividly in the vast majority of citizens who receive poor quality education and limited access to tertiary education. Surprisingly in the 21st century, it has only been since 2003 that public education has gone beyond Grade 8 in Chile. The educational weaknesses that Chile faces have led to low productivity and literacy rates - among the lowest globally. In attempt to break this trajectory, emerging middle class families struggle to enrol their children in the numerous private, for-profit, higher educational institutions in the country, many of them without accreditation. The financial costs for these families are staggering. Yet the few public universities that could offer an economical alternative tend for the most part to admit only the very gifted or those whose early education, mostly private, has adequately prepared them for the entrance tests. Public outcry has spurred the government to take steps to transform the educational system (Mizala et L. 2011). For example, in an effort to tackle poor quality teaching, incentives are offered in the form of full scholarships for students who choose to enter Teacher Education university programs. Some argue that the efforts of the government are ill spent. In their arguments, they cite the following: many individuals entering Teacher Education programs are products of poor quality education systems and little can be done in 4 years to change that; the teacher education programs themselves continue to pass on outdated teaching methods; graduating teachers from these programs recognize they face the prospects of unfavourable low standard working conditions, in terms of poor salaries and heavy workloads, once they do graduate. It is little wonder that the attrition rates of new teachers is disturbingly high, 40% after 5 years, and that the existing low standards in the education cycle continue.

Along with a small group of educators in Chile, we have placed hope for change to this chicken egg scenario in education through capitalizing on the use of technology. Our efforts are being made primarily in the area of foreign language Teacher Education where a growing body of research, based on poststructuralist theories of identity and socio-cultural constructivist theories of learning, supports our work. Between 2013 and 2014, we conducted 2 separate studies. One focused on the low-literacy skills of a group of pre-service teachers in the Teacher Education program and the other on peer support for incoming students to the program by upper year students. We recognized a lack of engagement on the part of the participants in these studies and that their futures as quality teachers were at risk. Participants in both of these studies were in need of different scenarios for learning, scenarios that were not being met within the institution and this, despite a New Curriculum having recently being put in place to improve student engagement, retention and results. Our studies were aimed at responding to their needs through measures taken beyond the Program and that were supported by the affordances of information and social media technology tools.

In the first study on literacy involving the use of e-readers with a group of 3rd year student teachers (Charbonneau-Gowdy, 2015), a key question we asked related to the theme of this paper was:

How does a guided e-reader program affect the identities of a group of pre-service teachers as learners, future teachers and as individuals?

In the second study where peer mentoring supported by a private online social network was offered to incoming students in the Teacher Education Program, we asked:

What influence does offering peer mentoring supported by a private social network have on the identities of a group of incoming students and their visions of becoming future teachers?

In the next section, we explain the sociocultural theories and literature that served to frame each of those studies along with more recent data. We consider this scholarly work important to our understanding of: a) the identity and investment changes we witnessed in the pre-service teachers; b) the part that mentoring supported by technology played in this research and c) the significance of the results of our initiatives involving technology tools, on the micro and macro level.

3 Literature review

In the last two decades, the scholarship that has taken place in the field of Second Language Learning, as elsewhere, has been preoccupied with sociocultural theories of identity and its relation to learning. Whole journals, in this field of study have been dedicated solely to its study. The research of Bonny Norton (1995) originally spearheaded this interest in identity and along with it issues of investment and power, which she deemed integral to our understanding of the socio-cultural contexts of learning sites. Norton explains that all learners come to learning spaces with a sense of self that is constructed through language, both past and present. Inspired by the work of Bourdieu (1991), Norton (Darvin & Norton: 36-37) has demonstrated in her research how learning spaces, like all sites of social communication, and we would include here institutions and cultures, are bound up with relations of power. These relations determine the likelihood of individuals to invest in learning, or, in the case of institutions and cultures, in the activities that define their communities. She uses the construct of investment to reference learners’ willingness to engage and be agentic in learning—the natural expectation of all effective educators. Learners will invest in learning, she argues, with the understanding that they will benefit in terms of acquiring a wider range of symbolic and materials resources and ultimately increase their social and cultural power. This cultural power is rooted in Bourdieu’s concept of cultural capital wherein social stratification occurs. Cultural background knowledge, preferences and behaviours that are recognized as valuable in academic systems are passed down by educated or higher classes to their children, or not, as in less advantaged cases. While there is significant research to suggest the advantages of cultural capital within these systems, less is known about mediating factors, such as programs and technology tools that might alter the trajectory of these processes.

The ongoing negotiation of learners’ positioning in learning spaces in particular illustrates the dynamic and fluid nature of identity and also that investment in learning is “complex, contradictory, and in a state of flux” (Norton, 2013:). Unlike the psychological construct of motivation (Dorney & Ushioda, 2009) that is considered a static characteristic tied to the individuals as learners, Norton sees investment as a socially and historically constructed relationship between learner identity and commitment to learning. As the spaces for learning and social communication supported by technology have increasingly become mobile, digitalized and moved online, micro-blogging and e-readers being just two examples that come to mind, they offer wider opportunities for certain learners to contest the social and historically-based power conditions that marginalize them in the traditional learning spaces. As we have explained above in the case of the social economy, these tools offer alternatives to human beings for constructing new spaces in response to systems that have traditionally failed to recognize or meet their needs. These spaces then can also provide a chance for learners to negotiate new more powerful identities. Turkle (1995, p.321) suggests that Internet–mediated environments are “doing more than providing an evocative object for our self-reflection...it is the basis for a fundamental reconsideration of human identity”. These digitalized worlds, in other words, offer individuals a chance to envision themselves in imagined communities where their capital, both cultural and social, is recognized.

In building a framework for our inquiries, we used recent research that focuses on identity and investment issues in combination with learners involved in using technology. Thorne et al.’s reports of research in fan fiction and Warschauer’s seminal research in the integration of laptop technologies into schools, both privileged and low-socio economic (SES) were instructive in our research. These studies acted as an analytical lens to frame our understandings of what was happening as we worked with per-service teachers in our own
respective mentoring settings. On the one hand, Thorne et al’s report of Black’s (2009) and Chen’s (2013) descriptions of how adolescent fan writers mediated cosmopolitan, insider identities and collective personal identities respectively, underlined for us the empowering possibilities that social networking sites can offer. On the other hand, Warschauer’s (2011:114) extensive findings revealed to us the divergent possibilities that result depending on whether technology is used as either an instrument for learner transformation or disempowerment. Warschauer offers a strong warning, based on abundant and grounded research, that e-learning programs that try to de-couple improved learning from improved teaching are destined to fail.

The close connection that Warschauer draws between teachers’ practices and learning when various affordances of technology are employed, has led us to widen our theoretical lens. For example, we chose to follow-up on the participants in the literacy study to understand the long term influence of that particular study on the participants, now that they have graduated from the program. In the process, we have sought out a better understanding of the mentoring process that we undertook in our studies with pre-service teachers at risk. Importantly, our adapted model of TPAK highlights the critical role that guidance, i.e. mentoring, plays in promoting the sustained use of technology in teaching and learning. Mentoring has a long history in educational research, not surprising given that this teaching approach aligns with social constructivist theories of learning that emphasize relationship building and mediated learning in which participants play an agentive and key role. Mentoring based on Lave’s (1996) classic work is “more about learning ways to participate than it is about specific techniques….Practices [of mentoring] are more than just what we do but are inclusive of the reflection and learning that accompanies that work ” (Hoffman et al. 2015). Findings from studies of successful mentoring reported on by Izadinia (2015) cite characteristics of good mentoring. They list: mentors as examples of good practice, open communication, making personal connections and providing academic emotional support. Significant to our studies, the findings focused on how these characteristics had positive implications for pre-service teachers mediating strong teacher identities. Yet, in none of the cases studied was technology used as a supporting vehicle for the mentoring. Also, they contained their research to the traditional teacher mentors that typically work with pre-service teachers in practice teaching settings.

In the next sections, we describe the methodology we used to collect data that helped support some of our findings including from a more recent data set. We then conclude with the implications of these findings for teachers, stakeholders and institutions of higher learning.

4 Methodology

In both of these studies, qualitative data were collected from groups of pre-service teachers in a 4-year Pedagogy for English as a Foreign Language Teaching program. Ethnographic tools were employed in both studies in order to uncover the rich data, and often subtle, nuances that are involved in issues of identity and investment in learning. The data sets in both studies were analyzed using standard qualitative methods for themes and patterns. Participants self-selected themselves to take part in both research studies. In Study 1, we chose a Participatory Action Research (PAR) design. It was clear from the outset that the participants were motivated to join the study. They expressed that they were well aware of their weaknesses in terms of their progress in the Pedagogy Program and saw the guided reading program as an opportunity for exposure to practicing their communicative skills that would hopefully lead to academic improvement. The lead author, as a classroom teacher of the participants over the 3 semesters of the research process, shared similar aspirations for these individuals. Another advantage of PAR, besides the collaborative relationship between researcher and participant it assumes, is the emphasis it places on participant voice (Baxter & Jack, 2008). Giving voice to the participants was an important goal of the research, given the silencing from traditional teaching approaches that most participants had been subjected to in early years of their education, and in many ways still continued to be in their current learning settings.

In Study 2, a Case Study approach was conducted. In order to respond to the central research question on identity, we considered it essential to have a detailed understanding of each student’s unique concerns, needs, interests, and expectations as they began their teacher-training program. We also recognized that this understanding could best be attained through the kinds of tools available to us within the Case Study approach. As incoming students, all of these individuals were in positions of instability both academically within the Pedagogy Program and socially in the larger context of the university student body as a whole. In the spirit of a qualitative research approach and mentoring practice, as researchers we were setting out to form closer bonds with the participants in order to support them. At the same time, we were seeking to
understand any changes that were taking place over the research period. These particular tools provided the necessary contact time for those social bonds to be established and evolve. The information they generated allowed us to adequately respond to our research questions in a way that would not have been possible within a more numbers-generating, point-in-time research approach.

Table 1: Participants, timeline and data collection tools

<table>
<thead>
<tr>
<th>Study</th>
<th>Research Question</th>
<th>Timeline</th>
<th>Participants</th>
<th>Data Collection Tools</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Guided e-reader program</td>
<td>How does a technology-supported reading program influence the identities of a group of pre-service teachers as learners, future teachers and as individuals?</td>
<td>Sep. 2013-Dec. 2014</td>
<td>10 students in 3rd and 4th year of English Pedagogy Students</td>
<td>Individual face-to-face or Skype interview notes</td>
<td>Weekly guided 45-60 minute interviews held with each participant (50 hours) in the first 3-months of the study, intermittently thereafter</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Group interview recordings</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Participant weekly writing journals</td>
<td>Weekly journals written by each participant (260 pages) based on reading on Internet, as part of their course requirements.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Documents</td>
<td>Pre and post results from standardized tests that form part of the course requirement.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Field Notes</td>
<td>Personal communication from other faculty, classmates and participants. Presentation of undergraduate theses in final year.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Observations</td>
<td>Looking at engagement in and beyond course activities</td>
</tr>
<tr>
<td>2. First Steps Peer Mentoring Program Online</td>
<td>What influence, if any, does offering peer mentoring, supported by a private social network, have on the identities of a group of incoming students and their visions of becoming teachers</td>
<td>April to July 2014</td>
<td>12 first year students in the English Pedagogy Program</td>
<td>Individual interviews – recorded and transcribed</td>
<td>24 individual interviews, beginning and end of study, 200 minutes (approx.) in total</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Observations</td>
<td>Online and face-to-face participant activity</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Field Notes</td>
<td>5 pages of researcher reflections</td>
</tr>
</tbody>
</table>
Table 1 summarizes the timeline and data collections tools of each of the studies. The guided e-reader program took place over 16 months from September 2013 to December 2014. The participants, all females, were 10, 3rd and 4th year pre-service teachers in the English Pedagogy program. Students were tasked with reading 1 hour a day and met with the researcher who acted as a mentor interested in hearing about the stories they were reading and providing guided linguistic feedback. The data sets included: notes from individual face-to-face and Skype interviews that took place weekly over the first three months and then intermittently in the last 13 months; audio recordings from 4 group interviews during the first 12-month period of the study, participant weekly written journals, various documents connected to the program administration, field notes and observations. Examples of each of these data sets are provided in Table 1.

Study 2 ran from April to July 2014 and involved 4 senior pre-service student teachers who conducted the study in fulfillment of their undergraduate thesis within the English Pedagogy Program. They mentored 12 self-selected first-year students who were new to the university and were enrolled in the same program. A Community Network, i.e. blog, was set up to provide 24/7 support, relationship building, advice and guidance to the participants between face-to-face sessions. Meetings were held and were recorded. Data were also collected from written correspondence on the blog, field notes and observations. Examples of the data sets for Study 2 are found in Table 1.

5 Findings and analysis

In revisiting the analyses and findings of the extensive data sets from these two studies in the limited space provided in this paper, we begin by focusing briefly on themes that emerged that were directly related to identity. We then present data from further recent follow-up contact with participants of Study 1 and analyse it together with earlier data sets for insight into the sustainability of those earlier results. We organize this discussion around the commonalities that the studies share and reveal in terms of the implications of the use of technology combined with the mentoring process in this particular Teacher Education context. Broader more detailed representations of the individual studies are discussed in earlier separate reports (Charbonneau-Gowdy, 2015; Capredoni et al. 2014).

5.1 Cultural capital, identity and investment

In both studies, we reported that the majority of participants showed strong motivation to succeed in learning. For example, in the context of the E-reader Literacy Study, i.e. Study 1, participants were committed to reading an hour a day on their e-readers and attending weekly guided discussion sessions, despite the considerable demands of their regular studies, practice teaching sessions and long commutes to the campus, often two hours or more. Likewise in the First Steps Peer Mentoring study, participants expressed the importance they saw in learning English to their future success in finding work opportunities in an increasingly competitive globalized market. In other words, both sets of participants revealed their acknowledgment of the potential cultural capital that would come with learning (Bourdieu, 2002), in this case another language.

Intertwined with the recognition of what success in learning could bring in terms of cultural capital, many of the participants in both studies revealed evidence of feelings of fear and anxiety. In the E-reader Literacy Study, for example, there was evidence from the participants of a fear of the following: further course failures; the high cost of their education and the burdens that this cost represented for themselves and their families; the tremendous high stakes and cultural focus on marks and grades; the pressure that accompanied the pride of family for being a first generation member to attend tertiary education. The tensions that surrounded these fears were evident in the demeanour of several of the participants at early stages of this particular study, especially in the classroom. Many demonstrated a shyness to engage, hesitancy about their accuracy when speaking, a reluctance to write and all accompanied by comments as well as physical signs of anxiety. The learner identities that most of the participants portrayed early on in the learning contexts were of being marginalized in the classroom context and that of a lower level student with borderline chances for success in the program. Some of the participants tried to mask such identities through a resistance to error correction, while others labelled themselves, as well as were labelled by some faculty, as just lazy.

Several participants in the First Step Peer Mentoring Study, i.e. Study 2, revealed a similar sense of angst. An excerpt from our Field Notes illustrates the lack of control that several mentioned to us in our conversations:
‘While the interviews were developing, Miss Sandra [classroom teacher] was giving feedback to a group of students. It was their first mid-term test and the results had been very poor in general. Many students had failed. While she was waiting to be interviewed, María told us that she was worried because she got a low mark and that result was demotivating. She never expected to have such a poor result. When she was telling us about her disappointment, she burst into tears. She didn’t want to go back to the room where the teacher was giving feedback to the group. She was very concerned about her future as a pedagogy student. Then, she asked if we had experienced something similar when we were in first year and if it was possible to improve those results. She told that, during the oral examination, her partner spoke much better than she did, and that intimidated her. Consequently, she didn’t speak. (Field Notes, Fernanda, April 2014)

Fernanda’s sense of disappointment in herself due to her failure on the test and her feelings of intimidation in the presence of another, seemingly more capable classmate, added to the lack of face she felt within the first weeks in the Pedagogy Program. We understood that her question to us as mentors suggested that she was entertaining thoughts of hopelessness in terms of her abilities to change her marginalized position within the Pedagogy Program.

Other participants exposed similar identities in the early stages of the mentoring in their interviews with us. Subsequent to these face-to-face conversations and in apparent response to our interest in the fears and concerns of the participants, we noted that there was much more activity on the Community Network. We had established the Network as a support between our meetings, but noted that for the most part the mentoring we did online, albeit evidently of value to those who participated, was contingent on our face-to-face contact with them in the physical space of the university.

Our analysis of the data sets that emerged later on in the E-reader Literacy Study paints a different story in terms of the evolving identities most of the participants were beginning to construct. We began to observe subtle and more obvious indications of change in the way many of the participants’ viewed themselves and their subjectivities. As Diana remarked midway through the first four months of the study:

> I feel more confident with myself when I’m talking because I didn’t used to be like that. I was always afraid of making mistakes. Now I think the book and the reading is like a support to me. (Diana, Group Interview, November 2013)

Diana, in her own words, clearly expresses an awareness of her increasing confidence to speak in class. Other signs of changes in Diana and many of the others were their more evolving vocal proactivity in the classroom despite the presence of more advanced others in the group, the visible exhilaration when some in the group received marks that far surpassed what they had achieved previously, increased attendance in class, more regular submission of assignments, as well as expressed enthusiasm for the books they were reading and the prospects of reading the next.

Norton’s (2010) construct of investment, which is broader than motivation, helps explain the changes to participants and to their engagement in literacy practices. Partially due to the convenience of the e-readers and the access they provided to a whole range of books and learning features, the participants began investing in increased and more regular reading. These literacy opportunities, as well as those that came from participating in the guided weekly discussions programs, led to the learners beginning to recognize, as evidenced from their testimonies and our observations that the value of their “cultural capital” was increasing in the classroom and in the context of the Pedagogy Program. With the increase in their individual cultural capital, there was a corresponding change in their learner identities, or their sense of place in that context. This change in identity was obvious in some of the participants’ willingness to speak more confidently in front of others. Their change in engagement in turn served to help some of the participants view themselves as key players in the classroom and at the same time to further their literacy skills even more. All of these changes harkened much more capable teacher identities in these individuals as they prepared for their careers in education.

We attribute these changes not only to the confidence that came with the participants’ increased knowledge gained in reading on e-readers but through the individual attention they received in the weekly guided interactions with the researcher as mentor. In these interactions, at the same time that the mentor was encouraging and listening to each participant, she was also indirectly providing an example of good literacy...
practice combined with teaching and technology practice as well. Oftentimes, for example conversations in these sessions would veer off to the mentor’s own current reading on her Kindle and together the participant with the mentor would build strategies on exploiting the use of the technology. Additionally, in these conversations participants would regularly seek from the mentor explanations about language and/or advice about teaching strategies that they were applying in their teaching practices, including with technology. In other words, some of the participants were not only constructing stronger identities as learners in these sessions, but as present and future quality teachers. Clearly, many of the characteristics of effective mentoring developed from the findings of Hoffman et al., 2015 and Izadinia, 2015, outlined above, were evidenced in these meetings.

Similar evolving changes in identity were exposed in the data analysis of the First Step Peer Mentoring Study. Our observations of the active investment on the part of the participants to take advantage of the mentoring in the online Community Network led to encouraging incidences, or signs, of some of the individuals constructing more confident identities as newcomers to the Program. From our field notes, the following excerpt explaining our observations of the participants after a few weeks into the mentoring program, illustrates the emerging more confident subjectivities of some participants:

The kids [participant newcomer group] were very enthusiastic and willing to participate. During the round of questions, they spoke more than they were asked. Their attitude and body posture was very natural. What caught my attention was the [different] way they faced the environment where we were. In the case of Constanza, she was very shy in the classroom, where she attends supporting classes, while she was outspoken and talkative outside [with us]. (Field Notes, April 30, 2014).

This observation is especially significant as it speaks to the dynamic nature of an individual’s social identity constructive process. It reflects similar changes observed in many of the participants as they built up increased confidence in their relationship with the fourth-year mentors who were conducting the study. We understand the participants’ comfort and openness while sharing aspects of their personal struggles, as newcomers in the program, are indicative of their sense of self in these relationships. We take from their changes in identity, at least in the presence of their mentors, a sign of their belief that they ‘matter’ in this particular social context. As Butler explains (1990), the positioning of self and other in a social situation is contingent on recognition, confirmation or rejection by others (Thorne et al. 2015). It seems that the recognition that Constanza experiences in the interactions with the mentors and others in the participant group, is still absent in the classroom. The efforts and conditions that the mentors were creating in terms of connecting with these newcomers both online in the Network and face-to-face in meetings at the university were reaping benefits that were unavailable in the classroom context.

Separating features of the mentoring process in the sessions in Study 2, as we did for Study 1 above, we understand that the mentors both in the quantity and quality of their meetings were building strong and trusting relationships with these at-risk students by being available to them both on campus and off, in person and on the Community Network site. Often the sessions would involve conversations about the fears that these newcomers had about the teaching practice in schools that in which they would be involved in the upcoming semesters. Again, exchanging stories and building up strategies of how they, the experienced senior students were facing these challenges were instances of good mentoring practice. Mediating examples of good practice, open communication, making personal connections and providing academic emotional support were all evidenced in the interactions of the senior pre-service teachers with the newcomers to the program and participants in the second study.

5.2 Imagined identities

The positive changes to the social identities of participants created through the mentoring relationships and that occurred over the period of each of the respective studies are indeed encouraging. Importantly, there was further evidence of individuals in both studies developing identities that had implications not only for their present but also their future selves as teachers as well. Along with some of the characteristics of future effective teachers that some of the participants demonstrated and that we have pointed out above, a remark made by Marco, one of the participants in the First Step Peer Mentoring Study, illustrates the kinds of future identities that some of the participants began to imagine:

In fact, at [in] the beginning, I did not have faith that I would become a teacher. But now, I really want to live the experience of teaching. (Personal Communication, June 24, 2014)
From this excerpt, we understand that through enriched opportunities for support and guidance in discussions and interactions with mentors in person and online, Marco was able to move beyond the identity that was assigned to him as a newcomer in his immediate environment in the Pedagogy Program. Instead he began to imagine himself within a future community of teachers. The fear and lack of worthiness that we observed in Marco’s identity at the outset and that labelled him unworthy in the program and hesitant about the profession were transformed into the excitement he felt about his imagined self as a future teacher.

Recent feedback from participants in Study 1, some who are now either in their final year of the education program or are already practicing teachers provides further evidence of the transformative value of the technology-supported mentoring sessions.

Vanessa, for example, with great pride, writes that she has gone from a non-reader to a passionate one and attests to the fact that she has consumed over 30 books in the last 2 years. In a recent communication she reports:

> I would like to tell you how amazing and satisfactory the experience of reading intensively has been for me. After you bought two excellent and interesting books for me, I have not stopped reading. I have not been able to buy them online but thanks to Internet I can download pdf files of other books that have caught my attention. I was surprise[d] that after finishing my second book (doctor sleep) I had the need to read more. I had created a routine of reading an hour a day thanks to your investigation... I had never been able to read more than [a]100-page[s] book but I have read a series of 6 books in two months. These books were about 400-700 hundred pages so I felt proud of myself. Since last time we spoke, I have read more than 30 books. This has helped me to be more aware of the English language when I teach and read. I know more vocabulary but I think that I need to work on my writing skills more to be able to use and acquire all my new vocabulary. (E-mail, Nov. 27, 2015)

In her e-mail account, Vanessa reveals that her identity has been transformed through the experiences and guidance of the e-reading program, from a less than literate person to a very literate one. Language is power as Bourdieu (1991) points out. Vanessa has been able to access that power that has led to an empowered sense of self who proactively invests in finding new self-directed ways to learn and develop in her transformed identity as a learner. Her ability to critically analyse her language skills is further testimony to the academic development she has experienced and continues to pursue. It is important to remember that Vanessa was considered an at-risk student prior to the mentoring sessions due to her lack of engagement and consistency in her academic activities in the Teacher Education Program.

Vanessa’s statement that the mentored e-reading project that she took part in has made her more aware as a teacher as well as a learner are indeed significant. In closing her e-mail, she adds: “Thank you for making me part of a project that has changed my literary life. I will definitely use this method once I can teach and be able to transmit how beautiful and helpful a book can be.” From her words, we understand the implications that the e-reader project has had for Vanessa’s imagined identity as a teacher. Her words reflect the passion that she sees as part of that identity. In her role as a passionate and engaged teacher in the future, we can assume that accessing “the beautiful and helpful” resources will undoubtedly imply the use of technology where Vanessa as she herself so powerfully expresses, finds the literature that she “needs”.

The adapted TPAK (Figure 1) model has been developed by the lead author as a means to demonstrate visually the key conditions that need to be in place in order to effectively foster ICT in teacher education. In light of our analysis of the follow-up feedback data from Vanessa and several other participants who wrote now a year after the study, it is clear that key conditions in the outer circle of that model were present. These conditions included: opportunities for effective mentoring/guidance; context-specific solutions for using technology to resolve the tensions in the participants’ realities, sustained support over time, albeit less in Study 2, enhanced occasions for participants to have an agentive role in mediating more powerful identities. Technology was key in support of each of these conditions. Our findings that reveal a sustained use of technology for continued self-directed learning over time and evidence of a growing confidence on the part of participants in the use of technology for teaching clearly provide increasing proof of the validity of our model.

www.ejel.org

©ACPIL
6 Conclusion

We recognize that the impressive evidence of changes that were witnessed in several of the pre-service teachers’ present identities, and those that some began to imagine for their future selves as teachers, might lead one to conclude that these results could have been achieved irrespective of technology. For example, a library supported reading program or face-to-face peer mentor programs could have served to respond to the tensions we saw in these pre-service teachers at risk. There may be some basis to those conclusions. The point we wish to make is that in this particular context, with its many challenges, it was the presence of the technology support tool, i.e. e-readers in Study 1 and the Online Community Network in Study 2, that offered the necessary affordances to support such changes. Indeed, we believe that there is strong evidence to suggest that it was the affordances of the technology that were crucial in providing the context for enriching opportunities for good mentoring. Together these interdependent elements, i.e. mentoring and technology tools, were key to the encouraging findings that resulted in both studies. We argue that without these tools and the efficiencies they provided, the changes in identities we reported would have been questionable. We further argue that this combination of technology with good mentoring enabled opportunities for the participants to construct knowledge and empowered identities that made the difference to their present realities as well as their imagined future ones as teachers. The importance we see in the technology with mentoring remind us of what Warschauer (2011) has pointed out - giving a child a computer does not ensure quality learning. In terms of support, the e-readers provided a wide range of mobile and accessible reading materials in English, either cost prohibitive or unavailable in the Chilean context. Yet it is likely that the books available to the participants would have not been accessed without the encouragement and interest of the mentor. Similarly, the Online Social Network guaranteed an opportunity to the newly enrolled pre-service teachers, access to 24-hour peer mentoring that without which, given the limited time of all individuals involved in the study, the sustained and consistent relationship building that was integral to the positive changes we witnessed would have been problematic.

We began this discussion of the two studies by suggesting that increasingly more powerful technologies are offering new ways for communities of individuals to connect globally to access the symbolic and material resources they need in their lives. Established institutions in light of these movements have been forced to stand up and take notice. In both of these studies, the institution had failed to understand the realities of these teachers-at-risk and left them marginalized in that setting. It took efforts outside the institutional offerings from a small group of concerned others armed with new generation technology tools for many of these pre-service teachers to have ways to negotiate more desirable identities – the kind of identities that reflect quality teachers and sustained users of technology both for teaching and learning. The question is: Will educational institutions and those that support them take notice?

References


Design Framework for an Adaptive MOOC Enhanced by Blended Learning: Supplementary Training and Personalized Learning for Teacher Professional Development

Karsten Gynther
Research Program Manager, Center for Teaching and Learning, University College Zealand, Denmark
kgy@ucsj.dk

Abstract: The research project has developed a design framework for an adaptive MOOC that complements the MOOC format with blended learning. The design framework consists of a design model and a series of learning design principles which can be used to design in-service courses for teacher professional development. The framework has been evaluated by alpha-testing and beta-testing, and the relationship between design principles and the intended, the implemented and the attained designs has been analyzed. The project is methodologically inspired by Design Based Research.

Keywords: adaptive learning, personalized curriculum, MOOC, blended learning, design based research

1 Introduction

In 2020 it will be a requirement that Danish primary school teachers have a bachelor degree in the subjects they teach. More than 10,000 teachers, who for many years have taught a course without being formally qualified, need professional development and therefore municipalities ask for new concepts for in-service training. There is a need for concepts for supplementary training that are flexible in relation to teachers' work situations, are based on the fact that the teachers already have a number of professional skills, and at the same time are resource-efficient compared to the price and the time teachers must use to be formally qualified. Finally, the concept has to be scalable because it is uncertain how many teachers need training within each subject area. A number of municipalities (the customers) and University College Zealand (UCSJ: the provider) are in the process of examining whether the new training format "MOOC" (Massive Open Online Course) can solve this training task.

As part of this process UCSJ has established a research project with the aim of developing a design framework which can guide the development of instructional designs, adapted to experienced teachers' different learning needs and study the factors affecting the actual realization, legitimacy and efficacy of the design.

2 Methods

The project is methodologically inspired by Design Based Research (DBR) (Brown, 1992; Collins, 1992) – a method widely used in MOOC research (Gasevic et al, 2014). The design framework has been developed through iterative design experiments (diSessa & Cobb, 2004). Several prototypes have been evaluated and redesigned and research has generated theory that can guide the further development process. We have analyzed interviews with participants and teachers and made observations of the participants' interactions with each other and with the technology (Moodle). Through these design experiments it has been possible to develop a design framework consisting of a set of pedagogical design principles that can be communicated through one or more design examples (Hrastinski et al, 2010).

3 Prior research

Research in MOOCs has until 2012 been scarce (Kennedy, 2014; Liyanagunawardena et al, 2013), which is of no surprise since MOOCs were first offered in 2007/2008.

MOOCs are based on previous research in e-learning (King, 2014) and experience from Open Educational Resources (OER) where MOOCs differ by integrating OER in an instructional design with an embedded but mediated teacher presence and clear learning objectives (Liyanagunawardena et al, 2013). The research has been oriented towards only a few topics including MOOC typologies with the dichotomy: C-MOOCs to X-MOOCs (Rodriguez, 2012; Liyanagunawardena et al, 2013). Rodriguez describes a C-MOOC as an online course
that don’t align with the course content nor the instructor, but to the learners and their knowledge. They are build inspired by the philosophy of “Connectivism” (Rodriguez, 2012). X-MOOCs are based on interactive media, primarily videos and text. X-MOOCs are typically run by a corporate education company and have adopted a more behaviourist pedagogical approach, with the emphasis on individual learning, rather than learning through peers (Conole, 2014).

However this discussion is not so dominant anymore (Bayne & Ross, 2014), and several MOOC providers are developing MOOCs that integrate several different pedagogical approaches depending on the objectives of the learning inspired, for example, by Laurillard’s pedagogical framework (Laurillard, 2012; King et al, 2014).

Participant perspectives and especially the high dropout rates among students still have had great attention (Rodriguez, 2012; Kennedy, 2014; Vivian, 2014). Hypotheses about how to reduce the dropout rate based on research show that learning is supported if the participants can interact with each other and with the teacher. Social presence and teaching presence, therefore, are important in an educational design (Kop et al., 2011) – forms of presence which particularly have been explored in the context of the “Community of Inquiry” framework (Col) (Garrison & Anderson, 2011). The Col framework stresses that the students educational experience depends on three types of presence: The cognitive presence, which is the students engagement with the content, the social presence, which is the students engagement with other participants and the teaching presence, which is the teachers engagement in the course (Garrison & Anderson, 2011). The Col framework stresses that the students educational experience depends on three types of presence: The cognitive presence, which is the students engagement with the content, the social presence, which is the students engagement with other participants and the teaching presence, which is the teachers engagement in the course.

MOOC research has been primarily oriented towards developing social interaction between participants, for example, through peer to peer response methods. However, this has not solved the problem concerning dropouts (Gasevic et al, 2014). In formal education, where high dropout rates are unacceptable, there has been an increasing interest in educational designs that blend MOOCs with either on-campus teaching or synchronous online teaching and learning environments (Bayne & Ross, 2014; Gasevic et al, 2014; Holotescu et al, 2014; Israel, 2015).

The typical MOOC student is an adult who already has a degree and is fully or partly in job. The participation in a MOOC is for professional development either out of personal intellectual curiosity or in connection with the acquisition of specialized skills related to work (Vivian, 2014; Kellogg 2014; King et al, 2014). MOOCs can be an effective design for acquiring work specialized skills if the design is competency-based and enables personalized learning that matches the professional’s need for additional skills (Norton et al, 2013, Milligan & Littlejohn 2014; Gasevic et al, 2014). This requires an educational design that can identify an individual’s skills, identify skill needs and adaptively design a study for each student (Kostolanyova & Sarmanova, 2014). Personalized learning and adaptive education is a growing field of research (Kinshuk, 2015), also within the field of MOOCs where research, however, has been limited (Gasevic et al, 2014). The concepts of “personalized learning” and “adaptive education” are not clear concepts. "Personalized learning" is used not only to characterize competence-oriented learning but also in connection with theories about particular learning styles (Akbulut & Cardak, 2012). "Adaptive education" also covers several areas, including adaptive technical systems and adaptive instructional designs, better known as differentiated instruction. In the latter case, curriculum, learning resources, teaching and guidance are tailored to the learner’s needs.

4 Design framework for adaptive learning design - initial considerations

Adaption is feedback from an educational system adapted to the needs of learners (Bateson, 1998; Hattie, 2011). We distinguish between different forms of feedback (U.S. Department of Education, 2010):

Differentiation is education, where participants have the same learning goals, but the teaching method varies so they adapt to the individual student’s needs.
Individualization is teaching, where the participants also have the same learning goals, but participants can move forward at different speeds and relate to a particular content area or a given activity in different ways, and teaching is tailored to individual needs.

Personalization is education, where participants have different learning objectives, depending on their learning needs. The training is customized, so this is possible, and personalized instruction may also provide opportunities for differentiation and individualization.

In a research field, which grew from an influential study on adaptation by Lee J. Cronbach (Cronbach, 1957), it has been documented by many educational researchers that adaptive learning designs which adapt teaching to the individual learner’s needs, have an positive effect on the learning outcome (Akbulut & Cardak, 2012).

Attempts to individualize instruction with a technical system is however an older idea. Frederick Taylor (1911) was interested in the idea of a “teaching machine”. In 1958 B.F. Skinner introduced the idea of technology mediated programmed learning (Skinner, 1958), and in the 70s a lot of research in the field of Computer-Assisted Instruction (CAI) took place. The criticism of this approach and especially the radical behaviorism that Skinner developed has been intense in education research for decades (Wenger, 1998).

Adaptive learning systems are this century’s attempt to develop an educational technology adapted to users’ needs, and Siemens et al (2015) refers to this technology as “fifth-generation” educational technologies. Important knowledge can be gained from the design and development of these systems, even if taking into consideration the basic criticism of the learning theories on which some of these systems are based.

Adaptive learning systems
There is a variety of different definitions of adaptive learning systems. The differences are mainly related to the level of adaptation, one imagines a system must be able to perform in relation to a participant and the learning process.

Most adaptive learning systems consist of three components (Natriello, 2011; Oxman & Wong, 2014):
- A content model.
- A learner model.
- An instructional design model which is a strategy for the adaption process.

4.1 Content model
The content model structures the content of learning objectives, sequences and tasks to be solved (Natriello, 2011). A content model divides the subject into smaller elements, which can be associated with different types of learning resources (Thalmann, 2014).

4.2 Learner model
An adaptive learning system also contains a model of the learner (Wenger, 1987). The model is based on one or both of the following categories: a) the learner’s current knowledge, and b) the learner’s learning preferences.

It is widely agreed that it has a learning effect if the teaching is adapted to the individual’s knowledge. Pre-understanding or prior knowledge is considered as one of the individual factors that has the greatest importance in a learning process (Glaser, 1984). The model of the learner must visualize the personalized curriculum a given person should be offered in a concrete course. Most adaptive learning systems therefore identify the learner’s existing knowledge and compare the learner’s knowledge with the knowledge structure or curriculum for a given subject.

The majority of all commercial adaptive learning systems also try to model the learner’s preferences for certain types of learning processes. Attempts to categorize the learners in cognitive types or learning styles are here very common. In a review of 70 published articles on adaptive learning systems (Akbulut & Cardak, 2012) 81 % of the participating learning systems were using cognitive types or learning styles for modeling learners. Most used were cognitive types based on Kolb (1984) and learning styles based on Felder- Silman (1988) or Dunn and Dunn (1974). Despite the widespread use of models of the learner building on typologies of preferences in
terms of learning styles or cognitive types, the same study showed that “findings on concrete learning outcomes were not strong enough” (Akbulut & Cardak, 2012 s. 835).

It is therefore important to be critical towards adaptive learning systems that emphasize the identification of specific preferences and hypotheses concerning specific learning styles. Especially because the development of a model of the learner on the basis of hypotheses related to the learner's preferences can develop into what is called "stereotype methods" (Shute & Zapata-Rivera, 2010).

The third dimension in an adaptive learning system is the strategy of adaptation. In terms of supporting the learner's navigation in the system the designers of the system use a variety of adaptation strategies. Basically, we can distinguish between two adaptation strategies: recommendation systems and guided navigation (Khribi et al, 2015). In a recommendation system the technology identifies a range of possibilities which the system prioritizes for the learner on the basis of a learner model or on the basis of the learner's performance in the system. But the learner is free to choose whether to follow the recommendation. By guided navigation the system hides the links which are not relevant to the learner, either because they do not match the model of the learner or because they do not match the learner's continuous performance in the system.

An important design discussion is the question of who should have control of the adaptation process. Is it the system or the learner (Shute & Zapata-Rivera, 2010; Simens et al, 2015)? Review of research on adaptive learning systems shows that this is not always reflected in the design of the adaptive learning system (Akbulut & Cardak, 2012; Ford, 2013). The problem is that the adaptation process may be invisible to the learner, since the rules or algorithms which are used to control the system is not known or understood by the user. The system can collect a large amount of data about the user (big data) through the monitoring of learners' interactions with the system (Simens et al, 2015). This raises a number of ethical questions and dilemmas of privacy and users' control of their own data. Who owns the data, an adaptive learning system produces, and what can and should this data be used for?

5 Design criteria

Based on knowledge about adaptive learning systems, we have defined a set of design criteria for the development of adaptive learning design in general:

- Modelling of the learner must be based on documented effects.
- Development of adaptive learning design must be based on a precautionary principle (ethical code) which means that we do not use stereotypical methods for modeling of the learner.
- Modeling should (only) visualize a) the learner’s professional skills and b) experience and skills to learn in a MOOC format.
- Adaptation performed by a technical system based on non-transparent algorithms cannot stand alone.
- Adaptation must be a dialogue (negotiation) between the learner and a teacher on the basis of one or more technically-generated information.
- The adaption strategy should be recommendations and the adaptation process must be transparent and controlled by the learner.
- The learner must control own data.

6 Findings

Based on the research review above, a series of design workshops and three iterative design experiments, we have developed a design framework for design of adaptive learning environments in formal education.
Figure 1: Design framework for an adaptive hybrid MOOC

The design framework visualizes three design levels:

6.1 Setting

The design framework is based on a well-known design model which frames the design as a setting for formal training with a participant, a content and a teacher.

But we are following the widespread criticism of this model and situate the three elements of the model in the context they are part of (Garrison & Anderson, 2011).

- The learner is part of a personal learning network (PLN).
- The subject is part of a broader academic culture and its interpretation of the subject.
- The teacher is situated in an educational institution and more widely in an educational system.

The development of a specific adaptive learning design must be based on the framing and the concrete anchorage of the three elements in their specific contexts.

6.2 Relationships

The framework visualizes the characteristics of the relationship between the design elements described above:

- The relationship between the learner and the subject is characterized by a personalized curriculum. Each participant has their own unique curriculum. The project has shown that participants with long working experience in a field have acquired a number of competencies related to the curriculum - skills that are very different from participant to participant.

- The relationship between a participant and the teacher is characterized by complementarity. In traditional teaching concepts the relation between participant and a teacher is the core of the instructional design and teacher presence is the starting point for concrete designs for learning. However, this is not possible in an instructional design where all participants have their own personalized curriculum. In a group of participants who each have their own curriculum it is not possible to realize a multiple relationship: a participant - a content - a teacher. The relationship between participant and teacher must be complementary if you want to support that all participants have a personalized curriculum.

- Finally, the relationship between the teacher and the subject also has a characteristic feature that is far from usual perceptions about being a teacher. The traditional role of the teacher is the lecturer who interprets a subject and mediates the relationship between the learner and the subject in a face-to-face setting. The teacher identifies himself with the role of being a teacher. The project shows that the relationship between the teacher and the subject must be transformed from a teacher role to an author role. The teacher is rather a designer, an author and a producer of a number of learning resources. A role that also entails that the teacher is part of a larger production team.
6.3 Principles

Level 3 in the model visualizes the design principles. These principles relate to each of the three characteristics described above.

6.3.1 Personalized curriculum: Multiple learning path:

The design must be able to:
- identify the participants current skills - visualized in a competency profile.
- visualize a competence-gap in terms of a personalized curriculum.
- recommend a learning path which adaptively matches the learner’s personalized curriculum.
- identify the student's ability to learn in and with a MOOC.
- establish an adaptive scaffolding of the student's learning process in the MOOC.

The principle of multiple learning pathways, which we will refer to as the design potential or affordance of the design.

6.3.2 Production of learning resources: The content model

In order to realize the principle of multiple pathways of learning, the educational institution in advance has to produce a content model of the course, that:
- covers the entire curriculum of the subject.
- includes a deconstruction of the subject to competency units.
- guides the production of learning resources and forms of participation, which without progression are linked to each unit of competence.

This design principle can be described as a constraint for adaptive learning designs. The project demonstrates that particularly the breakdown of the subject to competencies which participants can study with no progression is a major challenge for the teacher/author that produces the concrete MOOCs.

The design framework includes no constraints regarding the choice of types of activity associated with specific stereotypes, learning styles, etc. The framework thus encourages the development of a number of different types of activity associated with each competency including:
- Passive activities: Participants are exposed to a learning resource.
- Active activities: Participants need to do something related to a resource (solve a quiz, etc.).
- Constructive activities: Participants must produce inputs to the system that contains ideas that are not found in an available system resource. (Ex. formulating solutions to a problem linked to their own practice).
- Interactive activities: Participants are engaged in a dialogue with another participant, a teacher or the system on a given subject matter.

The above list is based on Natriello, 2011 and we will add:
- Collaborative activities: Participants create together an output on the basis of the above activities with the possibility of including resources and tools that are not available in the learning design.

6.3.3 Complementary teacher presence: Representation of the teacher

The final design principle is a key constraint for the design of MOOCs in general and thus also for adaptive designs for learning on the basis of the MOOC format. Since the teacher cannot be present in a multiple number of learning pathways, the teacher must be represented in the design. The teacher must be mediated in a form that minimizes the disadvantage of a learning design where the teacher cannot be physically present. The concrete mediation of the teacher should, as far as possible, allow personalization of the teacher even though it is not possible to get immediate synchronous feedback from a present teacher. Therefore, we are working on developing a design principle which we tentatively call asynchronous teacher telepresence. The project shows that it is extremely difficult for teachers to accept this constraint, and therefore educational institutions need to scaffold teachers who must perform the transformation from “teacher presence” to “asynchronous teacher telepresence”. At the same time the project demonstrates that there are many ways to
mediate the presence of the teacher including multiple video formats which are well known from MOOCs in general.

The principle of complementary teacher presence can be formulated as a scale, and an educational institution must in each case decide the extent to which it will complement the asynchronous teacher presence with synchronous presence forms either online or on campus. In this project UCSJ (the provider) has decided to supplement the design framework with blended learning activities on campus. Through a series of design experiments, the project has therefore developed principles which can complement the overall design framework.

6.4 MOOCs and blended learning

“Blended learning” is a floating signifier and definitions vary considerably. We use the following definition: “Blended learning courses integrate online with face-to-face instruction in a planned, pedagogically valuable manner, and do not just combine but trade-off face-to-face with online activity (or vice versa)” (Vignare, 2007 p.38).

Blended learning can improve the quality of education (Garrison and Vaughan, 2008), but as in all education, this depends on the quality of the instructional design. For instance, using blended learning in addition to a MOOC as a compromise to fix a poor online environment or to support the habits of the ‘teacher-dependent’ learner, does not increase the learning effect (Milligan and Ringstedt, 2015).

Research on design principles for combining MOOCs with face-to-face teaching is scarce (Holotescu et al, 2014; Israel, 2015). It is not possible to combine classroom instruction with the original MOOC concept which has a large number of participants spread throughout the world. Blended learning is possible only in concepts that are not massive, e.g. the so-called “Little Open Online Course” (LOOC), Small Private Online Course (SPOC) (Chauhan, 2015), or in concepts combining a group of enrolled students on campus with global participants (Ronkowitz & Ronkowitz, 2015). In our project, we work primarily with small MOOCs similar to a SPOC.

Our design experiments with blended learning have been inspired by the COI Framework (Garisson & Anderson, 2011). We have used the latest updated COI model (2015):

![The Community of Inquiry](https://coi.athabascau.ca)

**Figure 2:** The COI framework, 2015.

There are two major differences between this model and the learning environment we have developed in our adaptive MOOC. Firstly, the “teaching presence” in a MOOC is mediated (in asynchronous videos) according to the design principle referred to above. Secondly, the students’ “cognitive presence” is not about engagement "with content". Participants engage with different content according to their personalized curriculum. This means that interactions between teacher and participants on campus must be prioritized in a different way than in traditional blended learning concepts.
We have developed the following design principles for face-to-face interaction in a blended adaptive MOOC concept.

- **It is not possible to teach common content - but the subject can be introduced.**

In our traditional blended learning concepts, classroom interactions are often given priority to content that depends on learning methods, which are not possible to implement online, e.g. learning processes that require sensory based perception. This is not possible in an adaptive design in which participants each have their own curriculum. But even if the participants already have a range of skills and extensive work experience in a profession, the subjects and disciplines develop over time and all students will benefit from having introduced the newest paradigms.

Use face-to-face interaction to support the asynchronous and mediated teacher presence in the MOOC.

- **Through the introduction of the subject and the course in general, participants establish a trust to the teacher as an expert who can get them all the way through the course.** *Monitor student performance in the MOOC and elaborate in face-to-face teaching, on the content that is difficult for all students.*

- **Provide adaptive response in terms of individualized and differentiated feedback on individual performance in the MOOC.**

Because the participants have different personalized curriculums, time on campus must be given priority to what is absent in a MOOC, i.e. professional feedback from the teacher. In doing so, the student model can be updated and the recommendation of an adaptation strategy which took place at the beginning of the course may be revised in dialogue with each student.

- **Scaffold learning in and with a MOOC.**

The learning effect of participating in a MOOC is closely related to whether one has learned how to learn through this training format (Milligan and Griffin, 2015). Because most of our participants are MOOC beginners, we have to support them in learning in and with a MOOC.

We also use face-to-face interaction in the same manner as in our other blended concepts. We support “goals and direction”, we are “setting climate” and we support “discourse”, i.e. students' interaction with each other and with the content.

### 7 Evaluation

First of all we distinguish between evaluation of the technical aspect of the artefacts developed in the project and the usefulness and organizational impact of these artefacts (Hevner & Chatterjee, 2010). Secondly, we distinguish between the development of technologies and technical systems per se and the development of learning design, enhanced by new technologies. In our research, the evaluation has focused on the latter.

The evaluation of the developed design principles follows methods and guidelines from Design Based Research (Akker et al., 2006; McKenney & Reeves, 2012). In our evaluation we distinguish between the design principles outlined in the framework above, and *specific designs for learning developed by individual teachers/authors in a given educational, institutionalized context*. The specific design which teachers and an educational institution develop on the basis of the framework will always be a unique and particular solution to a so-called “wicked problem” (Buchanan, 1992). In a DBR project there is no straight line from the developed theory (design principles) and the actual design solution. “Design principles are not intended as recipes for success, but to help others select and apply the most appropriate substantive and procedural knowledge for specific design and development tasks in their own settings” (McKenney et al. 2006 p 73).

A specific design will always be a codified representation of the design principles based on their interpretations. And even though this project has developed technologies and artefacts to be integrated in the learning design (a self-assessment tool and a prototype of the MOOC-platform, Moodle), there is a risk that such prototypes will be scaled and used without understandings of the basic theoretical assumptions underlying the developed design principles. The developed design principles and artifacts function only as "boundary objects" (Star & Griesemer, 1989) between researchers and the teachers/authors. Specific learning
designs can therefore easily develop into mutations (legitimate or lethal) which research should subsequently study in order to revise the developed theory (Hung et. al., 2010).

The relationship between design principles and specific designs is illustrated in the following model.

![Diagram](image)

**Figure 3**: Framework for translation and extension/scaling innovations (Hung et. al., 2010 p. 93)

The designs developed by teachers/authors have been evaluated according to feasibility, legitimacy and efficacy (Mckenney, Nieven & Akker, 2006; Mckenney & Reeves, 2012). Feasibility relates to the realization of the design in an educational institution. Is the design relevant and feasible for the institution? Legitimacy is a matter of the compatibility of a design with the basic view of learning, subjects and course design in an educational institution. Efficacy relates to the cost-benefit ratio between resources and desired outcomes of the design. The degree of feasibility, legitimacy and efficacy affects the intended design an educational institution produces and offers to its customers. But the intended design is not the same as the implemented and the attained design. The intended design is what the design is set out to do. The implemented design is how it is actually used in practice by teachers and students, and the attained design is the specific outcome of the design—in our case the learning outcome (Mckenney & Reaves 2012).

An evaluation model must test both the intended, the implemented and the attained designs which we have visualized in the following evaluation model used in the project:

![Evaluation model](image)

**Figure 4**: Evaluation model

The evaluation was conducted using alpha testing, beta testing and in the year to come also gamma testing (Mckenney & Reeves, 2012). Our alpha trials have been controlled by the research team with maximum support for teachers and students. The aim was to test the feasibility of the design in our institution and...
explore the teachers’ and the students’ assumptions about viability and impact on learning outcome. In our beta test we have tested designs in a real life context but still with some support. The goal has been to explore conflicts between the intended design and its implementation according to institutional feasibility and viability, map out fostering and hindering conditions for implementation and measure the initial impact on learning outcomes. Gamma testing are trials focusing on widespread adoption with minimal support. The purpose of this kind of evaluation is to measure the impact, the efficiency and the sustainability of the design. What is the relationship between learning outcomes among participants, the use of resources and fostering and hindering conditions for sustainability? The project is in a planning phase for gamma testing.

7.1 Data sources and analysis

We have collected data and conducted qualitative analyses of:
- Design workshops with MOOC designers (the teachers/authors).
- Content and design of the MOOCs produced by the institution on a Moodle platform.
- Interviews with MOOC designers (the teachers/authors).
- The institution’s decisions about strategy, management and support according to policy papers from the project.
- Observations of student self-assessments and additional training on campus.
- Student interactions in the MOOC.
- Interviews with students and MOOC teachers.
- Results from a questionnaire survey on user satisfaction conducted by the institution.

Data were analyzed in order to saturate categories for understanding (Glaser & Strauss, 1967/2008). In the evaluation of the implemented design we were looking for categories in terms of “mechanisms” (Pawson & Tilley, 1997). In our understanding of the relationship between the intended design, the implemented design and the attained design, we are inspired by “realistic evaluation” as illustrated in the model below.

![Diagram of relationships between design levels](image)

**Figure 5:** Relationships between design levels. (Inspired by Pawson & Tilley, 1997/2013 p. 58)

Particularly in the analysis of the relevance of the design and its usefulness to students, categories were consistent with the categories developed by Everett Rogers (Rogers 1962/1995) in his theory about attributes of innovations and their rate of adoption. These categories were therefore applied to the study.

7.2 Results

7.2.1 The institution’s choice of intended design

The framework has been realized as follows: University College Zealand (UCSJ) has produced MOOCs in seven different subjects and will produce MOOCs for all subjects in the Danish primary school by 2018. The first step for a participant in a MOOC course is to complete a self-assessment in which he assesses his qualifications on a
scale from 1-5 on the basis of the learning objectives of the course - objectives formulated in terms of competencies. The self-assessment is conducted with a tool developed within the project which based on the student’s input generates and visualizes a competence profile illustrating the percentage of the curriculum that the student must study. The developed tool also works as a recommendation and navigation system that generates an adaptive match between the competence gap and selected study themes. The MOOC platform for each of the 7 subjects is designed so that adaptation is possible, no matter which skills the student needs to acquire to pass the exam. The curriculum in a subject is divided into a number of themes that are organized so they can be accessed without progression. Each theme is assigned a set of competencies that the students can acquire through study work e.g. by accessing video resources, texts, exercises and quizzes and by participating in peer to peer response and collaboration etc. The recommendation system is supplemented by a 90 minutes guidance session with a teacher in order to further support the technical recommendation system. During the guidance session, the student’s self-assessment is reviewed and the teacher provides additional guidance on how to choose from the adaptive themes and navigate within the MOOC platform.

The evaluation shows that there is a high degree of fidelity between the design principles and the intended design of the 7 MOOCs.

As UCSJ has decided to offer a blended learning concept for teacher professional development, the students' interaction in the MOOC is supplemented by face to face instruction on campus. The extent of on-campus training is chosen by the municipalities who are given the opportunity to purchase this kind of additional training. In relation to this, two interesting mutations have been identified in that one of the municipalities has decided not to buy additional training, whereas another municipality has decided to purchase additional training to such an extent that the concept can be characterized as “MOOC enhanced classrooms”.

The intended design is a result of decisions at three different organizational levels: the strategic, the tactical and the pedagogical levels. At the strategic level UCSJ has decided an entirely new business model for continuing education. MOOC production of courses is both costly as well as time-consuming and while municipalities pay for additional on-campus teaching, UCSJ has to face production costs a year in advance of receiving revenue from the courses. On the tactical level UCSJ has employed people for video production, organized training and support to teachers who produce MOOC content, organized workflow of teachers in a new way and initiated negotiations with the teachers on the copyright of MOOC content.

The evaluation shows that the intended design is feasible but its efficacy has been questioned by management. However, as UCSJ for strategic reasons and in accordance with policy papers has decided to be at the forefront of technology-enhanced education in Denmark, the project is still carried out on a large scale.

The strategic and tactical decisions are organizational prerequisites for the realization of an innovative learning design. On a pedagogical level the intended design is a result of the teachers' decisions and choices of learning design for the 7 MOOCs. The evaluation shows the following:

- There is a relationship between the discipline or subject matter and the teachers' choices of MOOC pedagogy, but a subject does not determine a specific MOOC-pedagogy and there are more similarities than differences between the seven MOOCs. Even though the framework focuses on the interpretation of how content is situated in a specific subject culture, a stronger emphasis of this must be done in future introductions of the framework.

- The greatest legitimacy problem of the design is related to the breakdown of a subject into competency units without progression. This design element conflicts with the teachers’ common conceptions of curriculum design. This key constraint has to be introduced in a better way for MOOC designers. This can be done by producing additional “boundary objects” in terms of exemplary materials, which can support the designers' professional curriculum reflections and show how a competence-oriented curriculum can be transformed into a MOOC (van den Akker, 1998).

- Teachers who teach the same subject or family of subjects may have very different views on the subject, which is reflected in their learning design. We have data showing that in some disciplines there are very different views on the MOOC pedagogy; some teachers believe that you cannot teach their subject in a MOOC, while others believe that it can easily be done. The evaluation has identified a conflict between
legitimacy and feasibility as UCSJ in some disciplines has had difficulty finding teachers for MOOC-production.

- Teachers have different approaches to the design process and their approaches may change during the design process. We have observed transformation strategies where on-campus instruction is simulated or remediated in the learning design of the MOOC. If the teacher is a beginner when it comes to MOOC design, or receives little pedagogical support, our data indicate that the teacher will employ a simulation strategy. For the experienced MOOC or e-learning designer, a MOOC offers a completely different learning environment with specific affordances and constraints, which is reflected in their design.

- Design choices based on an explicit theory of learning is not observed in the 7 MOOCs. Design choices related to learning processes are very similar in the seven MOOCs which all share many similarities with X-MOOCs. This may be due to the fact that learning theory is not explicitly reflected within the framework and the associated design principles. The design framework should at this point be revised in future iterations.

7.2.2 The implemented and attained design

The evaluation of the implemented design shows that there are four different clusters of mechanisms which have significance for the attained design in different local contexts:

- The participants' perception of relevance and usefulness of the intended learning design.
- UCSJ's introduction of the intended design for students.
- The students’ study conditions.
- The students’ academic qualifications.

In relation to the implementation of the intended design, our data indicate that the principle of a personalized curriculum and an adaptive learning design with options for personalized learning paths works well for students. The students are very satisfied with the content in the MOOC and they assess learning resources to have high professional quality. Data show that the students spend most time accessing learning resources while peer to peer response activities and assignments have lower priority. The data also indicate that additional teacher presence is an essential mechanism for students’ experience of the legitimacy of the design. The students prefer a design with additional training on campus, and the mutation described above as a "MOOC-enhanced classroom" has been well accepted.

In contrast, this mutation is seen as a major challenge by the MOOC teachers since it is difficult to organize meaningful teaching on campus for students who each have their own curriculum. The development of additional design principles for blended learning has not been sufficient to support the teachers in meaningful planning of activities on campus and the framework must be improved in future iterations.

The students’ experience of the relevance of the design and its usefulness can be explained by five attributes of the design (Rogers 1962/1995):

The degree to which the design is perceived as consistent with students’ existing values and past experiences regarding ongoing education.

- The degree to which the design is perceived as relatively difficult to understand and use.
- The degree to which the potentials of the design can be observed or explained for students.
- The degree to which designs may be experimented with on a limited basis.
- The degree to which the design is perceived as being better than the ongoing education the students are used to.

Data from interviews and observations show that the design is very far from students' experience with ongoing education and teacher professional development. Particularly the lack of teacher presence in the MOOC and especially the lack of teacher feedback is considered challenging. Peer to peer response activities are not perceived as a qualified replacement of teacher feedback, and the MOOC teachers have had difficulty
explaining why this kind of feedback is meaningful. It has also been difficult for the students to learn how to use this part of the design, which may have contributed to the fact that this type of activity is largely deselected.

However, the overall design principle (the affordance of the design) has not been difficult to observe as an attribute to the design or explain to students. They are all experienced school teachers who appreciate the fact that the design allows for a personalized curriculum and an adaptive personalized learning path for each student although it should be noted that the relative advantage of this does not imply that students simply accept the perceived constraints.

Finally, students have been unable to test in advance aspects of the design as the concept has been fully implemented from day one without an initial introduction or training in the study skills required of learners in a MOOC. In line with other studies, we find that MOOC learning skills are important for learning outcomes (Milligan & Griffin, 2015), and the MOOC design needs to scaffold and develop these skills. The framework must therefore be improved in future iterations, especially in relation to introduction of peer to peer response activities and collaborative community participation.

According to student evaluations there is furthermore an unused potential in relation to community participation. The framework (Figure 1) visualizes how students are rooted in a personalized learning network (PLN), but this part of the framework has never been integrated into either the intended or implemented design. UCSJ has only used the framework to implement SPOCS (Small Private Online Courses), which are only open to students whose municipality has purchased access. Several students have identified an even greater potential for ongoing teacher professional development if the MOOCs were open to all teachers in a given subject within a given municipality or, alternatively, across municipalities. Firstly, the student’s would like to have access to the MOOC after they have finished their exams in order to keep their professional skills up-to-date. Secondly, the students’ would like to collaborate in the MOOC with those of their colleagues who already have a formal exam in a subject. Colleagues, who also would like continuous professional development and access to the latest knowledge in a subject, knowledge which the MOOC could represent through regular updates. The MOOC could thus become a professional community for ongoing teacher professional development in a municipality - and not just a training course. The evaluation has identified a new “legitimate mutation” of the design that may increase the relative advantage of the design considerably. This could significantly affect the students’ perception of the design, and the mutation may also be a new business case for UCSJ.

However, the most important mechanisms affecting the students’ experience of the usability of the design, do not at all relate to the intended design or the way it has been implemented by UCSJ. The most saturated category in our evaluation concerns the study conditions. In Denmark, it has been customary that the employer pays for the time employees spend on in-service training activities on campus. The basic design framework, however, can be realized in a design which can be accessed online via asynchronous activities, and this design has only to a limited extent been supplemented with activities on campus in a blended learning concept. The flexibility of the design in time and space has been important for the local viability of the design. Some municipalities have chosen to implement the design in their local context in a way in which the employees get very little or no time to participate in study activities. The consequence is that several students see the concept as a discount solution for teacher professional development, and the intended design is in this local context mutated to a “lethal mutation”.

The last category, which affects the learning outcome, is the students’ academic qualifications. We have so far only few data regarding this as only a small group of students have taken exams, but based on interviews with MOOC teachers, we have formulated a preliminary hypothesis regarding the correlation between the students’ academic prerequisites and the learning outcomes measured in a test.

We differentiate between the students’ academic qualifications in a subject and their educational qualifications to teach a subject in school. Based on these two types of academic skills, we have generated a model visualizing four different profiles of school teachers who need formal supplementary education:
The evaluation shows the following:

- The intended and implemented designs from UCSJ are equivalent to the needs of the students from Quadrants 1-3, who all have different personalized curriculum needs.
- It is possible to pass the exam based on qualifications from Quadrants 1-3.
- The design gives students from Quadrant 2 in particular the opportunity to demonstrate their excellence.
- Students who have poor academic qualifications in a subject and poor pedagogical qualifications (Quadrant 4) cannot pass the exam and should be advised to take an ordinary education with full curriculum.

8 Further research

In the forthcoming year, we have planned a research project with three different activities:

- **a) Redesign of the developed framework**
  According to the evaluation of the design of an adaptive MOOC we need to develop a new iteration of the framework. First of all a community and collaboration-oriented view on learning and participation should be better integrated into the framework. And secondly our design principles for additional blended learning activities need to be improved. The evaluation of the framework also showed that the “relationships” and the “principles” in the framework have to be better introduced to the MOOC designers and the MOOC teachers. We have therefore decided to produce exemplary materials which can introduce the framework. The evaluation shows that particularly three areas have to be better introduced. First of all the exemplary material must show examples of a competence-oriented curriculum design. Secondly the material must show examples of different collaborative learning activities in the MOOC – especially peer to peer activities. Thirdly the material must show examples of meaningful blended learning activities on campus.

- **b) Gamma testing of the design**
  In the year to come we have planned a gamma testing of the design. Our objective is to study the relations between the implemented design in different context, the participants’ academic qualifications and their learning outcomes.

- **c) Exploring innovative mutations.**
  The evaluation has identified two promising but unexpected mutations of the design and the research project will study and develop learning principles for these mutations. First of all the evaluation has identified a potential for teacher professional development for all teachers in a municipality, if the design is transformed from an in service course to an open learning community. We have therefore decided to develop an entirely new framework for producing MOOCs for professional community building and ongoing teacher professional development for all teachers in a municipality. Secondly the evaluation has showed a potential for using our archived MOOCs in a blended learning concept in our ordinary bachelor degree programs. We are therefore in
the planning phase of a new research project, that in the next two years will explore and develop a framework to guide the use of MOOCs in "MOOC enhanced classrooms" in our ordinary undergraduate program.

References


Bringing Open Educational Practice to a Research-Intensive University: Prospects and Challenges

Elizabeth Masterman
University of Oxford, UK
liz.masterman@it.ox.ac.uk

Abstract: This article describes a small-scale study that explored the relationship between the pedagogical practices characterised as “open” and the existing model of undergraduate teaching and learning at a large research-intensive university (RIU). The aim was to determine the factors that might enable (conversely impede) the greater uptake of open educational resources (OER) in universities of this type. The research was informed by two theoretical frameworks. The first was derived from the literature on open educational practice and served as the basis for an interview schedule. The second was derived from the literature on RIUs and provided a structure for reflecting on the data in three areas of activity: pedagogy, outreach and governance. The researchers conducted semi-structured interviews with 14 academics, selected either for their involvement in open practices or for the recognition they had received for excellence in their teaching. The interview schedule was derived from a literature survey focusing on open pedagogic models. Topics discussed with interviewees included the “flattening” of the teacher-student relationship, students’ assumption of responsibility for their own learning, learning as (or in) a community and the possible influence of open practices in research on teaching. Findings suggest that open educational approaches can be accommodated in a university’s prevailing pedagogic model without compromising its integrity. However, openness can enhance the specifics of that pedagogy; for example, through aligning research-informed teaching with emergent open practices in research and equipping students with the skills necessary for living and working in an open world. There is a closer alignment between releasing OER and an RIU’s strategic mission for outreach. Nevertheless, the spread of open practices in both pedagogy and outreach hinges on issues of governance, which in RIUs is characterised by considerable emphasis on the autonomy of individual academics.

Keywords: open education, OER, research-informed teaching, higher education, pedagogy, digital scholarship

1 Introduction

For more than a decade the world has witnessed the burgeoning of open educational resources (OER): “teaching, learning, and research resources that reside in the public domain or have been released under an intellectual property license that permits their free use or re-purposing by others” (Atkins, Brown and Hammond, 2007: 4). OER, and their more recent aggregation into massive open online courses (MOOCs), are seen as vehicles for the democratisation of education. The principal intended beneficiaries are learners worldwide, both students in formal education and those engaged in lifelong learning, whether or not they are affiliated to an institution. Following on from an early focus on the practical matters of licensing and technology associated with distributing OER, the level of research was raised in order to embrace pedagogic and institutional issues; for example:

Open education is not just about disseminating resources ... but also about an opportunity toward broadening and deepening our collective understanding of teaching and learning (Iiyoshi and Kumar, 2008: 439).

The boundaries of the debate around open education are increasingly expanding in order to encompass the institutional, cultural and pedagogical implications of adopting an open model rather than retaining focus on the resources themselves (McAndrew and Farrow, 2013: 70).

Research into the real-life practices of academics within this array of pedagogical, cultural, technical, legal and institutional factors is important in part because, as Harley has observed, “sustainability of open education resource initiatives will be determined ultimately by actual user demand” (2008: 198).

The above observations provided the impetus for a small-scale investigation at the University of Oxford, which is a leading provider of online reusable learning and teaching resources in the UK (many of these can be accessed through its “Open Spires” portal: http://openspires.it.ox.ac.uk/). The purpose of the project was to explore the relationship between open educational practice and the academic culture of Oxford in order to illuminate the factors that might be conducive (or otherwise) to greater uptake of OER in teaching and learning in the University. Three research questions were addressed:
To what extent do Oxford academic staff recognise, in their research and teaching, values and practices that are associated with openness?

To what extent is their current teaching practice shaped by open practices in their research?

What constitutes optimal engagement with open educational practice on the part of the institution?

The design of the study was informed by a theoretical framework derived from the literature on open educational practice. To place the research in a broader context, the project team considered the findings through the lens of the University’s function as a research-intensive university (RIU), in particular its distinctive “tutorial” model of individual and small-group teaching led by active researchers.

In reporting the study, this article begins with a survey of the literature on open educational practice, identifying key characteristics which were subsequently built into a schedule for interviewing 14 academics. It then turns to the literature on research-intensive universities in order to outline three areas of activity that are germane to the study: pedagogy, outreach and governance. A description of the research methodology and findings follows, and the article concludes by reflecting on the implications of the findings for those areas of activity.

Note: MOOCs are explicitly excluded from this article for two reasons. Firstly, the remit of the study was to investigate OER only. Secondly, at the time the research was carried out the focus of MOOCs was on learning in an informal context, rather than as a means to supplement formal studies.

2 Literature survey (i): characteristics of open educational practice

The first part of the literature survey explores the basic principles that underlie notions of openness, and then moves on to overviews of openness in teaching and learning, open practices in research and institutional approaches to the promotion of OER.

2.1 Fundamental principles of openness

A strong statement of the basic motivation underlying open practices in education can be found in Atkins, Brown and Hammond’s influential report for the Hewlett Foundation: “the simple and powerful idea that the world’s knowledge is a public good and that technology in general and the Worldwide Web in particular provide an extraordinary opportunity for everyone to share, use, and re-use knowledge” (2007: 9). For Lerman, Miyagawa and Margulies, this idea should have a specific resonance for the academic community: “Open sharing of knowledge is at the heart of the academic process. For many faculty, it is an intrinsic value, convincingly demonstrated in their teaching and research” (2008: 214).

Although the sharing of knowledge can be traced back several centuries (Peter and Deimann, 2013), technology has made it possible for this sharing to become global. Web 2.0 technologies in particular are seen to support open practices which include new, informal, means of communication and dissemination; alternative peer review models; and a growing recognition of new forms of research output (Scanlon, 2013; Lane and McAndrew, 2010; Veletsianos 2013). In terms of learning, the open sharing of knowledge has facilitated the blurring of boundaries between disciplines; between roles (research and teaching, teacher and learner); between the scholarly community and the lay community; between institutions and the world beyond; between formal and informal learning; and between geographical borders (Iiyoshi and Kumar, 2008 among others). Thus, technological advances are considered not merely to improve or expand current scholarly behaviours, but to transform them (Veletsianos and Kimmons 2012).

2.2 Sharing and reusing OER

In relation to open sharing, the research team was interested in the question of motivation rather than in the legal and technical aspects. Summarising papers by others, Hylén (2009: 139) lists reasons for releasing one’s educational resources that include altruism, a desire to stimulate innovation, “a wish to share with others for creative, educational, scientific or research purposes”, “the pleasure of being involved in peer production”, and enhancement of one’s reputation. Beetham et al. (2012) suggest that confidence is a prerequisite for sharing, while Van Acker and colleagues (2013: 179) propose knowledge self-efficacy as a predictor: “When teachers believe that their OER has an added value for others, they will be more inclined to share.”
It is challenging to research teachers’ motivation to reuse OER, since it lies “under the control of the individual and is difficult to measure” (Pegler, 2012: 12). Even so, studies by Masterman and Wild (2011) and Pegler (2012) indicate that reasons for reuse are largely pragmatic; for example, an improvement to the quality of students’ learning, the rarity of certain resources and efficiency. Indeed, it is not immediately clear whether reusing resources counts as an open practice since, as Hylén (2009) implies, the altruism of others in sharing their resources openly features little, if at all, in a teacher’s decision to reuse OER. Furthermore, the open licence – the attribute that distinguishes OER from other resources on the Web – does not necessarily serve _per se_ as a motivator to engage with OER. Lecturers interviewed by Masterman and Wild (2012) appeared to have a low awareness of the copyright conditions governing third-party resources; rather, they operated on a common-sense notion of fair use or, simply, “I need that: I’ll use that.” In fact, pragmatic and pedagogic factors aside, there would appear to be more motivation _not_ to reuse OER. As Iiyoshi and Kumar (2008: 432) observe in relation to reuse in general, “Higher education … places a high premium on originality, whereas adapting or improving another’s educational materials is rarely understood to be a creative, valuable contribution.”

Thus, there appears to be an asymmetry in the sharing and reuse of open educational resources, despite the OER movement’s professed goal of mutuality in their exchange and development (Willems and Bossu, 2012).

### 2.3 Characteristics of open pedagogic models

Ehlers (2011: 6) offers the following definition of open educational practice: “…collaborative practice in which resources are shared by making them openly available, and pedagogical practices are employed which rely on social interaction, knowledge creation, peer-learning, and shared learning practices.”

A number of proponents of openness argue that, for the potential of OER to be truly realised, there needs to be a radical change in current educational practice. Indeed, Geser (2012: 41) argues that “if the dominant model is teacher-centred education – a teacher mediates authoritative textbook or course content and learners digest and reproduce it – the Open Educational Resources will not make for a difference in education. In such a model teachers may download Web-accessible open teaching material to prepare classes, and students may use some content to prepare material for lessons, but this will remain a one-way channel of content provision, in which physical textbook or course content is replaced by digital material.” Ehlers (2011: 5) presents an alternative environment, in which “learners are involved [in] the creation of content … teachers are moving away from content centred teaching … learning processes are seen as productive processes and learning outcomes are seen as artefacts which are worth sharing and debating, improving and reusing…”

The ability of learners to discover more information directly has the potential to alter the balance of power around access to knowledge (Casserly and Smith, 2008). The result is a shift in the teacher’s role from source of knowledge to mentor or learning advisor (Ossiannilsson and Creelman, 2011), facilitating open educational practices on the part of learners (Schaffert and Geser, 2008). For his/her part, the learner should become “an arbiter of his or her educational needs and desires” (Cape Town Declaration, 2007). This change in relationship is to be acted out within a constructivist model of learning where there is more dialogic engagement between teachers and learners: “knowledge is co-created and facilitated through mutual interaction and reflection” (Ehlers, 2011: 4), and priority is given to learning communities instead of teacher-centred education (Geser 2012). The types of learning activity envisaged in this model should focus on the “development of knowledge and skills required for tackling and solving problems instead of subject-centred knowledge transfer” (Geser, 2012: 38), with the goal of preparing both students and teachers for participation in a knowledge economy (Schaffert and Geser, 2008). Generally, this will demand “an active, constructive engagement with content, tools and services in the learning process” (Geser, 2012: 38); these tools should support collaborative, self-managed learning that allow students to draw from a range of sources of information (Schaffert and Geser, 2008).

A contrary view suggests that openness can co-exist with current pedagogic models. For example, Panke and Seufert (2013) identify several longstanding theories that they consider to be more or less directly applicable to learning and teaching with OER, including Social Constructivism and cognitive learning theories. Beetham et al. (2012: 7) suggest that what might look like a change in teachers’ pedagogy may in fact be “rediscovering the specificity of their disciplinary pedagogy through a new lens (content sharing on the open web), rather than discovering … a new ‘open’ pedagogy.” They also propose that, conversely, it might be sufficient for teachers
merely to “adopt those aspects of open practice that amplify their existing pedagogic practices most effectively.”

2.4 Open learning

The literature reviewed in section 2.2 suggests that a more learner-centred approach on the part of teachers is a prerequisite to students’ engagement with openness in their learning. Characteristics of open learning identified in the literature include:

- greater autonomy: students take responsibility for their learning (Ossiannilsson and Creelman, 2011);
- learning through collaborating on “open knowledge-building projects” (Beetham et al., 2012) with other students;
- validating each other’s learning by sharing, and giving feedback on, essays and other outputs (Ehlers, 2011; Beetham et al., 2012).

According to Schaffert and Geser (2008), these practices mean that students should demand educational approaches that equip them for employment in a knowledge society; they should propose new tools and services; and they should respect intellectual property rights and use open licensing for their own outputs. This is an ideal; in reality students can be conservative in their approach to learning. Ossiannilsson and Creelman (2011: 376) claim that, as a consequence, “Teachers who use OER instead of lecturing risk being seen as ‘not real teachers’ and may get lower evaluation results than colleagues who teach more traditionally.”

2.5 Open practices in research

The characteristics of open practices in research are summed up by Weller (2011) under the label of “digital scholarship”, by Scanlon (2013) as “open scholarship”, and by Veletsianos and Kimmons as “networked participatory scholarship”: that is, “the emergent practice of scholars’ use of participatory technologies and online social networks to share, reflect upon, critique, improve, validate, and further their scholarship” (2012: 768).

A digital scholar displays curiosity about the potential of new digital tools and assembles a personal learning environment comprising a repertoire of tools which they continually update as technology evolves and employ for both professional and personal purposes. This blurring of the personal and professional in the use of technology is carried across into the digital scholar’s communications and, argues Weller (2011), enables them to be an effective communicator, since revealing personal elements of oneself creates “hooks through which connections are established.”

Practising open approaches in one’s research (open science) includes openly licensing the methods, data and other artefacts that can enable others to reproduce the results reported. Formal outputs are published through open access routes from preference, and open peer review (Anderson, 2013) may also be favoured. Self-publishing also features prominently: the digital scholar produces a range of informal, non-peer reviewed, outputs to report their work in progress and/or results prior to formal publication e.g. blog posts and tweets (Weller, 2011; Scanlon, 2013). In this way, social media supplement, rather than displace, traditional digital media for disseminating research (Veletsianos, 2013).

2.6 The institutional dimension

A number of motivating factors have been advanced for institution-level engagement with OER. Outward-facing factors include sharing knowledge for the public good, which is seen as a “social responsibility” of the institution (Ford, 2013); and attracting prospective students (de Langen, 2011). Inward-facing factors include opportunities to improve the performance of both students and staff (Ford, 2013) and efficiency: raising the standard of teaching through the wider use of free-to-use third-party resources (de Langen, 2011; Ford, 2013).

Some, including Harley (2008) and de Langen (2011), have identified a tension within producer institutions between creating OER to benefit teaching and learning on the one hand, and creating them as a marketing activity on the other. Dos Santos (2008: 7) observes that “The media discourse of OERs draws on the globalization discourse and widening participation discourse to foster the image of the institutions, their
mission and their role in the society in creating knowledge and a better world” rather than on a genuine commitment to sharing knowledge.

The literature offers a number of strategic drivers for engendering a positive climate towards open practices in teaching and learning, in addition to giving academics practical support to create and share their own OER, and to locate, evaluate and adapt third-party OER. For example, to establish the basic condition for openness – i.e., an appreciation of intellectual property rights – Mackintosh (2012) suggests an institutional open intellectual property initiative. A further option, particularly in research-intensive universities, is to leverage open practices in other academic activities such as open access publishing (Hoosen and Butcher, 2012).

3 Literature survey (ii): Characteristics of a research-intensive university

The second part of the literature survey places Oxford within its institutional “type” – a research-intensive university (RIU) – both to provide a framework for mapping the interview data on open practices to the University’s existing pedagogic mode and to broaden the relevance of the study to similar institutions.

Chirikov (2013) identifies three key features of RIUs as follows: a “high concentration of talent” among academic staff and students, “abundant resources” which are prerequisites to innovative research, and governance structures that allow considerable academic autonomy. In terms of the education that they offer, RIUs are characterised by:

- teaching that is research-informed (Spronken-Smith, Mirosa and Darrou, 2014; Zamorski, 2002);
- pedagogies that aim to inspire students to be “curious, driven, responsible and capable of academic thinking” in their capacity as “citizens and leaders of tomorrow” (Mapstone, Buitendijk and Wiberg, 2014: 3);
- a role as “ambassadors for educational outreach and innovation” (ibid.).

The practice of research-informed teaching has been characterised in a number of ways. Spronken-Smith and colleagues (2014) list four approaches to curriculum design intended to involve undergraduates in research:

- research-led: the curriculum is structured around content drawn directly from research, often the lecturer’s own;
- research-oriented: the curriculum emphasises teaching the processes of knowledge construction in the subject: e.g. how to think like a historian, chemist etc.;
- research-based: students carry out inquiry-based learning or other activities involving research. This might also involve learning research skills and methods (Zamorski 2002);
- research-tutored: learning is focused on students writing and discussing papers or essays.

Aligning research and teaching in this way has implications for the teacher-student relationship, with institutions becoming “inclusive communities of academics and students as co-constructors and investigators of knowledge” (Lucas, 2007): that is, akin to the open model of co-created knowledge outlined in section 2.3 above.

4 Approach

From the literature surveyed in section 2 of this article the research team developed a conceptual framework of open educational practice. This provided the basis for a semi-structured interview schedule for use with academic staff. Questions relevant to the current article sought academics’ perspectives on sharing and reusing both OER and third-party resources in general, open pedagogic models, students’ learning in an open world and the influence of open practices in research. Other questions addressed related topics such as the open sharing of pedagogic knowledge (not reported here). The schedule was piloted with three representatives of the target population and subsequently revised.

The overall research design received ethical approval from the University’s central ethics committee.

Interviewees were selected using a purposive sampling method, which identified a) academics who were known (from previous research projects) to be already involved in open practices at the University (for example, contributing to its OER collections or being active in open science) and b) academics who were not known to engage in these practices. The latter were identified from staff who had been honoured in a teaching
awards scheme run by the University’s student union; it was thought that such individuals would be interested in discussing their teaching even if they had not thought about “open” issues (the data subsequently showed this supposition to be correct).

The interviews were conducted with 14 members of teaching staff from a range of disciplines during autumn 2013. They were audio-recorded and transcribed by the two interviewers. They made unfocused indexical transcripts (Gibson and Brown, 2009): unfocused in that they created “a record of ‘what happened’ within a given recording of speech” (ibid.), and indexical in that the data were organised in relation to the interview questions.

The data were analysed in two stages. In stage 1, two researchers analysed the transcripts and coded them according to each interview question. In stage 2, the collated data were reorganised by research question and synthesised into narrative interpretations. The research team was interested in the different perspectives that interviewees offered on the topics of discussion rather than in the number of participants who expressed a similar view. The narrative interpretations were circulated to interviewees for approval before the recommendations of the project were developed from them.

5 Interview findings

This section presents findings from the interview questions relevant to the subject of this article. A comprehensive report on the overall project is provided in Masterman and Chan (2015).

5.1 Sharing knowledge and resources

All interviewees believed that knowledge should be open and shared for the public good. Making knowledge open was also seen to justify the existence and functions of a university; for example, “an easy access to decent, well-researched work, robustly defended opinions and arguments is vital to democratic life” (humanities tutor). However, some caution was expressed about the moral implications of sharing knowledge that can be put to harm and about academic competitiveness as a barrier.

In addition to releasing OER for Oxford’s collections, evidence was found that individual departments had put learning resources on publicly accessible websites, either for outreach or to make it easier for their students to find the resources when away from Oxford. Participants gave a number of reasons for sharing their educational resources, including helping to stimulate debate in the wider community (“they’re thinking about the issues in a way they wouldn’t have been doing before, and the more people I can get to do that, generally the better”: humanities tutor) and personal satisfaction that their work was valued by a wider audience.

The impediments to sharing identified by interviewees included a lack of recognition for good teaching (as opposed to research), personal disposition (the feeling that one’s teaching is personal to oneself), and a sense that teaching at Oxford is personalised to one’s students and not readily shareable with the wider community.

5.2 Reusing resources

The interview data suggest that it is common practice in Oxford to reuse third-party materials. For example, a humanities tutor felt that her role entails collating and distilling resources produced by others and adding her own perspective to them, “so it’s just part of [a] resource chain, if you like.” However, there was little evidence that interviewees actively sought out OER. Indeed, most were unable to identify the characteristic that distinguishes OER from other freely available online resources: namely, the Creative Commons (or similar) licence.

In addition to commonly cited barriers such as the difficulty in finding resources and poor pedagogic quality, interviewees identified institution-specific constraints on the reuse of resources: namely, the higher academic level of Oxford courses (which can restrict the educational relevance of resources) and the focus on students’ own thinking.
5.3 The roles of the teacher and the student, and the relationship between them

Discussions about the teacher-student relationship were structured around four statements derived from the literature on open educational practice. These were intended to encapsulate the characteristics of the “innovative” pedagogical models that are claimed to be a logical extension of creating and using OER.

1. a) The teacher’s role changes from source of knowledge to learning adviser, and b) The student takes responsibility for their own learning, including what they learn. Interviewees identified these as existing properties of the Oxford “tutorial” model of teaching and learning, in which students meet with their teachers weekly, either individually or in small groups (in addition to lectures, seminars, practicals and other formats familiar to the wider higher education sector). The focus of the tutorial is the exchange of ideas around an essay – or, in the sciences, a set of problems – which each student will have spent the preceding week researching and preparing independently. As a social sciences tutor observed, “The whole underlying philosophy of Oxford is that we advise the students in a tutorial about what they are to go out and learn during the week.” One humanities tutor saw himself as “... a researcher who ... has a life committed to the production of new knowledge and new ways of thinking ... the teaching is driven by research and ... they’re coming to participate in that; they’re not coming to learn from a schoolteacher.” Another remarked that, even though students take responsibility for their own learning in the Oxford model, they need to be guided so that they can genuinely take responsibility and learn to select what is worth reading rather than what superficially seems more attractive or relevant to their immediate interests.

2. Knowledge is co-constructed through mutual interaction and reflection between teacher and students. The concept of a partnership between tutor and student and of learning as a conversation “in which learners move towards establishing expertise” (humanities tutor) was also considered a cornerstone of the tutorial model at Oxford. However, despite the less hierarchical relationship, interviewees felt the tutor retains the advantage of deeper knowledge and longer experience in practising the subject. Openness may have given a broader knowledge base to the student, but this is still within “the comfort zone of the senior partner” (mathematics tutor). Interviewees also felt that characteristics such as the dialogic element of learning predate the “open” era by several centuries, and that the contribution of technological innovation and open access to resources has been to broaden the knowledge base available to students.

3. The development of knowledge and skills required for tackling and solving problems has priority over subject-centred knowledge transfer. Interviewees suggested that subject-centred knowledge transfer needs to have a temporal priority because students require a base of factual and conceptual knowledge about their domain of study before they are able to think, reason and solve problems in the domain.

4. Students learn primarily from each other, as a community. Several interviewees felt that students learn primarily from their tutor, but in a way that facilitates their learning as a community outside formal classes. However, the competitive culture in the University was considered to some extent as an impediment to students’ learning from each other.

5.4 Learning through creating OER

Interviewees were invited to consider the idea of students producing OER as outputs from learning activities and the kinds of learning outcome that would thereby be supported. Only two interviewees made a direct connection between student-produced OER and open practices as a whole. One commented that the teacher’s job is not only to share their own knowledge with the student, but also to open the student’s eyes to other knowledge which he or she might share. The other made the point that, since students are using the resources and learning from them, they should contribute to the cycle themselves.

A number viewed learning through creating OER as an opportunity for students to develop their communication skills in general, as well as the analytical skills required in their discipline. However, even though students already create online resources, YouTube videos and so forth, interviewees were concerned about the pedagogic quality of such materials should they be released as OER. Several advocated some kind of control mechanism.
5.5 Open practices in research

In questioning interviewees about their research activities, the research team sought to ascertain how far the experience of open access publishing, involvement in open science or engagement with social media in research might have an influence on interviewees’ teaching.

The data suggest that this influence is currently still weak. Only a few interviewees appeared to perceive a natural or logical link from openness in research to open practices in teaching: for example, the inclusion of open access journal articles in students’ reading lists or the realisation that one can protect one’s teaching materials with a Creative Commons licence.

A tutor in the natural sciences thought that two inhibiting factors might be the essentially personal nature of teaching at Oxford and the more rapid turnover in one’s research: “you do the research and publish it ... then you go off and do something else.” In contrast, where one tends to teach the same thing every year (with slight modifications) there is less reason to share materials regularly. A third explanation for the lack of cross-fertilisation, suggested by a tutor in the medical sciences, is that many people active in open science have research-only posts.

In light of Oxford academics’ increasing use of social media and Veletsianos’ observation that “sharing should be treated as a scholarly and educational practice” (2013: 648), the research team was interested in the extent to which those interviewees who use social tools to disseminate their research also use them in their teaching.

Once again, the cross-over effect appears weak. Of the five interviewees who reported using one or more of the above technologies for academic purpose, only one (a social scientist) stated that he uses them in teaching: he encourages his students to follow him on Twitter. Another interviewee from the social sciences indicated that his blog posts tend to be “slightly arcane” and cover issues that are not directly associated with the curriculum.

The one interviewee who said that he does use social media in his teaching suggested that the activity may also have something to do with the stage of one’s career: academics who have tenured posts or who have established themselves in other ways may feel more confident to experiment. He referred in this respect to “a tension between what in an ideal world would be good globally and what is demanded ... by your university.”

5.6 Engagement with open educational practice at an institutional level

Interviewees generally considered that being “open” as an institution is in keeping with the core philosophy of knowledge as a public good, with Oxford’s global responsibility as a world-leading university that holds an extensive archive of resources and with its status as a charitable institution. More specifically, openness can help to counteract an elitist image: “it says ‘Oxford isn’t this closed place that only privileged people get access to; ... it’s really getting out there to improve world knowledge’” (medical sciences tutor).

Responding to the question whether Oxford should engage in specific open activities in order to maintain its reputation and to keep up with competitor institutions, a tutor in medical sciences felt that the University should not do so merely for reputational purposes; rather, an enhanced reputation would be an outcome. Other interviewees felt that Oxford should engage with OER order to maintain its profile among competitors.

Discussing the feasibility of a top-down implementation of open practices, interviewees’ views fall into three categories:

- the desirability for a mechanism to ensure the pedagogic and production quality of OER released by the University;
- the requirement for practical support to academics for the creation of OER and for legal guidance on intellectual property rights;
- the impact of the University’s federal structure (comprising the “central” University and over 40 self-governing colleges) and its devolved model of decision-making.

Within the University’s devolved model, decisions are taken at the lowest level appropriate to the matter in hand, in keeping with the principle of academic freedom. Decisions at progressively higher levels –
departments, faculties, divisions and the University as a whole – are made primarily when support is required: for example, where resources need to be allocated. In this way, in the words of one interviewee, Oxford functions as a community rather than as an organisation.

In terms of implementing open educational practices at Oxford, the decision to engage with OER (whether as producer or consumer) therefore lies with the individual academic. However, as one interviewee observed, it is also possible for individual departments to adopt their own policies and release what they feel to be worthy of sharing. Even so, the view was expressed that advice and practical support should come from central teams, as finding the required information can be difficult in a devolved system.

6 Discussion: Implications of the findings for research-intensive universities

This section considers how open practices at an RIU might be influenced or determined by three of the attributes identified in section 3: a research-informed pedagogy, a mission for educational outreach mission, and its governance and institutional culture.

6.1 Mapping openness to institutional pedagogy

To explore the implications for teaching and learning at Oxford, we can position the findings from the interviews within the University’s overall research-informed pedagogy. Extrapolating from the four interpretations of research-informed teaching identified in section 3, and from the data gathered in this project on academics’ readiness to engage with third-party resources in general, it is possible to envisage potential roles for OER in research-informed teaching that would not compromise its integrity, as Table 1 shows.

Table 1: OER in research-informed teaching. Each approach is illustrated with a quotation from the interview data

<table>
<thead>
<tr>
<th>Approach:</th>
<th>Examples of student learning activities:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Research-led:</td>
<td>“The teaching is driven by research and ... they’re coming to participate in that.” Read open access journal articles and openly licensed project reports.</td>
</tr>
<tr>
<td>Research-oriented:</td>
<td>“…guiding a student through your own interpretation of a discipline in order to help them learn their own techniques.” Gain insights into the research process through “work in progress” shared by digital scholars through social media, including blogs. Have opportunities to work with the open source tools used for research in the domain (eg NetLogo for modelling).</td>
</tr>
<tr>
<td>Research-based:</td>
<td>“Learning to be a good learner is learning how to do research.” Access OER collections containing digitised texts and digital surrogates of artefacts. Take openly licensed courses (including MOOCs) for learning research skills. Receive coaching in open science methodologies.</td>
</tr>
<tr>
<td>Research-tutored:</td>
<td>“The student leaves the tutorial with a different perspective on the essay which they brought to it.” Take openly licensed courses (including MOOCs) on academic writing and related skills. Produce blog posts as alternatives to conventional essays, thereby extending the possibilities for discussion beyond the tutorial in terms of time and place.</td>
</tr>
</tbody>
</table>

These roles could be instrumental in bringing that teaching more into line with the emergent open practices in research. Furthermore, their use could help students to understand that knowledge is “something shared, not something owned” (to quote an interviewee from the humanities) and to grasp “the complex and provisional relationships between research and knowledge” (Zamorski, 2002).

To sum up, the overlaps between, on the one hand, Oxford’s longstanding pedagogic model of individual and small-group teaching with its view of the student as an adult participant in their own learning and, on the other hand, the ideals of open pedagogic practice, are not necessarily a sign that the University does not “need” OER (i.e. in the sense of solving a particular educational problem). Rather, they also remind us that OER are not “a different type of educational material,” but “[fulfil] the functions any type of educational material, but with the added benefits of being usable and adaptable without the expense of paying licensing fees or securing permissions” (Glennie, Harley and Butcher, 2012: 287).

The overlaps also call into question the claim that engagement with OER entails radically new pedagogies and, therefore, how far engagement with OER constitutes either a necessary or a sufficient condition for achieving
the four pedagogic objectives singled out in the conceptual framework underpinning the interviews. In this respect, the project findings probably come closest to Beetham and colleagues’ (2012) observation that teachers consciously “pick and choose” elements of openness to suit their existing pedagogy. However, interrogating our understanding of the ways in which research-informed teaching is practised in Oxford in the light of open models of teaching and learning makes it easier to identify specific, and relevant, roles for OER.

6.2 Educational outreach

RIUs take their outreach mission seriously; indeed, Oxford’s Strategic Plan for 2013–18 specifically refers to “[developing] our globally available teaching resources and collections for our own community, for our distance-taught students across the world, and for learners everywhere.” The use of the term “globally available” in place of “open” is significant. While this more cautious approach might be inimical to proponents of openness, it is simultaneously enabling. That is, it may give confidence to academics who espouse the view of knowledge as a common good but are reluctant (at least, initially) to allow others to modify their material under an open licence.

Despite this noble mission, RIUs are not immune to the problems that hamper academics’ release of their materials as OER: lack of time and lack of reward. Indeed, one could make the case that the obstacles to individual initiatives of this kind are greater in RIUs, on account of the tensions between research and teaching that invariably result in the privileging of the former over the latter (Geschwind and Broström, 2015). Viewed in this light, the release, as OER, of podcasts from undergraduate lectures or research seminars provides a quick and easy means both to further the institution’s outreach mission and to address an aspect of research-informed teaching.

From outside an RIU, the emphasis on releasing OER as part of the institution’s outreach mission, coupled with a lack of strategic attention to integrating OER into undergraduate teaching, may give the impression of an imbalance between their production and use of OER. If there is a divide between producer and consumer institutions, then RIUs would appear to conceive of themselves primarily as producer institutions. This can potentially lay them open to the criticisms referred to in section 2.6. More widespread use of OER in teaching, especially OER from other institutions, may not only obviate such criticisms, but can also further equip the universities’ own students as citizens in an open world.

6.3 The influence of institutional culture and governance

Implementing pedagogic innovation and promoting global outreach on a whole-institution level (as opposed to grass-roots initiatives by individuals and groups) depend on a recognition of their importance at a strategic level and, therefore, on the existence of appropriate enabling structures. In this respect, releasing OER as a part of an institutional belief in the importance of outreach is less challenging than deploying open resources and open approaches to pedagogy, as these can impinge on the academic autonomy enshrined in an institution’s governance.

Although the implementation of the mandate of the Research Councils UK mandate on open access publishing in 2013 could be considered an example of top-down decision-making regarding open practices at Oxford, there are two key points to make. First, the RCUK mandate was a requirement from outside the University; there exists no such external driver in relation to openness in teaching and learning. Second, there are important qualitative differences between an academic’s research and teaching activities. Research is public and its outputs are shared as a matter of course (as well as for career advancement), while teaching is more personal: personal to the teacher, to the relationship with the particular student and to a particular context. The ultimate decision whether to engage with OER is, arguably, equally personal.

7 Conclusion

This article has drawn upon interview data with 14 academics at the University of Oxford in order to explore the prospects and challenges in bringing open educational practices into the mainstream at a research-intensive university: that is, to establish an environment where such practices are regarded as normal. Sharing OER as part of a strategic mission for outreach remains the greatest prospect, as it fits in with a longstanding core value of the University. In terms of a research-informed pedagogy the seeds of open practice are already present in the reuse of third-party resources, and in resonances between the open pedagogic model presented
in section 2.3 and existing approaches to teaching and learning at Oxford. To nurture these seeds entails a two-pronged approach: pragmatic and pedagogic. Pragmatically, the institution has a responsibility to promote, among staff and students alike, an understanding of licensing and what constitutes the legitimate use of third-party resources. Pedagogically, the use of OER can be encouraged in accordance with the University’s objective to develop students as “citizens of tomorrow” in an open world and/or to prepare them for academic practice in an open world. However, in doing so OER should not be positioned as a distinctive (and implicitly superior) type of educational material. In terms of strategic direction, longstanding principles of governance will always underpin institutional initiatives. In a research-intensive university where academic autonomy is prized, individual staff will necessarily hold the balance in relation to the outcomes of such initiatives, and differing personal choices may result in inconsistent practices across the institution.

Turning to methodological issues, the conceptual framework at the heart of the work presented in this article was constructed from disparate sources, including “thought-pieces” as well as reports of empirical research, rather than being extrapolated from a holistic repertoire of practices currently observable in the field. This opens up the opportunity to challenge the claims of the open movement from the evidence of existing practice. More specifically, through identifying commonalities between the “state of the art” and the “stage of the actual” (Selwyn and Grant, 2009), it becomes possible to question the extent to which OER constitute either a necessary or a sufficient catalyst for the radical pedagogic change that they are sometimes perceived to herald.

Acknowledgements

The author thanks the following for their contribution to the project: Dr Chris Davies, Dr Jennifer Allen, Dr Steve Albury, Dr Jessica Chan. This article is based on a paper published in the proceedings of the 14th European Conference on E-learning (ECEL 2015) and on an oral presentation at the Open Education Conference 2015 (OER 15).

References

Cape Town Declaration (2007) “Cape Town Open Education Declaration: Unlocking the promise of open educational resources” [online], http://www.capetowndeclaration.org/read-the-declaration.


Ossiannilsson, E. and Creelman, A. (2011) “Quality indicators within the use of open educational resources in higher education”, in A. Mendez-Vilas (ed.), *Education in a technological world: Communicating current and emerging research and technological efforts* (pp. 372–382), FormateX Research Center, Badajoz, Spain.


Student's Reflections on Their Learning and Note-Taking Activities in a Blended Learning Course

Minoru Nakayama1, Kouichi Mutsuura2 and Hiroh Yamamoto3
1Human System Science, Tokyo Institute of Technology, Tokyo, Japan
2Faculty of Economics and Graduate School of Engineering, Japan
3Shinshu University, Matsumoto, Japan
nakayama@hum.titech.ac.jp

Abstract: Student's emotional aspects are often discussed in order to promote better learning activity in blended learning courses. To observe these factors, course participant's self efficacy and reflections upon their studies were surveyed, in addition to the surveying of the metrics of student's characteristics during a Bachelor level credit course. Regarding the causal relationships between these factors, the contributions of the factors of self efficacy and other characteristics were evaluated. The contents of notes students took during the course were lexically evaluated to determine whether this activity promoted reflection. Four indices of note-taking activities were extracted from the lexical analysis. Correlation analysis was conducted, and according to the provisional results of the correlation analysis between the four indices of note-taking and student's characteristics of their own degree of self efficacy, there were some significant relationships between note-taking indices and some of the self assessment indices, such as word rates in notes and the degree of out of course study, and between the content coverage of notes taken and self understanding.

Keywords: note-taking, blended learning, student's reflection, student's characteristics, causal analysis, text analysis

1 Introduction

Various types of e-learning are proliferating, and becoming more widely used due to their beneficial educational aspects (Hill, 2012). In particular, blended learning, which consists of face-to-face sessions and learning materials that are supported by information communication technologies (ICT), is the easiest way to use modern educational media which is familiar to both students and lecturers (DesLauriers et al. 2011). Conventionally, when the relationship between student's learning activities and achievement has been discussed, learning performance in an e-learning environment was always a more important topic than participant's satisfaction. Since encouraging student's learning activities has been shown to improve performance, the e-learning environment, which uses learning materials together with ICT, is considered to contribute positively to their results. Recently, flipped classrooms, which are a kind of a blended learning, are believed to promote student's self directed learning outside of classroom and to help collaborative learning in face-to-face sessions (DesLauriers et al. 2011).

To observe student's learning activity during courses, two types of learning evaluation have conventionally been used: emotional, and cognitive evaluation (Bloom et al. 1971). In addition to the use of learning motivation studies (Miyamoto, Nasu, 1995) to evaluate emotional aspects, evaluation of student's preferences and their level of satisfaction, such as through the use of the ARCS model (Keller, Suzuki, 1988), is discussed. Regarding students' attitudes towards learning, their learning efficacy and information which is based on self reflection are often considered (Pintrich 1990). For cognitive assessment, note taking activity has been observed in order to track student's learning progress (Kiewra, 1989; Kobayashi, 2005; Nye et al. 1984; Tynajä, 1999). In addition to recording the content of notes taken, a lexical illustration of notes enables the use of conceptual mapping representation (Novak and Canas, 2008). As a result, the effectiveness of learning performance can be confirmed, even during online courses (Nakayama et al. 2014a; Nakayama et al. 2014b).

In the past few years, more detailed analysis of participant's learning activity has been promoted, in order to improve and enhance learning performance. This is often referred to as learning analytics, and it can provide significant feedback to stakeholders (Vahdat et al. 2015). Some of the techniques have been developed using information based on conventional sources, such as student's characteristics and learning activities (Greller and Drachsler, 2012). In addition to improving learning performance, learning analytics provides a design process for learning, using an instructional design technique to optimise learning activity (Greller and Drachsler, 2012). Regarding the above discussion, a record of note-taking activity can be a source of learning
analysis. Also, the emotional effectiveness of note taking activity in a blended learning environment can be observed.

The purpose of this paper is to examine the relationship between participant's evaluations of their own self-efficacy and their note-taking activities. Towards this aim, two sets of questionnaires were used to survey student's self reflection, and their note taking activities were lexically analysed.

The following topics are addressed in this paper:
- Student's self efficacy and the ways in which they reflect upon their own learning activities were measured and evaluated.
- The relationship between student's self efficacy and student's characteristics were causally analysed.
- Note-taking activities were evaluated using metrics based on lexical analysis of both the lecturer's presentations and the contents of student's notes.
- The relationships between measurements of participant's self assessments and metrics of note-taking activity were examined in order to confirm the effectiveness of note-taking behaviour.

2 Method

2.1 Blended learning course as a survey course

The surveys were conducted during a blended learning course at a Japanese university. The course consisted of 15 weeks of face-to-face sessions. The course was a Bachelor level Information System Network credit course (Nakayama et al. 2011). For this cohort, several conventional surveys were conducted, to evaluate participant's characteristics at the beginning of the course. Some metrics were also surveyed in the middle of the course. In addition to these, two types of surveys of student's reflections were employed for this study.

To monitor participant's learning progress, all participants were asked to present the notes they took during each session of the course. These notes were scanned, and the images were stored on a PC. The textual content of the notes was lexically analysed.

To encourage participants to take notes, some note-taking techniques were provided, using examples of well-taken notes. Instructions were given twice during the course, once early in the course and again at the midpoint.

The valid number of participants for surveys was 40, but the number of valid participants for note content analysis was 27.

2.2 Characteristics of students

In this study, student's characteristics, such as Personality (Goldberg 1999; IPIP 2004), Information Literacy (Fujii 2007), Note taking skills (Nakayama et al. 2014a) and Learning Experience (Nakayama et al. 2007) were continuously surveyed (Nakayama et al. 2007; Nakayama et al. 2014b, 2016). These metrics are introduced here.

Personality: Five factor scores were extracted using a public domain item pool, the International Personality Item Pool (IPIP) inventory (IPIP 2004). The five components are "Extroversion" (IPIP-1), " Agreeableness" (IPIP-2), " Conscientiousness" (IPIP-3), " Neuroticism" (IPIP-4) and " Openness to Experience" (IPIP-5).

Information Literacy: Information literacy inventories (32 items) were defined and developed by Fujii (2007). Originally, 8 factors were extracted, and they can be summarised as two secondary factors: Operational Skills (IL-1), and Attitudes towards Information Literacy (IL-2) (Nakayama et al. 2008).

Learning experience: Students' online learning experiences were measured using a set of questions, and three factors were identified, as follows. Factor 1 (LE-F1): Overall Evaluation of the e-learning experience, Factor 2 (LE-F2): Learning Habits, and Factor 3 (LE-F3): Learning Strategies (Nakayama et al. 2007).
Note-taking skills: Student's note taking skills were measured using the following three factors (Nakayama et al. 2014a). They are NT-F1: Recognition of functions of note taking, NT-F2: Methodology of utilising notes, and NT-F3: Presentation of notes.

2.3 Participant's reflections upon learning activity

Participant's emotional factors and impressions of their leaning attitudes during the course were surveyed, using two sets of questionnaires. The first one is a self efficacy metric consisting 9 question items which were developed by Pintrich (1990), as shown in Table 1. The second one is a metric of participants' level of satisfaction regarding their experience during the course, such as the participant's self directed effort. Student's self assessment of the degree of effort, self satisfaction, and study hours are frequently included in course assessments. These types of questions are often used in participant's assessments of courses. Some of them were measured using a 5 point scale, and others were measured using a 10 point scale.

Table 1: Questionnaire items regarding self efficacy

<table>
<thead>
<tr>
<th>Question item</th>
<th>Mean</th>
<th>SD</th>
<th>SEM</th>
</tr>
</thead>
<tbody>
<tr>
<td>I'm certain I can understand this contents taught in this course</td>
<td>3.75</td>
<td>0.67</td>
<td>0.05</td>
</tr>
<tr>
<td>I expect to do very well in this class</td>
<td>3.75</td>
<td>0.70</td>
<td>0.17</td>
</tr>
<tr>
<td>Compared with others in this class, I think I'm a good student</td>
<td>3.28</td>
<td>0.74</td>
<td>0.14</td>
</tr>
<tr>
<td>I think I'm not good enough in this class</td>
<td>3.28</td>
<td>0.70</td>
<td>0.21</td>
</tr>
<tr>
<td>If I were to assign grades, I would give high marks to this class</td>
<td>3.60</td>
<td>0.51</td>
<td>0.19</td>
</tr>
<tr>
<td>I am sure I can do well on the problems tested assigned for this class</td>
<td>2.85</td>
<td>0.27</td>
<td>0.27</td>
</tr>
<tr>
<td>Compared with other students in this class I think I know a great deal about the subject</td>
<td>3.28</td>
<td>0.70</td>
<td>0.21</td>
</tr>
<tr>
<td>My study skills are excellent compared with others in this class</td>
<td>3.18</td>
<td>0.45</td>
<td>0.23</td>
</tr>
<tr>
<td>I know that I will be able to earn the material work</td>
<td>3.38</td>
<td>0.13</td>
<td>0.07</td>
</tr>
</tbody>
</table>

2.4 Lexical comparison of lecturer's presentations and student's notes

The contents of participant's notes were read and recorded manually, as computer readable text. The lecturer's hand-written notes to be presented to participants during face-to-face sessions were also transformed into computer readable text. Notes of both the participants and the lecturer were lexically analysed using the Japanese morphological term analysis tool MeCab. Nouns were extracted from the texts of the notes. From these, term-session matrices, such as frequency of nouns across sessions, were generated. The term frequencies in the contents of notes of both the lecturer and the participants were evaluated as follows (Nakayama et al., 2014a, 2016).

- Word ratio: the ratio between the number of terms written and the number of terms given (the number of terms participants recorded vs. the number of terms the lecturer presented).
- Coverage: the coverage ratio was calculated as a percentage of the number of terms recorded by participants.

To extract the semantic structures in the contents of note taken, a social network analytical technique was used on the texts of notes (Jin, 2009; Rabbany et al. 2011). In comparing the contents of the lecturer's presentations with the student's notes, co-occurring nouns were analysed using a previously reported methodology (Nakayama et al., 2014a, 2016). Term co-occurrence shows the structure of the conceptual meanings using a lexical representation of the term connection patterns. Noun transitions in the notes were extracted from phrases, such as A-B and B-C extracted from the text A-B-C. The relationship between the two terms, known as 2-gram nouns, is summarised using an adjacency matrix. An example of the lecturer's presentation in Session 13 is shown in Figure 1. The matrix of the participants should coincide precisely with the lecturer’s matrix when all contents have been transferred to the participants. The adjacency matrix can be illustrated as a networked graph, such as a conceptual map (Novak, 2008; Rabbany et al. 2011). The difference between the two maps shows the distinctness in processing information between the lecturer and the participants. Therefore, the differences indicate the degree of transformation of the lecturer's contents. The differences between the two matrices can be calculated as a distance measure. The distance between the lecturer's presentations and student's notes is defined using two metrics, as follows:
Additional Distance means the sum of the number of additional nodes or edges in a matrix. Insufficient Distance means the sum of the number of reduced nodes or edges in a participant’s matrix, in comparison with the lecturer’s matrix.

Both distances are influenced by the total number of terms in the lecturer’s presentation, so that the relative distances are calculated using the number of terms the lecturer presented in each session.

As a result, note-taking activity was evaluated using four indices of note-taking, then overall averages across all sessions and partial averages for the first and the second halves of sessions were calculated, respectively.

![Example of adjacency matrix (Left) and the relationship between two adjacency matrices (Right)](image)

### 2.5 Causal relationships analysis across the indices

The relationships among the indices mentioned in the above sections were examined using a structural equation modelling technique (SEM). The possible causal relationships and the parameters of the models were estimated using structural equation modelling software (AMOS) (Toyoda 2007), and the validity of the models was tested using indices of the fitness of the model (the GFI: Goodness of Fitting index).

### 3 Results

#### 3.1 Responses of participant’s self reflection

The means of participant’s responses for the two sets of questionnaires are summarised in two tables. Table 1 represents self efficacy and Table 2 represents their own reflections during the course.

All means for questions concerning self efficacy inventories are above the middle value of a 5 point scale, indicating that participants have responded positively. As these means are at the same levels, the latent factors are extracted using factor analysis with Promax rotation. The factor loading values for the two factor structures are also summarised in Table 1. As the table shows, the first factor contributes over 30% of the total. Therefore, regarding the contents of the question items, the label for the first factor (SE-1) is “self confidence in student’s own attitude”, and the label for the second factor (SE-2) is “self confidence in student’s own level of competence”. The mean scores for the two factors are displayed in Table 2, where the score of the first factor (SE-1) is higher than the score of the second factor (SE-2), while their correlation coefficient is small (r=0.13). The participants have confidence in their own attitudes rather than in their levels of competence.

The levels for self evaluative responses are also relatively high, as shown in Table 2. These results suggest that most students participate sincerely, and they satisfy the requirements of the course. The exception is participant’s “learning hours”, a question regarding their own learning opportunities outside of the classroom. This point is often noted by researchers of higher education (Kaneko, 2009).

The responses mentioned in the two tables correlate with each other, and these responses may also be related to the student’s characteristics which were mentioned in the above sections.
Table 2: Question items and means for self evaluation

<table>
<thead>
<tr>
<th>Label</th>
<th>Question Items</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>SL-1</td>
<td>Percent: self confident in student's own attitude</td>
<td>3.40</td>
</tr>
<tr>
<td>SL-2</td>
<td>Percent: self confident in student's own level of competence</td>
<td>2.87</td>
</tr>
<tr>
<td>1</td>
<td>Syllabus reading</td>
<td>3.66</td>
</tr>
<tr>
<td>2</td>
<td>Out-of-class study</td>
<td>2.83</td>
</tr>
<tr>
<td>7</td>
<td>Learning hours</td>
<td>2.38</td>
</tr>
<tr>
<td>3</td>
<td>Self directed effort</td>
<td>7.26</td>
</tr>
<tr>
<td>4</td>
<td>Self understanding</td>
<td>6.60</td>
</tr>
<tr>
<td>5</td>
<td>Self achievement</td>
<td>6.53</td>
</tr>
<tr>
<td>6</td>
<td>Self satisfaction</td>
<td>7.80</td>
</tr>
</tbody>
</table>

3.2 Causal relationships across the indices

3.2.1 Learning activity outside the classroom

In regards to the above discussion, learning hours and frequency of study outside the classroom should be measured, in order to evaluate student's self directed learning activity. A possible causal relationship is displayed in Figure 2. Significant path coefficients are indicated using bold characters, and non-significant values are represented by ( ).

Figure 2: Relationships between some student's characteristics and learning opportunity outside the classroom

Some student's characteristics, such as information literacy (IL-1 and IL-2), learning strategy (LE-F3), and some self evaluation inventories were selected. Since the subject of this course concerns information systems, the information literacy of operational skills (IL-1) affects the extent of syllabus reading, while student's learning strategy experience affects the degree of self directed effort. Both contribute to student's level of attention towards learning outside the classroom, which is shown in Figure 2 as causal paths. This confirms the importance of both lecture syllabi, and the degree of effort students make, as reflected in their number of hours of study.

3.2.2 Relationship between self efficacy and reflections

In the previous section, two types of metrics were introduced to evaluate participant's emotional factors, such as self efficacy and reflections. The means are summarised in Table 2.

As mentioned in Figure 2, information literacy affects participant's attitude, thus it has also been employed in this analysis. The contribution of information literacy and the relationships between self efficacy and reflections are summarised in Figure 3, using a path diagram. Though some path coefficients are not significant, the goodness of fit index (GFI) of the structure of this model is significant (GFI=0.87).
The factor of information literacy (IL-1) affects the factor of self efficacy, such as confidence in one's own attitude (SE-F1) and self directed effort. Both self efficacy (SE-F1) and self directed effort significantly affect self satisfaction, while self directed effort also affects student's own impression of their level of self understanding and indirectly affects self achievement. This causal path suggests that participant's confidence in their attitude and self directed effort have an effect on their self evaluation, such as the level of satisfaction, and the degree of understanding of the course contents.

3.2.3 Contribution of note-taking skills and learning experience

As mentioned in the Introduction section, note taking activity may have some effect on participant's emotional factors. As factors of student's learning experience have contributed to learning activity outside of the classroom, some additional factors may also affect their self evaluations. To validate the hypothesis, factors for note taking skills and factors for learning experience were mapped in Figure 3 using causal paths. The contribution of note taking skills was confirmed, as Figure 4 shows. Though possible paths which concern note taking skills have been indicated, most are not significant.

Additionally, factors for learning experience were introduced into the causal path diagram, as shown in Figure 5. Though some of the factors, such as LE-F1 (e-Learning experience) and LE-F3 (Learning strategies) significantly influence participant's self evaluation, the GFI of this model is not significant (GFI=0.79, AGFI=0.64, RMSEA=0.10).
Therefore, the contribution of participant's learning activities, such as note taking skills and student's learning experience towards their own self-assessment was not confirmed. To verify the hypothesis, a more detailed analysis was employed, such as making changes to participant's activities as the course progressed, and in the metrics of the contents of notes taken.

### 3.3 Note taking activity

Four types of indices for note taking activity were measured, using both the lecturer's presentations and student's notes from each classroom session across the 14 weeks of the course. As the number of terms depends on the contents of the lecturer's presentation, word rates and distances are normalised using the lecturer's metrics. In order to consider student's experience, the metrics between the first and second halves of the course were compared, such as the means of the first 7 sessions and the means of the second 7 sessions.

![Figure 6: Mean metrics of note-taking activity across the course 1st and 2nd halves](image)

Mean ratios are summarised in Figure 6, which compares these two ratios. Though word rates in the second half decreased in comparison with sessions in the first half, both means of lengths for sessions in the second half are higher than for means in the first half. There are significant differences in word ratios, and there are insufficient distances and additional distances (p<0.05) between the 1st and 2nd halves of the course as well. These results suggest that during the course, as students gradually take notes which use their own terminologies instead of those presented by the lecturer, the overall number of words decreases. Note-taking activity is based on student's note-taking skills. The factor scores for note-taking skills between the two halves of the course were compared, and the ratios summarised in Figure 7. As all three factor scores increased
during the sessions in the second half, these skills may have been sharpened by the lecturer’s instructions regarding note-taking techniques.

![Chart showing mean factor scores of note-taking skills in the two surveys](chart)

**Figure 7:** Mean factor scores of note-taking skills in the two surveys

**Table 3:** Correlation coefficients between differences in note-taking metrics and factor scores

<table>
<thead>
<tr>
<th></th>
<th>d-WR</th>
<th>d-CV</th>
<th>d-ID</th>
<th>d-AD</th>
</tr>
</thead>
<tbody>
<tr>
<td>d-NT_F1</td>
<td>0.04</td>
<td>-0.09</td>
<td>0.18</td>
<td>-0.12</td>
</tr>
<tr>
<td>d-NT_F2</td>
<td>0.58</td>
<td>0.22</td>
<td>0.03</td>
<td>0.42</td>
</tr>
<tr>
<td>d-NT_F3</td>
<td>0.39</td>
<td>0.09</td>
<td>0.12</td>
<td>0.32</td>
</tr>
</tbody>
</table>

Correlation coefficients were calculated between the differences in note metrics and the differences in factor scores of note-taking skills. These coefficients are summarised in Table 3. Both differences between F2: Methodology of utilising notes and F3: Presentation of notes correlate with the differences in word rates. The enhancement of these note-taking skills improves the number of words written down. Therefore, note-taking skill instructions affect metrics of note-taking activities.

### 3.4 Relationship between note-taking activities and student’s self reflection

As mentioned in the Introduction section, it is hypothesised that note-taking activity may affect student’s emotional aspects, such as self reflection. Though the effectiveness of student’s characteristics on improving self evaluation was tested in the above section, the significance of the contribution was not determined using causal relationship analyses.

Therefore, metrics for note taking activities are introduced instead of student’s characteristics, since these reflect student’s learning activity during the course.

The causal relationship illustrated in Figure 8 indicates paths to student’s self evaluations using the distances between student’s notes and the lecturer’s presentations. The GFI is sufficient to permit acceptance of this model. Both distances affect the two metrics of notes, namely word ratio and content coverage, in a conventional manner. Also, the additional distance impacts the degree of self satisfaction. Most metrics for note-taking affect self evaluations positively. However, the coverage for note-taking negatively influences the evaluation, as it means restricting student’s own written self evaluations. Regarding this relationship, note-taking activity contributes to student’s self evaluations regarding understanding and satisfaction in the course, for example. The causal relationships between the 1st and 2nd halves were compared using the metrics. Though a modified model can be produced for sessions in the 1st half, the model is not significant for the sessions in the 2nd half. The student’s process of improvement should be tracked in order to consider changes which might improve student’s self evaluations. Therefore, the gathering of additional data during further surveys will be required in order to determine the validity of students’ self evaluations in the second half of the course.
Discussion

Student’s emotions, such as motivation and self efficacy are a key factor in the promotion of learning and understanding (Miyamoto and Nasu, 1995). In particular, the factor of self efficacy contributes their learning activity (Pintrich and Goot, 1990). To understand the details of the concept of self efficacy, participant’s responses were analysed using factor analysis, and two factors were extracted from a survey of student’s self efficacy, namely self confidence in one’s own attitude and one’s own level of competence at the beginning of a course. The mean scores of the two self efficacy factors and the reflection indices represent student’s evaluation of their learning in the survey course. Since most scores were over the median of the scale, the course format was encouraging to most participants, and they enjoyed taking the course.

The causal relationships between these emotional factors and student’s characteristics, which were surveyed in order to understand their learning activity and their behaviours, were examined. The insufficiency of student’s outside-of-the-classroom learning activity in comparison with the lecturer’s expectations, in the context of conventional learning environments, has been widely discussed. Unfortunately, the existence of the same phenomenon in this blended learning course was confirmed, even though the course has employed various procedures, such as taking online tests, to encourage participants to do more outside of the classroom. In a causal analysis, the number of hours students spent studying, which is an indicator of self directed learning, is explained by the extent of their syllabus reading and by some of the student’s characteristics. This result may suggest that, during course design, assistance for students which considers their characteristics is required. Also, factors of information literacy contribute to both aspects of self efficacy and self evaluation.

In order to determine student’s learning activity during the course, the contents of their notes were analysed, and those contributions were examined. During the course, student's recognition of the need for better note taking skills improved, resulting in increases in the factor scores in the two surveys. The instructions regarding note-taking techniques may encourage most participants to take better notes. The results of correlation analysis of factor score differences between note-taking skills and indices of note-taking activity reveal that participants understanding of note-taking skills improved the contents of their notes. The results of causal analysis, which consisted of four indices of notes taken and student’s self reflections, show some significant causal relationships. For example, “additional distance” positively affects “self satisfaction”, while “word rate” positively affects “learning hours”. Regarding these relationships, encouragement of note-taking during a course may be a positive influence on participant’s self reflection. However, a more detailed analysis is required before any generalisations can be made. This analysis will be a subject of our further study.

Conclusion

The relationships between participant’s own reflections and note-taking activities during a blended learning course were analysed, to examine the effectiveness of both learning performance improvements and note
taking activity upon emotional factors related to learning. Towards this aim, various metrics of student’s characteristics and the contents of notes they took were examined.

Regarding the purposes of this paper, the results are summarised as follows:

- Participant’s self assessments and reflections during a blended learning course were measured and evaluated. Most responses were positive, with the exception of the results for learning hours outside of class.
- The relationship between student's self efficacy and student's characteristics was causally analysed. Regarding the relationship, it was confirmed that the level of information literacy and student’s learning experience contributed to factors of student’s reflection.
- Note-taking activities were evaluated using four metrics, such as word ratio, coverage, additional distance and insufficient distance. The activities were quantitatively assessed during the course. The relationships between these evaluations and student’s own evaluations were analysed.
- Using causal analysis, the relationships between the measurements of participant’s self assessments and the metrics of note-taking activity were examined. In this analysis, the note-taking activities were shown to have been influenced by student’s reflections.

The results indicate that note-taking activities significantly affect the level of self-assessment that is based on these reflections. In addition to this modelling, the study of learning behaviour is also discussed in order to improve learning performance.

Acknowledgements

This research was partially supported by the Japan Society for the Promotion of Science (JSPS), Grant-in-Aid for Scientific Research (KAKEN, B-26282046: 2014-2016).

Part of this study was presented at IEETel 2015 and ECEL 2015. The authors would like to thank those who provided useful comments regarding both of these papers and presentations.

References


Digital Literacy: A Prerequisite for Effective Learning in a Blended Learning Environment?

Chun Meng Tang¹ and Lee Yen Chaw²
¹James Cook University, Singapore Campus, Singapore
²UCSI University, Kuala Lumpur, Malaysia
chunmeng.tang@jcu.edu.au
chawly@ucsiuniversity.edu.my

Abstract: Blended learning has propelled into mainstream education in recent years with the help of digital technology. Commonly available digital devices and the Internet have made access to learning resources such as learning management systems, online libraries, digital media, etc. convenient and flexible for both lecturers and students. Beyond the physical classroom walls, learning can still continue at another place and time. However, although today’s students generally face no difficulties in using technology for everyday social and entertainment activities, it would be constructive to understand if the students can make effective use of technology for learning as well. It has been posited that to make effective use of technology for learning, one needs to have a certain level of digital literacy. Digital literacy for learning is more than just knowing how to operate the technology, but also having the right information management and critical thinking skills, as well as proper online behaviours. This study aims to answer the question: Do students require digital literacy to be effective in learning in a blended learning environment? To answer this question, this study examined the relationships between effective learning and four digital literacy constructs; i.e. underpinnings, background knowledge, central competencies, and attitudes and perspectives. Responses were first collected from the students who were taking courses in a blended learning environment at a local university and then analysed using partial least squares. Analyses show that the four digital literacy constructs could be reduced to three, and the three digital literacy constructs each had a statistically significant relationship with the effective learning construct. This study provides evidence that digital literacy is a prerequisite for students to be effective in learning in a blended learning environment.

Keywords: blended learning, digital literacy, effective learning, higher education, online learning, partial least squares

1 Introduction

Digital technology has become an integrated part of education (Benson and Kolsaker, 2015) and is changing the ways today’s students learn (Coccoli et al., 2014). Digital technology includes a wide range of computing hardware and software, e.g. mobile devices, web tools, application software, communications and storage services, etc. (Mohammadyari and Singh, 2015; Ng, 2012). Students use digital technology for such learning activities as reading and sending email, accessing learning management systems, reading e-journals or e-books, doing online quizzes, participating in discussion forums, and so on (Jones et al., 2010; Waycott et al., 2010).

Educational institutions are taking advantage of advances in digital technology to engage their students with various teaching and learning modes. One such mode is blended learning (Porter et al., 2014) which integrates technologies into the learning delivery process, and hopefully overcomes some limitations of face-to-face classroom learning (Akkoynulu and Yilmaz-Soylu, 2008). Blended learning allows students to learn anytime, anywhere, and in the way they want to. Complementing face-to-face classroom teaching with online learning (Coccoli et al., 2014), blended learning has become popular among educational institutions.

However, Joy and Garcia (2000) caution educators against assuming that students would learn better from technology-based learning delivery systems. Although students use technology in their everyday activities, they might not necessarily be familiar with or use technology for learning (Waycott et al., 2010). Students might use technology more for social or entertainment purposes but not for learning (Prior et al., 2016). Gurung and Rutledge (2014) share the view that digital learners need help on how to use technology effectively for learning. Ng (2012) contends that students might not know how to use technology for learning. Already possessing certain level of digital literacy, however, they should be able to learn to use technology for learning easily.
People who have multiple literacies to use digital technology efficiently and effectively are deemed to be digitally literate (Mohammadyari and Singh, 2015). As digital technology plays a key role in blended learning, it is expected that students need a certain level of digital literacy for them to learn effectively (Eshet, 2004). Hence, it is essential for educators to ask the question: Do students require digital literacy to be effective in learning in a blended learning environment? This study aims to answer this question.

The following sections provide an overview of blended learning, review the concept of digital literacy and its components, explain the measurement of effective learning, describe the research design and method, present the data analyses and results, and conclude the paper.

2 Research background

2.1 Blended learning

A learning delivery approach which blends face-to-face classroom learning and online learning, blended learning provides such flexibility as anytime and anywhere access to learning management systems (LMS). An LMS provides an online delivery platform for lecturers and students to share learning resources, equipping them with useful system tools and functions (Glogowska et al., 2011; De Smet et al., 2012). Blended learning promotes independent learning and online cooperation, and yet retains some face-to-face classroom teaching (Deschacht and Goeman, 2015). The basic premise is to complement face-to-face classroom learning by giving students the learning flexibility as enabled by digital technology.

Given limited classroom space and increasing student number, blended learning seems to be a feasible solution (Garrison and Vaqaha, 2013) which meets the needs of students, educators, and universities (Moskal, Dziuban and Hartman, 2013). Blended learning brings some benefits, e.g. higher classroom efficiency, greater teaching flexibility, more convenience for students, and better learning engagement (Owston, York and Murtha, 2013). Deschacht and Goeman (2015) analysed two groups of first-year university students to understand if blended learning had an effect on their academic performance. Both groups took the same courses and exams, but the course delivery mode was different. One group followed the blended learning approach and the other, face-to-face classroom learning. The findings showed that blended learning improved academic performance.

However, adopting blended learning does not necessarily improve the student learning experience (Cortizo et al., 2010). Benson and Kolsaker (2015) contend that technology is only one part of blended learning, and more understanding is still needed about its pedagogical benefits. In addition, the digital environment that students are in today could have caused them to develop different learning attitudes and styles (Coccoli et al., 2014). Jones et al. (2010) collected data from some 500 first-year students at five UK universities to study their use of technology for social and learning activities. Students born after 1983 were compared to those born before 1983. The findings showed that there were differences in terms of the use of technology among the students, not just between the groups but within the groups as well. Margaryan, Littlejohn and Vojt (2011) surveyed 160 third-year university students to understand what digital technologies the students used and how they used them. They compared students born in or after 1980 with those born before 1980. The findings showed that those born in or after 1980 were not more advanced in their use of digital technologies nor did they have very different learning styles from those born before 1980.

Kember et al. (2010) find that blended learning is not just about using LMS as an online repository of learning materials. Instead, educators should incorporate learning activities that engage students to foster active learning. Coccoli et al. (2014) explain that knowing technology alone is not enough for success in learning; equally important is that one needs to have the right competencies and attitudes. A study by Owston, York and Murtha (2013), which analysed how student perceptions of blended learning could have affected their course grade, showed that compared to low-achieving students, high-achieving students were more satisfied with their blended learning courses, claiming that these courses were more convenient, more engaging, and they learned better. Low-achieving students might find blended learning courses challenging if they lack independent study skills or if the difficulty level of the subject matter is high.
Blended learning can have different configurations of face-to-face classroom learning and online learning in different learning contexts (Garrison and Kanuka, 2004) and a good integration is always a challenge (McKenzie et al., 2013). Staker and Horn (2012) identifies four blended learning models for primary and secondary education: Rotation, Flex, Self-Blend, and Enriched-Virtual. D2L (2014), a company that specialises in developing integrated learning platforms, proposes five blended learning models: Face-to-Face Driver, Rotation, Flex, Online Lab, and Online Driver. Moskal, Dziuban and Hartman (2013) suggest that there is no one best blended learning model. Instead, there are a set of critical success factors, such as institutional goals and objectives; alignment between goals of administrators and faculty members; organisational capacity; faculty development and course development support; support for online students and faculty; robust and reliable infrastructure; longitudinal data collection and assessment; policy development; and funding model.

2.2 Digital literacy

Today’s students are familiar with digital technology and generally know how to access, create, and share digital information (Ting, 2015). Greene, Yu and Copeland (2014) suppose that to be digitally literate, one not only needs to be able to search and manage, but also to scrutinise and integrate digital information. Although today’s students are generally considered tech-savvy, many of them find it difficult to do so effectively. They conclude that students need to acquire planning, monitoring, and controlling skills in relation to information management, as well as critical thinking skills. Gilster (1997) supports the notion that to be digitally literate, one does not just know how to find information from the web, but also has the ability to understand and assemble information from different print or digital sources. Digital literacy involves the mastery of ideas, and is not just about using the technology itself.

The European Framework for Digital Literacy (EFDL), an outcome of the DigEuLit project and initiated to recognise the importance of digital literacy, defines digital literacy as follows:

*Digital literacy is the awareness, attitude and ability of individuals to appropriately use digital tools and facilities to identify, access, manage, integrate, evaluate, analyse and synthesise digital resources, construct new knowledge, create media expressions, and communicate with others, in the context of specific life situations, in order to enable constructive social action; and to reflect upon this process.* (Martin, 2006, p.155)

Jisc (2014) emphasises that digital literacy is context-dependent and suggests a seven-element digital literacy model: media literacy, information literacy, digital scholarship, learning skills, communications and collaboration, career and identify management, and ICT literacy. Ng (2012) explains that digital literacy comprises three key dimensions: technical, cognitive, and social-emotional. The technical dimension concerns the skills needed to use IT proficiently. The cognitive dimension concerns the skills needed to search, evaluate, and synthesise digital information critically, and at the same time, to be conscious of any ethical, moral, and legal issues. The social-emotional dimension concerns the skills needed to socialise online in a proper manner.

Bawden (2008) explains that the concept of digital literacy is very broad and can include very specific skills and competencies to general awareness and perspectives. He distinguishes four components of digital literacy: (1) underpinnings - the ability to read and write as well as to use software packages and computers; (2) background knowledge - an understanding of how digital and non-digital information is created from various forms of resources and communicated; (3) central competencies - the ability to assemble knowledge from multiple sources; and (4) attitudes and perspectives - the ability to learn independently as well as to exhibit good behaviour in a digital environment.

Digital literacy needs to be renewed as digital technology evolves over time. It can be classified into three levels (Martin, 2006): (1) digital competence - digital know-how; (2) digital usage - applications of digital competence; and (3) digital transformation - creation of new knowledge as a result of digital usage. Prior et al. (2016) observe that students can exhibit different levels of digital literacy. Thus, assuming that all students have the same level or a certain level of digital literacy can lead to a problem in online learning – What the students are capable of doing might be different from the expectations of teachers.
2.3 Effective learning

To assess how effective learning is as a result of adopting blended learning, the revised Bloom's taxonomy provides some good pointers. Commonly used as a reference framework when designing learning activities, objectives, and outcomes (Bloom et al., 2013), the original Bloom’s taxonomy was first published in 1956 (Bloom et al., 1956). As a cognitive taxonomy, Bloom’s taxonomy categorises learning outcomes, from the lowest to the highest, into six levels: knowledge, comprehension, application, analysis, synthesis, and evaluation (Tyran, 2010). The taxonomy was revised in 2001 with changes to its category names: remembering, understanding, applying, analysing, evaluating, and creating (Krathwohl, 2002).

2.4 Research model

Using the four digital literacy constructs; i.e. underpinnings, background knowledge, central competencies, and attitudes and perspectives, as conceptualised by Bawden (2008) and the revised Bloom’s taxonomy as a point of departure, this study proposed a research model (Figure 1). Another of our study adopted Jisc’s digital literacy model; this study included only Bawden’s digital literacy components.

![Research model diagram]

Figure 1: Research model

3 Research method

3.1 Construct operationalisation

To develop a scale for a construct, the construct must first be conceptualised theoretically (Segars, 1997). Following that, a group of scale items can then be developed based on the conceptual domain of the construct (MacKenzie et al., 2005). After a review of past literature and a questionnaire pretest, this study developed a 5-item scale for each of the four digital literacy constructs and a 6-item scale for the effective learning construct.

3.2 Data collection

An online questionnaire was used to collect data from the students of a university that had adopted blended learning. An invitation, with a link to the questionnaire, for the students to fill in the questionnaire was made on the LMS commonly accessed by them. The questionnaire consisted of four sections. Section A asked two questions about learning delivery. Section B consisted of two questions. One question was about the four digital literacy constructs (a total of 20 scale items, coded as D1 to D20, in random order) and the other the effective learning construct. All items were measured using a 5-point Likert-type scale, 5 being “strongly agree” and 1 being “strongly disagree.” Section C asked four questions about usage of LMS. Section D asked two demographic questions. A total of 176 respondents provided the responses. 15 responses were removed as outliers in subsequent analyses. Thus, there were only 161 valid responses. Of the 161 respondents, 87 were male students (54%) and 74 female (46%).
4 Data analysis and results

4.1 Learning delivery and LMS usage

Table 1 provides a summary of the respondents’ preference for different learning delivery modes. In order of preference (“prefer” and “strongly prefer”), a higher percentage of the respondents preferred classroom learning (74.5%), as compared to blended learning (64%) or online learning (63.9%).

Table 1: Preference for individual learning delivery modes

<table>
<thead>
<tr>
<th>Learning Delivery Mode</th>
<th>Classroom learning</th>
<th>Online learning</th>
<th>Blended learning</th>
</tr>
</thead>
<tbody>
<tr>
<td>N %</td>
<td>N %</td>
<td>N %</td>
<td>N %</td>
</tr>
<tr>
<td>Strongly not prefer</td>
<td>2 1.2</td>
<td>2 1.2</td>
<td>0 0.0</td>
</tr>
<tr>
<td>Not prefer</td>
<td>2 1.2</td>
<td>12 7.5</td>
<td>8 5.0</td>
</tr>
<tr>
<td>Maybe</td>
<td>37 23.0</td>
<td>44 27.3</td>
<td>50 31.1</td>
</tr>
<tr>
<td>Prefer</td>
<td>72 44.7</td>
<td>82 50.9</td>
<td>60 37.3</td>
</tr>
<tr>
<td>Strongly prefer</td>
<td>48 29.8</td>
<td>21 13.0</td>
<td>43 26.7</td>
</tr>
<tr>
<td>Total</td>
<td>161 100.0</td>
<td>161 100.0</td>
<td>161 100.0</td>
</tr>
</tbody>
</table>

Table 2 provides a summary of what the respondents thought about the effectiveness of different learning activities or resources. In order of effectiveness (“effective” and “very effective”), a higher percentage of the respondents thought that face-to-face meetings (82%) were more effective than online interactions (45.9%); and online resources (70.2%) were more effective than physical resources (63.4%).

Table 2: Effectiveness of delivery methods

<table>
<thead>
<tr>
<th>Delivery Method</th>
<th>Face-to-face meetings (e.g. in-class lecture, consultation with lecturer, group discussion)</th>
<th>Online interaction (e.g. blog, forum, chat, email)</th>
<th>Physical resources (e.g. print book, school library)</th>
<th>Online resources (e.g. e-book, digital database, audio or video webcast)</th>
</tr>
</thead>
<tbody>
<tr>
<td>N %</td>
<td>N %</td>
<td>N %</td>
<td>N %</td>
<td>N %</td>
</tr>
<tr>
<td>Not very effective</td>
<td>2 1.2</td>
<td>3 1.9</td>
<td>2 1.2</td>
<td>0 0.0</td>
</tr>
<tr>
<td>Not effective</td>
<td>1 0.6</td>
<td>15 9.3</td>
<td>14 8.7</td>
<td>9 5.6</td>
</tr>
<tr>
<td>Maybe</td>
<td>26 16.1</td>
<td>69 42.9</td>
<td>43 26.7</td>
<td>39 24.2</td>
</tr>
<tr>
<td>Effective</td>
<td>67 41.6</td>
<td>63 39.1</td>
<td>80 49.7</td>
<td>83 51.6</td>
</tr>
<tr>
<td>Very effective</td>
<td>65 40.4</td>
<td>11 6.8</td>
<td>22 13.7</td>
<td>30 18.6</td>
</tr>
<tr>
<td>Total</td>
<td>161 100.0</td>
<td>161 100.0</td>
<td>161 100.0</td>
<td>161 100.0</td>
</tr>
</tbody>
</table>

Table 3 provides a summary of the features the respondents liked the most about LMS (they could choose more than one feature). In order of frequency, the three largest percentages were online resources (78.5%), online course announcements (52.1%), and online assignment submission (47.9%).

Table 3: LMS features

<table>
<thead>
<tr>
<th>LMS features</th>
<th>N %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Online resources (e.g. lecture notes, PowerPoint slides, tutorial questions)</td>
<td>128 78.5</td>
</tr>
<tr>
<td>Online course announcements</td>
<td>85 52.1</td>
</tr>
<tr>
<td>Online assignment submission</td>
<td>78 47.9</td>
</tr>
<tr>
<td>Online assessment (e.g. quiz)</td>
<td>73 44.8</td>
</tr>
<tr>
<td>Online grade centre</td>
<td>59 36.2</td>
</tr>
<tr>
<td>Online discussion (e.g. blog, forum, chat)</td>
<td>34 20.9</td>
</tr>
</tbody>
</table>

Table 4 provides a summary of the usage of LMS.

www.ejel.org 58 ©ACPIL
Table 4: Usage of LMS

<table>
<thead>
<tr>
<th>Demographic information</th>
<th>N</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Semesters using the LMS</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 semester</td>
<td>50</td>
<td>31.1</td>
</tr>
<tr>
<td>2 semesters</td>
<td>69</td>
<td>42.9</td>
</tr>
<tr>
<td>3 semesters</td>
<td>28</td>
<td>17.4</td>
</tr>
<tr>
<td>4 semesters</td>
<td>5</td>
<td>3.1</td>
</tr>
<tr>
<td>5 semesters</td>
<td>2</td>
<td>1.2</td>
</tr>
<tr>
<td>More than 5 semesters</td>
<td>7</td>
<td>4.3</td>
</tr>
<tr>
<td>Hours using the LMS per day</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Less than 1 hour</td>
<td>93</td>
<td>57.8</td>
</tr>
<tr>
<td>Between 1 to 2 hours</td>
<td>48</td>
<td>29.8</td>
</tr>
<tr>
<td>Between 2 to 3 hours</td>
<td>16</td>
<td>9.9</td>
</tr>
<tr>
<td>Between 3 to 4 hours</td>
<td>2</td>
<td>1.2</td>
</tr>
<tr>
<td>More than 4 hours</td>
<td>2</td>
<td>1.2</td>
</tr>
<tr>
<td>Primary device accessing the LMS</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Desktop computer</td>
<td>57</td>
<td>35.4</td>
</tr>
<tr>
<td>Notebook</td>
<td>45</td>
<td>28.0</td>
</tr>
<tr>
<td>Smartphone</td>
<td>47</td>
<td>29.2</td>
</tr>
<tr>
<td>Tablet</td>
<td>12</td>
<td>7.5</td>
</tr>
</tbody>
</table>

4.2 Exploratory factor analysis

An exploratory factor analysis (EFA) is necessary to examine dimensionality of a scale before a confirmatory factor analysis (CFA) (Gerbing and Anderson, 1988). The analysis attempts to examine loadings of individual scale items across factors, identifying scale items that load strongly on a particular factor (Gefen and Straub, 2005). In this study, a factor analysis assessed the four digital literacy constructs using the principal axis factoring extraction method. A separate factor analysis assessed the effective learning construct. Straub, Boudreau and Gefen (2004) advise against mixing independent and dependent constructs in EFA but instead, suggest examining the constructs separately. Assuming that there were correlations among the constructs, the Promax rotation method was used (Hair et al., 2005). Before a factor analysis of the four digital literacy constructs, a check for multivariate outliers was performed. Following the rule that a case is considered a multivariate outlier if the probability of its squared Mahalanobis distance is equal or less than 0.001 (Tabachnick and Fidell, 2007), of the 176 cases, 10 cases were removed. KMO (> 0.5) and Barlett’s test (p < 0.05) were checked first for appropriateness for factor analysis (Hair et al., 2005). Both KMO and Barlett’s tests satisfied the criteria. Two criteria were used to decide deletion of scale items: (1) scale items loaded < 0.5 on any one of the factors, or (2) scale items cross-loaded > 0.5 on two or more factors (Hair et al., 2005). Iteration 1 showed scale item D10 cross-loaded on two factors. Thus, it was removed from further analysis. In iteration 2, a simple structure was obtained. Factor scores were then calculated to check for outliers. Those scale items that had a factor score of larger than +/- 3.0 were considered as outliers (Deneshkumar et al., 2014). Of the 166 cases, 5 cases were removed. Thus, the remaining 161 cases were kept for further analysis. Subsequent 7 iterations deleted 7 scale items (D14, D19, D6, D3, D7, D9, and D11) and obtained a simple structure. Table 5 provides a summary of the factors.

EFA revealed that the four digital literacy constructs proposed originally had been reduced to three. While the construct underpinnings retained its original scale items, scale items of the other three digital literacy constructs loaded on just two factors. In relation to knowledge acquisition in organisational learning, Huber (1991) identifies five processes: congenital learning (acquired in the form of prior knowledge); experiential learning (acquired by learning from doing); vicarious learning (acquired by observing others); grafting (acquired by hiring people who know); and searching (acquired by actively searching for information). With reference to the concepts of knowledge acquisition in organisational learning (Huber, 1991) and to better reflect the meaning of the scale items of each, these two newly-identified factors were labelled as experiential learning and searching respectively. In factor analysis, it is common to find the number of constructs originally proposed in a research model to change as a result of factor analysis; that is, the number of constructs may be reduced (Gable, Sedera and Chan, 2003) or added (Cohen, Thiraios and Kandilorou, 2008). After deciding on the number of factors to be retained, it is then necessary to interpret and label the factors based on the meaning of the scale items loaded on the respective factors (Hair et al., 2005).

A factor analysis of the effective learning construct showed a one-factor simple structure (L1 to L6, Eigenvalue = 4.526, % of variance explained = 70.590, Cronbach’s alpha = .935).
Table 5: EFA results

<table>
<thead>
<tr>
<th>Scale item</th>
<th>Mean</th>
<th>SD</th>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>(D17) I am motivated in learning new information both online and offline.</td>
<td>3.84</td>
<td>.821</td>
<td>.803</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(D16) I am comfortable with sharing information with others in discussion.</td>
<td>3.84</td>
<td>.757</td>
<td></td>
<td>.792</td>
<td></td>
</tr>
<tr>
<td>(D18) I can critically evaluate the information that I gather for its usefulness.</td>
<td>3.69</td>
<td>.785</td>
<td></td>
<td></td>
<td>.642</td>
</tr>
<tr>
<td>(D5) I know where to find information from different sources (e.g. school library, online database, web).</td>
<td>3.78</td>
<td>.724</td>
<td></td>
<td></td>
<td>.592</td>
</tr>
<tr>
<td>(D13) I am confident in using application software (e.g. email, office suite, web browser).</td>
<td>3.93</td>
<td>.826</td>
<td></td>
<td></td>
<td>.788</td>
</tr>
<tr>
<td>(D20) I have the skills to use digital technology (e.g. computer, tablet, smartphone) effectively.</td>
<td>3.90</td>
<td>.768</td>
<td></td>
<td></td>
<td>.722</td>
</tr>
<tr>
<td>(D12) I use digital technology (e.g. computer, tablet, smartphone) often both at home and at school.</td>
<td>4.12</td>
<td>.839</td>
<td></td>
<td></td>
<td>.670</td>
</tr>
<tr>
<td>(D8) I am familiar with the web.</td>
<td>3.82</td>
<td>.843</td>
<td></td>
<td></td>
<td>.586</td>
</tr>
<tr>
<td>(D2) I can distinguish the differences between print and online resources.</td>
<td>3.77</td>
<td>.744</td>
<td></td>
<td></td>
<td>.730</td>
</tr>
<tr>
<td>(D1) I know how and where to search for useful information both online and offline.</td>
<td>3.74</td>
<td>.763</td>
<td></td>
<td></td>
<td>.663</td>
</tr>
<tr>
<td>(D4) I am one of the members in the learning community.</td>
<td>3.57</td>
<td>.992</td>
<td></td>
<td></td>
<td>.623</td>
</tr>
<tr>
<td>(D15) I can integrate information that comes from different sources (e.g. school library, online database, web).</td>
<td>3.73</td>
<td>.748</td>
<td></td>
<td></td>
<td>.533</td>
</tr>
<tr>
<td>% of variance explained</td>
<td></td>
<td></td>
<td>45.236</td>
<td>6.595</td>
<td>5.090</td>
</tr>
<tr>
<td>Eigenvalue</td>
<td></td>
<td></td>
<td>5.841</td>
<td>1.228</td>
<td>1.068</td>
</tr>
<tr>
<td>Cronbach’s alpha</td>
<td></td>
<td></td>
<td>.827</td>
<td>.846</td>
<td>.782</td>
</tr>
</tbody>
</table>

4.3 Confirmatory factor analysis

Unlike EFA, in confirmatory factor analysis (CFA), the relationships between a construct and its scale items are prescribed before the statistical analysis (Gefen and Straub, 2005). This study performed a CFA with the partial least squares (PLS) approach. PLS approach aims to examine variances and significance of relationships, and is appropriate for making predictions (Fornell and Bookstein, 1982; Gefen, Straub and Boudreau, 2000). Gerbing and Anderson (1988) propose a two-step modelling approach to PLS analysis. They contend that a two-step approach that examines both the measurement model and structural model makes a complete confirmatory assessment of construct validity. The first step examines the measurement model, and the second step examines both the measurement and structural models simultaneously. Following Gerbing and Anderson (1988), in this study, the measurement model was tested first for internal consistency reliability, convergent validity, and discriminant validity (Dunn, Seaker and Waller, 1994). Next, by estimating the path coefficients and $R^2$, the structural model was examined for the relationships between the exogenous and endogenous constructs (Gerbing and Anderson, 1988). To perform the PLS analysis, this study used the SmartPLS software.

4.3.1 Measurement model

First, the loadings of individual items were examined. Those that did not load more than 0.7 on the intended construct were deleted to establish unidimensionality (Chin, 1998). Scale item D4 of the construct central competencies did not meet the threshold value (0.599). Thus, it was removed from further analyses. After D4 was removed, loadings of all scale items on their intended constructs were above 0.7.

Having established that all scale items had satisfactory loading, subsequent analyses checked for internal consistency reliability, convergent validity, and discriminant validity.

*Internal consistency reliability* - For satisfactory internal consistency reliability, composite reliability of a construct should exceed 0.7 (Chin, 1998, Fornell and Larcker, 1981). As depicted in Table 6, composite reliability of all constructs was above 0.7. Thus, internal consistency reliability of individual constructs was satisfactory.
Table 6: CR, AVE, and construct correlations

<table>
<thead>
<tr>
<th>Constructs</th>
<th>CR</th>
<th>AVE</th>
<th>Experiential learning</th>
<th>Searching</th>
<th>Effective learning</th>
<th>Underpinnings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Experiential learning</td>
<td>0.885</td>
<td>0.658</td>
<td>0.811</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Searching</td>
<td>0.883</td>
<td>0.716</td>
<td>0.643</td>
<td>0.846</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Effective learning</td>
<td>0.948</td>
<td>0.754</td>
<td>0.688</td>
<td>0.657</td>
<td>0.868</td>
<td></td>
</tr>
<tr>
<td>Underpinnings</td>
<td>0.897</td>
<td>0.685</td>
<td>0.592</td>
<td>0.642</td>
<td>0.572</td>
<td>0.828</td>
</tr>
</tbody>
</table>

Note: CR: composite reliability; AVE: average variance extracted; square roots of average variances extracted (AVE) are shown on diagonal; correlations between constructs are shown on off-diagonal.

Convergent validity - For satisfactory convergent validity, three criteria should be met: (1) composite reliability of a construct should exceed 0.7 (Chin, 1998; Fornell and Larcker, 1981); (2) average variance extracted (AVE) of a construct should exceed 0.5 (Chin, 1998; Fornell and Larcker, 1981); and (3) loading of scale items should exceed 0.7 on the intended construct (Barclay, Higgins and Thompson, 1995; Chin, 1998). When AVE is more than 0.5, the variance of individual constructs is larger than that contributed by the measurement error (Segars, 1997). As depicted in Table 6, composite reliability of all constructs was above 0.7. In addition, AVEs of all constructs were above 0.5. As depicted in Table 7, loadings of all scale items on the intended constructs were above 0.7. Thus, it was evident that all constructs had satisfactory convergent validity.

Table 7: Factor loadings and cross loadings

<table>
<thead>
<tr>
<th>Scale items</th>
<th>Experiential learning</th>
<th>Searching</th>
<th>Effective learning</th>
<th>Underpinnings</th>
</tr>
</thead>
<tbody>
<tr>
<td>(05) I know where to find information from different sources (e.g. school library, online database, web).</td>
<td>0.758</td>
<td>0.558</td>
<td>0.504</td>
<td>0.418</td>
</tr>
<tr>
<td>(06) I am comfortable with sharing information with others in discussion.</td>
<td>0.828</td>
<td>0.537</td>
<td>0.541</td>
<td>0.480</td>
</tr>
<tr>
<td>(07) I am motivated in learning new information both online and offline.</td>
<td>0.813</td>
<td>0.423</td>
<td>0.514</td>
<td>0.434</td>
</tr>
<tr>
<td>(08) I can critically evaluate the information that I gather for its usefulness.</td>
<td>0.843</td>
<td>0.561</td>
<td>0.653</td>
<td>0.569</td>
</tr>
<tr>
<td>(09) I can distinguish the differences between print and online resources.</td>
<td>0.415</td>
<td>0.777</td>
<td>0.449</td>
<td>0.512</td>
</tr>
<tr>
<td>(10) I can integrate information that comes from different sources (e.g. school library, online database, web).</td>
<td>0.572</td>
<td>0.879</td>
<td>0.635</td>
<td>0.600</td>
</tr>
<tr>
<td>(11) I know how and where to search for useful information both online and offline.</td>
<td>0.624</td>
<td>0.879</td>
<td>0.562</td>
<td>0.512</td>
</tr>
<tr>
<td>(12) I am able to recall the material that I have learned.</td>
<td>0.570</td>
<td>0.532</td>
<td>0.874</td>
<td>0.419</td>
</tr>
<tr>
<td>(13) I am able to explain the material that I have learned.</td>
<td>0.557</td>
<td>0.588</td>
<td>0.878</td>
<td>0.531</td>
</tr>
<tr>
<td>(14) I am able to apply the material that I have learned.</td>
<td>0.644</td>
<td>0.610</td>
<td>0.893</td>
<td>0.539</td>
</tr>
<tr>
<td>(15) I am able to critically analyse a problem situation to suggest solutions.</td>
<td>0.617</td>
<td>0.514</td>
<td>0.851</td>
<td>0.409</td>
</tr>
<tr>
<td>(16) I am able to evaluate the quality of information that I receive.</td>
<td>0.642</td>
<td>0.564</td>
<td>0.889</td>
<td>0.522</td>
</tr>
<tr>
<td>(17) I am able to integrate material from different resources to create useful information.</td>
<td>0.548</td>
<td>0.610</td>
<td>0.824</td>
<td>0.547</td>
</tr>
<tr>
<td>(18) I am familiar with the web.</td>
<td>0.466</td>
<td>0.591</td>
<td>0.413</td>
<td>0.813</td>
</tr>
<tr>
<td>(19) I use digital technology (e.g. computer, tablet, smartphone) often both at home and at school.</td>
<td>0.472</td>
<td>0.486</td>
<td>0.434</td>
<td>0.799</td>
</tr>
<tr>
<td>(20) I am confident in using application software (e.g. email, office suite, web browser).</td>
<td>0.504</td>
<td>0.602</td>
<td>0.529</td>
<td>0.883</td>
</tr>
<tr>
<td>(21) I have the skills to use digital technology (e.g. computer, tablet, smartphone) effectively.</td>
<td>0.514</td>
<td>0.449</td>
<td>0.501</td>
<td>0.813</td>
</tr>
</tbody>
</table>

Discriminant Validity - For satisfactory discriminant validity, two criteria should be met: (1) scale items should load > 0.50 on the intended construct, but lower or weakly on the other unintended constructs (Straub, Boudreau and Gefen, 2004); and (2) the square root of AVE of a latent construct should be larger than the
correlation between that particular construct and any other constructs in the model (Chin, 1998; Fornell and Larcker, 1981; Gefen and Straub, 2005). As depicted in Table 6, it was evident that individual scale items loaded > 0.50 on their intended constructs and significantly lower on any other constructs. Table 6 provides evidence that the square root of AVE of individual constructs was higher than the correlation between it and any other constructs in the model.

4.3.2 Structural model

The structural model was examined next. A bootstrapping procedure of 500 sub-samples was used to calculate t-statistics of path coefficients between the exogenous and endogenous constructs (Gefen, Straub and Boudreau, 2000). As depicted in Figure 2, two-tailed t-statistics showed all path coefficients between the constructs were significant at p < 0.01 (t-statistics > 2.57 were significant at p < 0.01). It was evident that the constructs of underpinnings, experiential learning, and searching explained about 56% of the variance in the effective learning construct (R² = 0.561).

Figure 2: Structural model

5 Discussion and conclusions

This study set off to answer the question: Do students require digital literacy to be effective in learning in a blended learning environment? This study provides evidence that for blended learning to be successful, there is a need for students to be digitally literate. As concluded by Mohammadyari and Singh (2015), people who have high digital literacy can adapt well to e-learning as they would find it easy to learn the technologies specific for educational purposes, and are more efficient and effective in information management.

Analyses show that the four digital literacy constructs conceptualised by Bawden (2008) can be reduced to three. These three constructs are: underpinnings, experiential learning, and searching, and together they account for more than half of the learning effectiveness of respondents in a blended learning environment at the local university. It is quite clear that to be digitally literate, a very basic requirement is possessing the skills to use digital technology. The similarities between Bawden’s (2008) digital literacy components and Huber’s (1991) knowledge acquisition processes explain how students can acquire knowledge in order to become digitally literate. In searching for information, students learn how and where to search for information effectively from different sources - this helps build their background knowledge. In learning to synthesise information for new knowledge and sharing information with others, students gain experiences to build their competencies and develop the right attitudes and perspectives. These three constructs are also consistent with Ng’s (2012) digital literacy dimensions, i.e. technical, cognitive, and social-emotional.

This study also highlights a notable observation. A higher percentage (74.5% vs. 63.9%) of the respondents prefer classroom learning as compared to online learning. In online learning, students and teachers do not normally meet physically but instead are connected on an online learning platform such as LMS (Prior et al., 2016). Phillips, Turnbull and He (2015) suppose that although online learning is becoming common these days because of its accessibility and flexibility, one needs a high level of self-directed learning readiness in order to do well. Considering that 74% of the respondents have used LMS for just one or two semesters, it is likely that they have just joined the university from secondary schools where face-to-face classroom teaching is common. Thus, some respondents might lack the confidence and skills for self-directed learning. The percentage of respondents who prefer blended learning (64%) is very close to that of online learning though.
It is also interesting to note that a higher percentage (82% vs. 45.9%) of the respondents find that face-to-face meetings (e.g. in-class lectures, consultations with lecturers, group discussions, etc.) are more effective than online interactions (e.g. blogs, forums, chats, emails, etc.). Despite the convenience brought by digital technology and the respondents having a certain level of digital literacy, they still find the need to meet in classrooms. This might be due to the urge for some physical community connection with other students as well as lecturers amid the virtual world enabled by digital technology.

Given that today’s young university students (most respondents are below 25 years old at the university this study was conducted) generally have good knowledge of using digital technology in their everyday activities (e.g. finding information online, watching videos, listening to music, using social media, etc.), it is not a surprise that a higher percentage (70.2% vs. 63.4%) of the respondents find online resources (e.g. e-books, digital databases, audio or video webcasts, etc.) more effective than physical resources (e.g. print books, school libraries, etc.). The top three most liked LMS features are online resources, online course announcements, and online assignment submission. Only 20.9% of the respondents like online discussions (e.g. blogs, forums, chats, etc.).

Learning from the findings of this study, when planning or delivering blended learning courses, lecturers need to first understand the students in terms of their level of digital literacy for learning. A good fit of digital literacy level to course expectations is necessary for successful blended learning. If some students have low digital literacy levels, additional exercises and tutorials can be used to help these students improve their digital literacy capabilities. Ng (2012) supports that students can learn to use educational technologies not familiar to them for learning if they are introduced to and given a chance to use these technologies. He reasons that the students would normally not use educational technologies unless there is such a need.

In addition, blended learning is reported to have increased student dropout rates (Deschacht and Goeman, 2015). One reason could be that unlike face-to-face classroom learning, blended learning requires a certain level of self-directed learning. Phillips, Turnbull and He (2015) propose that self-directed learning readiness is linked to three factors, i.e. self-control, self-management, and desire for learning. Prior et al. (2016) find that students who have strong self-efficacy are more confident, independent, and motivated. They conclude that a positive student attitude and high digital literacy can improve self-efficacy, which in turn contributes positively to such online behaviours as peer engagement, learning management system interaction, and convener interaction. Thus, by helping students to develop digital literacy, lecturers can also help foster self-directed learning among the students.

5.1 Research limitations

The respondents in this study had different LMS usage experience. The majority of them (60.3%) had used the LMS for two or three semesters, but about a third for only one semester. How familiar they were with the LMS could influence their views of how useful the LMS was in their learning process. In addition, the respondents were from different courses. The types and levels of digital literacy capabilities required of them could be diverse across subject matter areas.

5.2 Future research directions

The study context was a local university that had adopted blended learning. Future studies can examine the original research model in different contexts, e.g. primary or secondary schools, professional courses, working adults, full-time young students, etc. Also, the factors, i.e. underpinnings, experiential learning, and searching, explained slightly more than 50% of the variance in effective learning. There are other factors that could contribute to effective learning, e.g. environmental factors. Future studies can consider new factors, investigate interactions among the factors, and introduce moderators.

References


Bring Your Own Device to Secondary School: The Perceptions of Teachers, Students and Parents

David Parsons¹ and Janak Adhikari²
¹The Mind Lab by Unitec, Auckland, New Zealand
²School of Engineering and Advanced Technology, Massey University, Auckland, New Zealand
David@themindlab.com
J.Adhikari@massey.ac.nz

Abstract: This paper reports on the first two years of a Bring Your Own Device (BYOD) initiative in a New Zealand secondary school, using data derived from a series of surveys of teachers, parents and students, who are the main stakeholders in the transformation to a BYOD school. In this paper we analyse data gathered from these surveys, which consists primarily of qualitative data from free text questions, but also includes some quantitative data from structured questions, giving insights into the challenges faced by teachers, students and parents in moving to a BYOD classroom, and the potential benefits for teaching and learning, and preparing students for a digital world. We frame our analysis from a sociocultural perspective that takes account of structures, agency and cultural practices and the interactions between these domains. Thematic analysis was performed by considering these domains from the responses of the three stakeholder groups. We found that there were some tensions in these domain relationships, with contexts and practices having to be renegotiated as the BYOD classroom and the structures within which it operates have evolved. On the surface, it appears that many of the changes to cultural practice are substitution or augmentation of previous activities, for example using one-to-one devices for researching and presenting material. However, when we look deeper, it is evident that apparently straightforward adoption of digital media is having a more profound impact on structure and agency within the classroom. While the structural impact of digital infrastructures does raise some concerns from all stakeholders, it is clear that it is the curricular structure that is the most contentious area of debate, given its impact on both agency and cultural practice. While the majority of respondents reported positive changes in classroom management and learning, there were nevertheless some concerns about the radical nature of the change to BYOD, though very rarely from teachers. If there is an area where agency may be most problematic, it is in the responses of parents, who may feel increasingly alienated from their children’s learning activities if their own digital skills are lacking. These findings will be of interest to anyone who is engaged in BYOD projects, particularly those who are planning such initiatives or in the early stages of implementation.

Keywords: BYOD, secondary school, survey, sociocultural framework

1 Introduction

Since 2011 we have been gathering data from the first secondary school in New Zealand to introduce a Bring Your Own Device (BYOD) policy based on recommending the iPad. Over this time the initiative has moved from initial controversy in the local press over the proposals, through a pilot year, to an ongoing process of full implementation throughout the school. This process has gained national interest and the school has run two conferences to share their experiences with other schools and interested parties. Our own research has employed a number of methods, including surveys, interviews, observations and workshops. Some previous work has been published relating to the early stages of the project (Adhikari, Parsons & Mathrani, 2012; Parsons, 2013.) However, this particular paper focuses on the results of three surveys that were carried out between 2012 and 2014 to record the perceptions of teachers, parents and students from the school. It should be noted that this data is a snapshot of the first phase of the rollout of BYOD. From 2016 the school was fully BYOD across all years.

1.1 BYOD

The move towards BYOD in schools is driven by a number of factors. First, there is the recognition that education must adapt to technological changes in wider society. As the everyday use of digital tools by school students grows, so does the need for schools to integrate digital technologies to remain relevant (Engelhard and Seo, 2012; Collis and Moonen, 2008.) Second, there is the drive towards making digital tools available as an integral part of education rather than just episodic interaction in a computer lab. The extent to which this impacts on the curriculum depends on the ambition of the educators. Integration of digital tools may be the simple substitution of digital text books (Mardis & Everhart, 2013) or a more fundamental redefinition of the
Along with potential benefits, such as improved learning outcomes in some contexts (e.g. Cristol & Gimbert 2013), come some concerns, such as disruption in the classroom (Sharples, 2002) and concerns about a lack of inclusivity and an increase in cyber-bullying (Sangani, 2013). There may also be digital divides in learning outcomes (Wei et al, 2011.) Themes that have emerged from other research in a similar context (BYOD in New Zealand secondary education) suggested that the main positive outcome was a shift towards student centred learning, while the main challenges were change management and student management (Baker, 2014.) Another New Zealand study, this time in primary education, highlighted the importance of collaboration between the key stakeholders of teachers, students and parents (Falloon, 2015.) Ackerman & Krupp (2012) also stress the role of collaborative stakeholders in a successful BYOD implementation, in particular the forging of new partnerships between students and teachers in the classroom, emphasising the change in classroom relationships brought about by BYOD. Bruder (2014) emphasises the need for certain structures to be put in place to promote equity, security and appropriate curricula, to ensure that BYOD programmes achieve their potential benefits rather than introduce risks.

It is important not to view BYOD in isolation, not to focus only on the device. BYOD can only take place within the context of certain enablers, such as a suitable wireless broadband infrastructure, with supporting policies and procedures for secure and appropriate use, such as those outlined by UNESCO (2013), and may be associated with other initiatives such as a move towards cloud based resources (Lennon, 2012.) In addition, it does not operate independently of the teaching and learning process, driving changes in curriculum and pedagogy (Cochrane et al, 2014.)

1.2 Investigating digital device use in the classroom

There are a number of different approaches that may be used to investigate the use of digital devices in the classroom. For example Khalid et al (2014) applied a social constructivist perspective and grounded theory, identifying available knowledge and adoptable practice, advantages and adoption barriers as core topics of analysis. In contrast, Martin and Ertzberger (2013) took an experimental approach using pre-tests and post-tests, focusing on achievement and attitude. Cheung and Hew (2009) identified a number of methodological approaches used by different researchers, concluding that surveys are the most common method, with interviews, observations and focus groups also regularly used.

1.3 Analysis framework

Our analysis focuses on the broad spectrum of contexts within which a move to digital teaching and learning operates. Because our study looks at a BYOD initiative, this impacts not only on activities within the classroom but also those that take place in informal spaces and in the home. Therefore we adopted a sociocultural approach that takes account of structures, agency and cultural practices (Pachler et al, 2010.) This framework recognises the interrelationships between its three main components. (Figure 1.)

The role of agency, which is particularly powerful in a BYOD context, where learners have already appropriated their own devices, means that the presence of digital devices is only the starting point. The way that learners operationalize their own agency defines the actual role of these devices in the classroom; “a tool is what it is used for” (Bannon & Bodker, 1991, p. 238). On a similar theme, MacKenzie and Wacjman (1985) note that that specific technologies succeed or fail for a number of contextual reasons that derive from both structure and culture. For example we have noted how teachers of different subjects utilise mobile devices in their classrooms in very subject specific ways, and that these devices are not ideal for every situation (Parsons, 2013.)
Once digital tools are adopted, over time there is a two-way process through which the use of these tools changes the learning activities where they are applied. The structure within which this happens is important, but the tools can, in turn, impact on that structure. In our model, for example, using digital tools within the curriculum impacts on that curriculum. This concept has previously been referred to as the “coevolution” of tasks and artefacts (Carroll et al., 1991), and the “reciprocal shaping” of technology and society (Brosveet & Sorensen, 2000). There are also echoes of McLuhan here, where we ourselves are extended by technology use (McLuhan, 1964.)

In our analysis, we seek to identify data that relates to the specific items within each of the three concepts of the sociocultural framework and, where possible, the relationships between them. Our data is gathered from the perspectives of three different stakeholder groups; teachers, students and parents. Thus our analysis is focused on these differing perspectives, and we formulated the following research questions, based on the framework and our stakeholder groups.

- How have stakeholders responded to structural change as a result of the BYOD initiative?
- How has the agency of stakeholders evolved as a result of the BYOD initiative?
- How have the cultural practices of stakeholders evolved as a result of the BYOD initiative?
- How have structures, agency and cultural practices interacted during the period of the BYOD initiative?

2 Methods and materials

The source data for this article comes from three sets of online surveys administered in mid 2012, early 2013 and mid 2014. There were three separate sets of questions administered in each of these years, to teachers, parents and students at the school. There were no sampling criteria to include or exclude any members of these groups. We did not record any demographic data, but the students concerned were primarily from year 9 (first two surveys) and some from year 10 (third survey), so were aged 13-14. The gender balance at the school is approximately equal. As part of the low risk ethics process under which the research was undertaken, the surveys were all anonymous and voluntary, and publicised though the usual school communication channels (e.g. school newsletters.) The researchers designed the surveys but were not involved in publicising them. The questions were not identical in each survey, because we aimed to address a range of issues over time. The numbers of fully completed responses to each of the surveys are shown in Table 1. The school roll is approximately 2,000, but only one year group was involved in the pilot year (2012), and the programme has only slowly expanded through other year groups (there are seven in total.) Our 2012 and 2013 results therefore represent roughly 25% of the initial cohort of students and almost all the relevant staff. The number of parent and student responses dropped in 2014. This may just be due to ‘survey fatigue’ but we can only speculate about this. Despite these limitations, the amount of data gathered in these surveys is substantial, and combines both quantitative (multi choice, ordering, Likert scale) and qualitative (free text) data.
The qualitative data provides a number of insights into various aspects of the BYOD project. The thematic analysis of data was approached using axial, hierarchical coding. As Saldaña (2009) notes, the approach taken by the researcher to coding qualitative data may be influenced by a number of factors that will shape the interpretation of the data. In this case, the main constructs for the analysis were drawn from the sociocultural framework (Figure 1), while the units of analysis within these constructs were the stakeholder groups. Thus the constructs and groups were pre-emptive of the data analysis. Repeated ideas and themes that emerged from the data were linked to the appropriate constructs and groups.

3 Results

Our results are presented under the main concepts of the framework, namely structures, agency and cultural practices, addressing each of the first three research questions in turn. This analysis is primarily qualitative, but some quantitative results have been included where they relate to the themes of analysis. Qualitative data has been analysed in groups based on respondent type, that is, the three teacher surveys were analysed together, then the three student surveys, then the three parent surveys. This allowed us to identify variations in themes between these three stakeholder groups. In the qualitative analysis, in an attempt to identify core themes across the BYOD initiative, data from the three surveys has been analysed as a single data set. However, in the quantitative data we have also sought to identify any changes that are evident over time. These comparisons have to be interpreted with the proviso that we did not ask exactly the same questions in each survey, and we do not know to what extent the same parents, teachers and students answered the surveys.

3.1 Qualitative Coding

Free text survey questions were analysed in NVivo, coded using emergent themes (developed from repeated ideas) and subsequently gathered together under predefined broader constructs (Auerbach & Silverstein, 2003.) Following a simple content analysis of repeating ideas, the broad emergent themes are outlined in Table 2, cross referenced by construct and stakeholder role. We drill down further into these themes when we discuss each stakeholder group in later sections.

Table 2: Constructs and themes by stakeholder role from the qualitative data analysis

<table>
<thead>
<tr>
<th>Construct</th>
<th>Teacher Themes</th>
<th>n</th>
<th>Student Themes</th>
<th>n</th>
<th>Parent Themes</th>
<th>n</th>
</tr>
</thead>
<tbody>
<tr>
<td>Structures</td>
<td>Classroom (curricular)</td>
<td>15</td>
<td>Technology</td>
<td>22</td>
<td>Devices in school</td>
<td>13</td>
</tr>
<tr>
<td></td>
<td>practice</td>
<td></td>
<td>Affordances</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Technology limitations</td>
<td>19</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Agency</td>
<td>Classroom roles</td>
<td>10</td>
<td>Enabling</td>
<td>83</td>
<td>Student agency (positive)</td>
<td>34</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Restricting</td>
<td>66</td>
<td>Student agency (negative)</td>
<td>23</td>
</tr>
<tr>
<td></td>
<td>Equity</td>
<td>11</td>
<td></td>
<td></td>
<td>Parent agency</td>
<td>20</td>
</tr>
<tr>
<td></td>
<td>Giving students agency</td>
<td>24</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cultural Practices</td>
<td>Digital pedagogy</td>
<td>21</td>
<td>Interactions with others</td>
<td>14</td>
<td>Family dynamics</td>
<td>31</td>
</tr>
<tr>
<td></td>
<td>Student practice</td>
<td>6</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

From the rather general themes identified within the three main constructs of our analysis, a few observations can be made. The teachers tended to address a broader set of themes in their responses across all three constructs. Further, their negative experiences were confined only to the structural limitations of technology (e.g. occasionally unreliable wireless connectivity) rather than to any fundamental misgivings about the BYOD innovation as a whole. They also focused strongly on various aspects of the changes taking place in classroom practice; the changing roles of teachers and students in a classroom where student agency was increased through the use of digital devices, and the potentials of new digital pedagogies. In contrast, the students reported primarily within the agency construct, with little reference to cultural practice and, like the teachers, a structural focus on the technical infrastructure of the BYOD learning environment. Although a majority of student responses reported that BYOD was an enabling innovation, there were also many concerns expressed around the potential restrictions on agency. These ideas will be explored in more detail later in this article. Parents’ views on structures, given that they had no direct experience of the wireless infrastructure or device use in the classroom, focused more on the provision and value of the learning devices within the curriculum.
focusing on agency, like the students, there was a split between both positive and negative views of the effects on learning, though once again, positive views were in the majority. Another major issue was parental agency. Many parents felt excluded from the digital experience of their children in various ways, as discussed later. Impact on the family was the key concern in terms of cultural practice, and many parents chose to reflect on the perceived impact of the change in learning styles on the way their children behaved at home. Again, this will be discussed later.

Overall we can see that the teachers responded the most positively to the BYOD innovations, and parents had the most reservations. Students provided a range of views, both positive and negative, but all of which can give insights into the impact of the BYOD programme. In all three of these stakeholder perspectives, we see the power of agency. Teachers, who have the most agency, were the most positive about the move towards BYOD, while parents, who have the least agency, had the most reservations.

3.2 Structures

Structures are the most straightforward of the three concepts encompassed by the model. Simply put, they relate to the BYOD devices, the technological infrastructure within which they are used, and the curriculum within which they are applied. Table 3 shows the repeated ideas in the structural themes.

<table>
<thead>
<tr>
<th>Structures</th>
<th>Themes</th>
<th>n</th>
<th>Repeated Ideas</th>
<th>n</th>
</tr>
</thead>
<tbody>
<tr>
<td>Teachers</td>
<td>Classroom (curricular) practice</td>
<td>15</td>
<td>Changes in delivery of learning</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>Technology limitations</td>
<td>19</td>
<td>Connectivity issues</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Software problems</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Layers of complexity</td>
<td>4</td>
</tr>
<tr>
<td>Students</td>
<td>Technology Affordances</td>
<td>22</td>
<td>Network infrastructure</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Device affordance</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Non-digital curriculum</td>
<td>7</td>
</tr>
<tr>
<td>Parents</td>
<td>Devices in school</td>
<td>13</td>
<td>Device support</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Curriculum in society</td>
<td>7</td>
</tr>
</tbody>
</table>

Teachers’ responses around the construct of structure focused on either classroom (curricular) practices or technology limitations, since the curriculum had been impacted by the introduction of digital devices, with a knock on effect on infrastructure dependency. In terms of curriculum structure, classrooms were more devolved, collaborative, group based and student centric. Teachers here tended to express very similar views, the following comment being typical: 

“The focus in the classroom has changed, very student centred. Inquiry learning style is the norm and sharing is an important component of the class environment. Front of the room instruction is less important, in fact there is not really a front of the room. Have been experimenting with different classroom set outs.”

Reference to different approaches by other teachers were more equivocal. Some teachers were evidently somewhat resistant to change:

“Big gaps in pedagogical practice showing between those with devices and who are using them and others who aren’t.”

There were several comments that related in some way to the layers of complexity introduced by digital tools. One example was;

“Remembering a plethora of passwords.”

When students commented on structural elements, a few referred to some issues with the wireless infrastructure, but a larger number expressed concerns about the affordances of different devices, with an emphasis on the relative merits of iPads and laptops. Some commented about the disruption of being in classrooms with a mix of devices. Another significant set of ideas related to the non-digital curriculum, in the sense that there was a keenness not to let digital devices take over all teaching and learning activities. This example is indicative:

“Occasionally I think we should be able to make big awesome projects with crafts and stuff without the iPad.”
When it came to the parents’ responses, most of the comments relating to device support were around the provision and maintenance of the devices themselves. One other comment in this theme related to a somewhat different aspect, that of equity, an issue highlighted by Bruder (2014).

“The homework set was assuming that everyone had broadband which we didn’t because I couldn’t afford it as I was paying off a tablet (we now have it).”

The other repeated idea in this theme was the role of a digital curriculum as it relates to 21st century society. The following comment was typical:

“I think it’s the way of the future, and when they leave school they will need to know this technology.”

The quantitative data from the surveys also provided some useful insights into structural components. In terms of pervasive technology, the wireless infrastructure turned out to be more problematic than was first anticipated. In the 2012 survey, only one member of staff expressed concerns about network connectivity. Having actually experienced device use in their classrooms, twenty teachers expressed issues with network connectivity in the 2014 survey. Thus we note how structures may act as constraints to agency.

When analysing individualised mobile communication, one interesting finding from the data was that the proportion of students who were using a non-iPad device actually appeared to increase between 2012 and 2014, from 4% to 19%. Most of this change was due to students using laptops. One reason given for this by a parent was due to the different handling of the laptop; some iPads were carelessly exposed to accidental damage by other students.

“He has a laptop now as his iPad kept cracking”

Another motivation, again expressed by a parent, was the greater power of a laptop.

“We had no problems with the iPad but now he is getting more specialised it appears we may need a Mac to accommodate his learning requirements.”

This time we see a more positive relationship between structure and agency, with choices being made from the perspective of potential benefit.

Looking at the curricular frame of the institution, most of the curriculum in New Zealand schools is driven by the National Certificate of Educational Achievement (NCEA), which is the main national qualification for secondary school students. NCEA results are recognised by employers and by higher education institutions both nationally and internationally. In most subjects, students sit externally assessed examinations. Within this external constraint, it is clear that the in-school curriculum cannot freely evolve. Thus the changes we have seen within the curriculum are confined to changes in the way that the existing content is delivered. The most common change to curriculum delivery within the school is that work has become more research based. When asked what changes students had noted in their learning (2014 survey) around 25% of the students referred to benefits for research, some explicitly. For example

“I have noticed that research is a lot easier for classes”, and “faster to do work and better access to information”

Despite these positive effects, some parents, teachers and students were concerned about the dissonance between digital teaching and learning and traditional written exams.

“It concerns me that NCEA is seemingly lagging behind with assessing our students.” (Teacher, 2014)

Although the future strategy for NCEA includes at least some online assessment (NZQA, 2013), in the short term the school has to prepare its students for written exams. This is a major constraint by structure on both agency and cultural practice.

### 3.3 Agency

One of the core components of agency is the ability to act on the world. In the context of BYOD this means having a suitable skill set for making optimum use of digital tools, thinking critically and processing and applying the information to create new knowledge. Table 4 shows the repeated ideas in the agency themes.
Table 4: Themes and repeated ideas from the ‘agency’ construct

<table>
<thead>
<tr>
<th>Agency</th>
<th>Themes</th>
<th>n</th>
<th>Repeated Ideas</th>
<th>n</th>
</tr>
</thead>
<tbody>
<tr>
<td>Teachers</td>
<td>Classroom roles</td>
<td>10</td>
<td>Changing the teacher role</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Resistance and dissent</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Equity</td>
<td>11</td>
<td>Enabling individual attention</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Students assisted by devices and peers</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>Giving students agency</td>
<td>24</td>
<td>Not digital natives</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Directing learning</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Devices enabling agency</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td>Students</td>
<td>83</td>
<td>Higher productivity</td>
<td>13</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>More enjoyment of learning</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Better learning outcomes</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Ease of access to resources</td>
<td>45</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Ease of communication with others</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Restricting</td>
<td>66</td>
<td>Off-task behaviour (self)</td>
<td>18</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Off-task behaviour (others)</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Reduction in skills</td>
<td>33</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Physical impediments</td>
<td>6</td>
</tr>
<tr>
<td>Parents</td>
<td>Student agency (positive)</td>
<td>34</td>
<td>Increased motivation</td>
<td>14</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Improved performance</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Digital skills development</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Improved self-management of learning</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Benefits for students with learning difficulties</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Student agency (negative)</td>
<td>23</td>
<td>Impact on reading and writing</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Difficulties migrating to digital teaching and learning</td>
<td>15</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Lack of visible agency</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Parent agency</td>
<td>20</td>
<td>Homework is hidden</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Lack of digital skills to support students</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Unwillingness of students to give parents agency</td>
<td>7</td>
</tr>
</tbody>
</table>

Teachers noted that their agency in the classroom had undergone a change, usually in terms of progressing towards new roles within the classroom. The following quote indicates an example of this change.

“As a ‘non-techie’ I was keen to be involved but terrified. As the year has progressed I feel I have become far more competent, confident and really ready to take things further.”

However another aspect of teacher agency was the tendency of some to resist and dissent, opposing imposed changes of practice. One teacher questioned the level of consensus within the staff:

“Consensus on the popularity of the BYOD program within school is much more varied than I believe the school realizes.”

Equity was explored from two dimensions; teachers being able to be more equitable in their teaching, and students gaining a more equitable agency in the classroom due to the support of devices and peers.

While many teachers appear to want to give students more agency in the classroom, it appears that there are several barriers. One is that teachers have found that many of their students are not ‘digital natives’ and cannot naturally work effectively with technology without considerable guidance.

“Students not being the digital natives they are purported to be. They are VISUAL natives rather than digital.”

As a result, a greater level of teacher agency is required to direct the digital classroom than some teachers expected.

“Biggest unexpected so far has been the amount of explicit instruction and direction students have needed to both drive the device and their own learning using it.”

Notwithstanding these issues, teachers also reported various ways in which they could transfer agency to students through the support offered by digital tools. For example podcasts and the physical mobility of learning offered by the devices.

Students reported several repeated ideas around positive aspects of their own agency. By far the most common idea was the ease of access to learning resources. Students also expressed that they felt they were more productive in class, were better able to communicate with teachers and peers, enjoyed learning more, and had improved their learning outcomes. One student comment encapsulates a number of these ideas together:
“We are able to access information from the internet much easier. Our learning has advanced because of this. We can record and present our projects in a creative way. We are able to communicate with our teachers through email, iMessage and other apps. We can hand in work faster and not have to waste printing ink or even be at school to hand in work.”

There were however a number of ideas that reflected more negative aspects of student agency. These focused around the off-task behaviour of themselves and others. Some students reported a perceived drop in certain skills, mostly related to handwriting. The following, one presumes, was written tongue in cheek, but was not unrepresentative:

“Can’t rite az gud.”

A few students also reported physical issues such as headaches, eye strain and poor posture.

Parents reported a number of positive effects on student agency. The most frequently mentioned was motivation, for example:

“We have found that our son has been thoroughly motivated by the iPad, there seems to be a huge benefit in terms of his willingness to complete tasks via the device”

Improvements in learning performance were noted by some, often with a specific mention of agency:

“My child has become a more independent learner. I noticed in the last 12 months that my child’s performance improved…achieving better grades.”

A side effect of using digital tools for learning also enabled students to develop digital skills, for example

“My child is quite computer literate since using the iPad.”

Better self-management of learning was also noted as a feature of student agency:

“He is well-organised and up-to-date with his homework often completing it early.”

Parents of students with learning difficulties were particularly impressed by the increase in their agency:

“Having a child with ADD - the difference is huge. It engages her in a way that normal teaching doesn’t.”

Of course not all reflections from parents about their children’s agency were necessarily positive. Some parents felt that the use of digital devices has impacted in their children’s ability to read and write in the traditional way. The majority of comments however focused on various aspects of students seeming to have difficulties transitioning to the new teaching and learning environment. These often reflected back onto parental perceptions of their children’s preferred learning styles:

“My daughter feels due to no longer writing out her work she often does not retain information as well as she used to.”

Some other comments suggest that their children lack agency in the digital context. These covered several related ideas but this comment is indicative of some students’ lack of agency using digital tools

“My daughter just gave up and went back to pen and paper and refused to present work on the tablet.”

The other theme identified by parents was their own agency, which many believed had been diminished in terms of their ability to engage with their children’s schoolwork. They either felt that the homework was hidden from them, either deliberately or because it was all electronic and so not as easily visible as written homework, or they felt that their digital skills were inadequate to help their children. A feeling of lack of agency coupled with feelings of exclusion are summed up in this comment:

“Didn’t seem to have much work to be done at home - that he told me about”

From the quantitative data, there are some insights into digital skills, which can have a major impact on agency. We note that the overall skill levels of staff appeared to be slightly lower in the 2014 survey than in 2012 (Figure 2, top). However it should be noted that the 2012 staff were early adopters who volunteered to take part in the first year of the BYOD initiative. The figures for 2014 represent a larger cohort of teachers across the school. This suggests that we cannot expect the agency of staff overall to reach its maximum potential until the BYOD approach has been fully rolled out across all school years so that all the staff have had the opportunity to fully develop their digital skills.

From the surveys of students, we note a strikingly different pattern (Figure 2, bottom), though it should be noted that we asked a somewhat different question about their levels of skill in making meaningful use of digital devices in learning. Further, the 2014 survey only had three options instead of five. Nevertheless, there is a marked increase in the perceived level of digital skills, so the potential for agency appears to have increased over time. These results for teachers and students suggest a possible skills gap, but of course the skill set that teachers need to bring to bear is more complex and demanding than the skill set needed by the
students. Nevertheless, for those who are already actively engaged in using the one-to-one devices, there is certainly skill development going on. Two responses from the 2013 teacher survey noted:

“My skills have grown SO MUCH”

“The students and I have definitely gained some skills with using these devices”

As student skills and agency have evolved, students appear to have developed critical thinking about the role of technology in the classroom. In the 2014 survey, although almost all of the students were in favour of using one-to-one devices for learning, around half suggested changes in practice (Figure 3).
As indicated in the qualitative data, many of the students requested a balance between digital device use and more traditional classroom activities. Perhaps underlying these feelings is a concern that well-understood agency that students have gained through skills taught in their earlier school career, such as reading books and handwriting, are being replaced by less familiar skills. We might postulate, perhaps, that some students feel a lack of agency in the process of this skills transfer, given the results outlined in Figure 3. Compounding this, from the qualitative data, some students and parents feel that handwriting skills are declining, suggesting a diminution of agency in this area.

In their free-text responses, both students and parents occasionally referred to the students being treated as ‘guinea pigs’, i.e. the subject of an experiment. This response again suggests anxieties about agency; being acted upon, rather than acting on the world. We might suggest that many of these anxieties about agency are a direct result of being part of a culture in transition. Similarly, parental concerns about their own agency with regard to their children’s school work often suggests an increasing sense of separation, suggesting that there may be a significant skills gap between parents and students.

### 3.4 Cultural practices

Cultural practices emphasize the areas that can benefit learning, as they relate to collaboration, meaning making and media use. Our surveys indicate positive transformations of cultural practices within both formal and informal learning spaces. Indeed, the concept of space in the digital world has moved from a sense of belonging to a physical place to a sense of belonging to a communications network (Strivastava, 2005.) Table 5 shows the repeated ideas in the themes of cultural practices.

**Table 5: Themes and repeated ideas from the ‘cultural practices’ construct**

<table>
<thead>
<tr>
<th>Cultural Practices</th>
<th>Themes</th>
<th>n</th>
<th>Repeated Ideas</th>
<th>n</th>
</tr>
</thead>
<tbody>
<tr>
<td>Teachers</td>
<td>Collaboration</td>
<td>6</td>
<td>Peer collaboration</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Feedback</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Student practice</td>
<td>6</td>
<td>Student culture (positive)</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Student culture (negative)</td>
<td>3</td>
</tr>
<tr>
<td>Students</td>
<td>Interactions with others</td>
<td>14</td>
<td>Student collaboration</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Adult communications</td>
<td>6</td>
</tr>
<tr>
<td>Parents</td>
<td>Family Dynamics</td>
<td>31</td>
<td>Media use</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Reduced personal contact</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Device addiction</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Changes in social behaviour</td>
<td>15</td>
</tr>
</tbody>
</table>

In terms of cultural practices, one of the most important transformations is the increase in student to student and student to teacher (and vice versa) collaboration. Peer collaboration comes as part of the pedagogical transformation, but another effect is the ability for teachers to give immediate feedback. Teachers’ assessment of student culture was varied. Some comments were positive, e.g. classes being able to manage
themselves even in the teacher’s absence. However there was also some evidence of negative impacts on the students’ learning culture, for example:

“Some relationships have deteriorated in homerooms since the loss of interaction of face to face time with their peers and teachers.”

Students emphasised the communication aspects of cultural practices. Digital one-to-one devices have widened communication opportunities and provided common platforms for collaboration between students. For example, one student stated:

“iMessage helps kids connect with sick members of their group in group projects”.

If we consider these digital media in isolation, they might appear as somewhat one-dimensional. However, the settings and learning spaces where these communication channels are utilised, and the learning activities enabled by them, suggests that the BYOD initiative has brought a shift in the wider understanding of learning with and between contexts. In fact, it has contributed to integrating formal and informal learning spaces by extending team work and collaborative learning beyond the school gates. Students are now able to collaborate in real time to complete group tasks. Communication and collaboration between teachers and students has also improved, thus the idea of adult communication appears in Table 5. This also includes a handful of students who do claim to communicate with their parents about their learning.

Since the impact of change goes beyond the classroom, parents too noted changes in social interaction. The key theme that emerged from the data was various impacts in family dynamics. Many parents were concerned with the change in the social behaviour of their children. One parent reported:

“She is now constantly on the iPad, for things other than school work”

Reference to media use tended to focus on non-educational purposes. Parents mentioned various social media sites being used at home, rather than devices being used for study. Of course it is possible that parents are just more sensitive to their children using their devices for leisure activities. One somewhat wry comment implied that perhaps learning was taking place even if this was not obvious.

“Well I am sure they are learning something but they are glued to the damn thing.”

In terms of social behaviour, a number of parents stated that their children had become less communicative, more aggressive, less interested in physical activities and less willing to do things with the family.

“My daughter has become withdrawn and no longer talks to me.”

Of course we have to note that the cohort for this study was aged 13-14, when these behavioural changes are not uncommon, regardless of whether a digital device is used in the classroom. Thus, while we cannot dismiss these concerns, neither can we isolate any effects of the BYOD classroom. Others commented that they now had to communicate with their children electronically rather than face to face. However, some others acknowledged the positive changes even while expressing some concerns, for example.

“...very secretive around their IPAD but also very switched on to learning.”

Another concern explicitly raised by several parents was ‘addiction’ with respect to student relationships with their devices.

“Since she got her tablet, she has been addicted to it. She’s been less active, usually goes to her room and plays with it rather than plays outside with friends like she used to do.”

In a separate study, young New Zealanders suggested that a preference for cyber communication in social settings, purposeless preoccupation with a device, and feelings of anxiety when unable to use a device might be indicative of device addiction (Vacaru, Shepherd and Sheridan, 2014.) However, the authors of that study caution against using the term ‘addiction’, suggesting ‘problematic use’ is more appropriate, but such behaviour is certainly an issue of cultural practice that needs monitoring.

Looking at the quantitative data, student use of technology has, despite some concerns by parents, remained focused predominantly on educational activities (Figure 5). Media use has also extended the students’ ability to express and communicate their work, as this parent reported in the 2013 survey:

“The quality of presentations on the device are incredible. It’s great to be able to see the science assignment posted on YouTube.”

Much of the reported media use might be seen as primarily substitution or augmentation, rather than more fundamental changes in teaching and learning. However the staff surveys reveal that the true impact is seen in teaching practice and student engagement, for example; a more informal approach to classroom teaching,
more ability to differentiate disparate learning styles and abilities, more flipping of the classroom and more engagement from boys in terms of their writing.

Figure 4: Student’s nature of technology usage in school and at home (self-reported)

The structural impact of pervasive technology has of course impacted on the culture of the school, and leads to challenges for teachers such as keeping an eye on students during classes to prevent them from going off task.

3.5 Interaction of structures, agency and cultural practices

As described previously, structures, agency and cultural practices characterise the sociocultural framework. Most importantly, this framework sees learning through mobile devices in and around different learning spaces and is governed by a triangular relationship between the three components represented in Figure 1. Our final research question asks how these components have interacted during the period of the BYOD initiative. There are a number of aspects associated with each component and these aspects have either positive or negative impacts on each other in the experiences of students, teachers and parents in both formal and informal learning spaces.

Looking at the structure component, it contributed positively to the agency of students and teachers in terms of digital skills. The BYOD device and the technological infrastructure in school provided an opportunity for skills development. The results show that digital skills have improved in students since the BYOD initiative and also suggest a slow but positive trend in the digital skills of the teachers (Figure 2).

Other aspects of structure, however, act as constraints, in particular the curricular frame and its associated external examinations. Our results indicate that many students have included time with pen and paper, combining learning strategies to prepare for the NCEA assessment method. For example:

“I do think learning with devices is great but we need a balance until NCEA is done via computers as it’s hard to get back into using pen and paper for exams”

In a different context, one of the aspects of cultural practices (media use) is having an impact on structure (learning environment). There are some concerns for classroom management and distractions caused by the inappropriate usage of the one-to-one devices by students within the classroom.

One of the most important benefits of the BYOD initiative is the increase in collaboration (cultural practices) across formal and informal learning spaces. This is enabled by improved mobile communications (structure) and contributes to the development of agency in the students.

Despite some contradictions and challenges, interaction between the three components of the social-cultural framework in the context of BYOD has resulted in positive outcomes. However, there are a number of constraints caused by structure, and tensions raised by changes in culture.
4 Conclusions and future work

The longitudinal analysis of the BYOD project, based on the multiple surveys conducted with different stakeholders at different points in time has given us a good understanding of how the BYOD classroom has developed since its introduction. The analysis of data based on the social-cultural framework has been worthwhile to understand the relationships and interactions between the digital devices and infrastructure, the various stakeholders and the learning environment.

The majority of the quantitative results were positive, including improvement in the digital skills of students and teachers, increases in opportunity for individual mobile communications and collaboration for learning activities and also the advancement in social and personal development of students. From the qualitative data there were some persistent issues around the nature of media use by students and the impact it is having on teaching and learning activities. Qualitative data from teachers was substantially positive, while responses from parents and students were more mixed. This may suggest the impact of agency; in this context, teachers have the greatest agency, parents the least.

Our findings also suggest that students perceive their digital skills as developing rapidly, while teachers are more circumspect. From our interpretations of our qualitative data, we suggest that this is because members of staff are considering the development of their skills in the context of transformations of classroom practice, which demands a more extensive skill set than student use of one-to-one devices.

The focus of this article has been on survey data from the initial stages of a long term BYOD initiative that is not yet fully embedded. The data we have collected suggests that this is a period of transition and in many ways the BYOD initiative is being used also as an opportunity to redefine itself. There are skills that need to be developed further, dissonances between new forms of teaching and learning and traditional assessment structures, and anxieties about the unknown impacts of such major changes to schooling. There is clearly much more work to be done before we truly understand the implications of what is currently happening in the BYOD process. The next stage of our work will continue to investigate the themes introduced in the paper as the school completes its BYOD rollout.

References


