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Introducing Educational Technologies to Teachers: Experience Report

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The dramatic rise in use of digital media has changed the way learning is taking place and has led to new ways to teach with digital technologies. In this article, we describe the experiences of teaching a course that introduces educational technologies to teachers in Macau. The course design is based on connectivism, a learning theory for the digital age that emphasizes interaction with digital media and active engagement in sharing digital artefacts. The learning outcomes are constructively aligned with learning and teaching activities and assessments. We share the insights we gained of the learning needs and the disparity in the technological skills and competencies of the students. The course design is evaluated in terms of the students' learning outcomes and progress through the stages of learning with technology. We present evidence from journal writings that show metacognition, active reflection and critical evaluation, and we identify anxiety and increased confidence with digital tools, as well as concerns about group work. This article contributes to the discussion on teachers learning to teach with technologies.

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Introduction

Changes in computer and information technology are having a profound influence on learning and teaching in the 21st century. Traditionally, the Internet has been a medium for research and information-gathering. In recent years, new models of education, social-networking sites, the open-source and open-access movements and advances in mobile technologies have transformed teaching and learning practices (Siemens & Conole 2011; Siemens & Tittenberger 2009). Web-based tools such as wikis, blogs, e-books, online videos and podcasts offer new avenues for multimedia computing and multisensory learning.

The new forms of digital interaction, expression, communication and entertainment (Shelly, Gunter & Gunter 2010) have led teachers to rethink their traditional teaching practices (Wiske 2004). Prensky (2001) claims that when planning lessons, teachers have ignored "digital natives", who are accustomed to playing computer games and who are skilled in multitasking, parallel processing, graphic awareness and random access. Although the idea of a distinct generation of tech-savvy young people has been disputed (Bennett & Maton 2010; Jones et al. 2010), the diversity of technological skills (Corrin, Lockyer & Bennett 2011) has created new challenges for today's educators. The explosion of social networks has also changed the nature of learners. Students are likely to have accounts with Flickr or Picasa, Google, YouTube, Twitter, Facebook and LinkedIn, and the decentralisation of the management of learning pushes decisions, such as association with other learners or clustering of material into categories, from teachers to the learners themselves (Downes 2010). Yet at the same time, students expect guidance and training from academics in effective use of technology required for coursework (Dahlstrom 2012).

Over the years, educators have sought ways to incorporate technologies for learning into their courses. In the 1980s, Chickering and Gamson (1987) formulated seven principles for using technology to enhance the quality of undergraduate education:

(1) Encourage student-staff contact using communication technologies.
(2) Encourage cooperation among students through web-based collaborative tools.
(3) Encourage active learning through simulation tools.
(4) Give prompt feedback, and monitor the diverse forms of electronic presentations created by students.
(5) Emphasise time on task by enabling staff and students to work when and where they want.
(6) Communicate high expectations, and enable peer evaluation through criteria articulated by the teacher or collaboratively generated by students.
(7) Respect diverse talents and ways of learning by providing opportunities for diverse learning styles, and enabling self-reflection and self-evaluation.

Chickering and Gamson's principles do not originate in any specific learning theory. However, advocates for a theoretical approach to integrating technologies in the learning context argue for a philosophical basis for the use of the technologies (Kirschner 2004). A number of models grounded in learning theories have been developed for learning with technologies. The Conceptualization Cycle model by Mayes and Fowler (1999) involves conceptualisation, construction and dialogue. The cycle blends instructivist teaching approaches that emphasise content presentation with technologies, with constructivist learning approaches that engage the learner in the active performance of tasks. Salmon's (2003) five-stage model for Computer-Mediated Communication (CMC) is influenced by personal-construct theory (Kelly 1955) and social constructionism (Vygotsky 1978), and emphasises the use of collaborative online systems that lead to socialisation, information exchange, knowledge construction and development of affective values. The 12-stage Conversational Framework (Laurillard 2002) is underpinned by the phenomenographic perspective on student learning, and uses technological media for discursive, adaptive, interactive, reflective and collaborative learning tasks.

Technologies based on the constructivist approach to learning (Piaget 1978; Vygotsky 1978) focus on the social and communicative aspects of learning (Johnson & Johnson 1994; Scardamalia & Bereiter 2006) to facilitate knowledge construction and reflective thinking. Collaborative web-based technologies (Goodyear 2001; McConnell 2000) that develop practice in a particular community (Lave & Wenger 1991) are grounded in theories of situative learning. Sites such as Cloudworks (Conole, Galley & Culver 2011) draw on theories of communities of inquiry (Garrison, Anderson & Archer 2000), communities of practice (Wenger 1998), activity theory (Engeström 1987) and actor-network theory (Latour 1997).The phenomenographic perspective on learning (Bowden & Marton 1998; Marton & Trigwell 2000) sees educational media as offering new ways of representing knowledge (Laurillard 2008) to present a range of opportunities for a higher level of learner engagement that presents multiple perspectives, making new kinds of learning possible.

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In recent years, connectivism has been proposed by Siemens (2004) as a learning theory for the digital age in lieu of traditional learning theories that do not address knowledge, learning and meaning as networked elements in information and communication technologies. In a connectivist learning environment, learning takes the form of a network of connections formed from experience and interactions with a knowing community; educators play the roles of aggregators, assimilators, analysts and advisors (Downes 2005). Siemens and Downes have been running Massive Open Online Courses (MOOC) based on connectivist principles (cck12.mooc.ca/).

Higher-education institutions have responded to the emergence of new "millennium learners" by fostering technology adoption in course teaching. At our university, these initiatives (Thota & Whitfield 2009) take the form of setting up learning-management platforms, providing digital content and resources and offering student support and teacher training for using digital technologies. The need for a new kind of teaching for the digital age has led us to design a course that is grounded in learning theories, taxonomies and instructional design for learning with technologies.

The Education and Technology course (MEd112) at the University of Saint Joseph, Macau, China, is mostly taken by students who are full-time teachers from primary and secondary schools, working towards a master's degree in education. The course aims to empower teachers with the skills they need to give their students a technology-rich learning environment. The course, which is designed using connectivism (Siemens 2004), emphasises peoples' active engagement with resources in interaction with others and embeds learning and knowledge within diversity of opinions and the ability to connect fields, ideas and concepts. The course is underpinned by the constructive alignment (Biggs & Tang 2007) of learning and teaching activities, learning outcomes and assessments. These learning and assessment outcomes are drawn from Bloom's Digital Taxonomy (Churches 2008) and the SOLO taxonomy (Biggs & Collis 1982), while the results from the relation and sharing components of the course design are drawn from the taxonomy of the affective domain (Krathwohl, Bloom & Masia 1964).

The next section of the paper deals with the theoretical background for the Education and Technologies course, followed by the description of the course design. The course design is then evaluated in terms of the learners' outcomes and our experiences in teaching the course. Finally, we outline future directions for the course.

Theoretical Background of Course Design

The MEd112 course is grounded in learning theories and in learning and assessment taxonomies, and anchored in a theory-based instructional design. In this section we briefly describe the theoretical background of the course:

(1) Connectivism as the foundational learning theory;
(2) Bloom's Digital Taxonomy for cognitive learning outcomes;
(3) Taxonomy of the affective domain for affective outcomes;
(4) SOLO taxonomy for assessment purposes; and
(5) Constructive alignment for instructional design.

Connectivism

Connectivism focuses on learning that occurs when individuals interact socially using collaborative technologies. The connectivist learner produces knowledge through creating and sharing digital artifacts. According to Siemens (2006, p.90), the key features of a connectivist learning environment are diversity, autonomy, interactivity and open learning processes. Siemens argues that learners should be empowered to air their points of view and contribute to the diversity of shared knowledge. They should have the autonomy to actively seek and engage in the learning situations. The knowledge created should be engendered through interactive learning sessions in a learning environment that is characterised by its openness to stimulate discourse. A connectivist learning environment ideally includes a space for interaction between experts and students, a space for self-expression, debate, dialogue and communication of new information and knowledge and a space to nurture ideas and test new approaches (Siemens 2006). This learning environment supports and contributes to informal and lifelong learning (Downes 2005, 2006).

The MEd112 course design is anchored in four connectivist principles (Kop 2011): aggregation of resources; relation of new knowledge to old; creation of artifacts to show learning; and sharing of insights with other learners.

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(1) Aggregation or access to a collection of resources to read, watch, or play: student access to information and resources is aggregated through the Moodle learning-management system. Information about learning theories and pedagogic models for learning with technology is provided through links to e-books, e-journals, online videos, open-source software, and web repositories.
(2) Relation of new knowledge to old after reading, listening, or watching the content: students have opportunities to relate new knowledge to earlier knowledge through reflecting on their experience in online journals and blogs. Online questionnaires are used for gathering information about students' technological competencies, motivation and self-efficacy levels.
(3) Creation of digital artifacts to show learning after reflection and sense-making: students create lesson plans using blogs, podcasts, videos, animations, visualisations, e-books, electronic flash cards and learning objects.
(4) Sharing of insights with other learners: students are encouraged to create shared spaces (using platforms such as Facebook, Blogger and Google Docs) to engage in self-expression, debate and dialogue. Links to new knowledge and information sourced from personal networks are shared through social-bookmarking sites and by subscribing to RSS feeds.

Bloom's Digital Taxonomy

Bloom's Digital Taxonomy (Churches 2008) matches ordered thinking skills from Bloom's revised taxonomy with activities related to the use of tools and technologies and the processes and actions associated with them. The elements of the taxonomy (remembering, understanding, applying, analysing, evaluating, creating) are matched with processes (such as bookmarking, social networking, retrieving and publishing) that are associated with today's digital tools (wikis, blogs, social networks and learning-management systems).

For the MEd112 course, we identified intended learning outcomes from Bloom's Digital Taxonomy. Students work in pairs to review Web 2.0 tools suitable for teaching and learning. The student pairs then present their evaluations to their peers and demonstrate the use of the web tools. Discussions in online forums enable students to show their understanding of the potential role and effectiveness of educational technologies. Students collaborate in teams to harvest, apply and share digital artifacts in online repositories. Online journals and blogs are used for reflections on the collaborative process of learning with peers. For a final project, each student designs a lesson plan using a pedagogic model suitable for using digital media in the classroom, and demonstrates the use of the media. The teacher and the other students offer constructive feedback after each lesson-plan presentation.

Taxonomy of the Affective Domain

The taxonomy of the affective domain (Krathwohl, Bloom & Masia 1964) deals with the thoughts, feelings and actions that students are expected to develop as a consequence of the instructional process. The five levels of the taxonomy describe a continuum of affective values where the learner learns to attend to phenomena, to respond to them, to value them and finally to conceptualise them as a way of life. The internalisation of values shows the student's achievement at the level of characterisation, which is marked by the development of a philosophy of life.

In all the assignments for the MEd112 course, we have integrated criteria drawn from the affective domain to account for the relation and sharing components of the connectivist course design. Students' abilities to work productively as part of a pair/team and to demonstrate values such as a strong work ethic, cooperation and initiative are assessed. The students are asked to reflect on their development as responsible learners and to discuss a wide variety of useful personal initiatives indicative of a growing commitment to life-long learning. Effective communicative skills for presentations and peer critique are also part of the intended learning outcomes.

SOLO Taxonomy

The Structure of the Observed Learning Outcome (SOLO) taxonomy (Biggs & Collis 1982) was devised to enable educators to formulate objectives for desired learning. SOLO levels are defined to match the evolving structural complexity of learning, which changes first quantitatively, and then qualitatively. The taxonomy deals with the content of the learner's response to a task and is applicable to assessment in both the cognitive and affective domains.

In the MEd112 course, students are assessed holistically based on their participation during learning sessions and their assignment work. Students must submit all the assignments to pass. They must also meet the attendance requirements. We have set up explicit criteria, based on the SOLO taxonomy, for judging the performances against the criteria.

Constructive Alignment

The principle of constructive alignment is grounded in the constructivist understanding of encouraging deep approaches to learning through an aligned design for teaching (Biggs & Tang 2007). It is an instructional-design framework for systematically aligning intended learning outcomes, in terms of performances of understanding required from students, with teaching methods, learning activities and assessment tasks to elicit these outcomes, as well as to assess student performance.

In the MEd112 course, we have constructively aligned the learning outcomes with teaching and learning activities, and with specific assessments targeted for eliciting the intended learning outcomes. Figure 1 gives an overview of the course-design components, showing the digital technologies and media that were used in the course, the connectivist-based learning and teaching activities, assessments that used rubrics based on the SOLO taxonomy for grading and the intended learning outcomes drawn from the learning taxonomies.

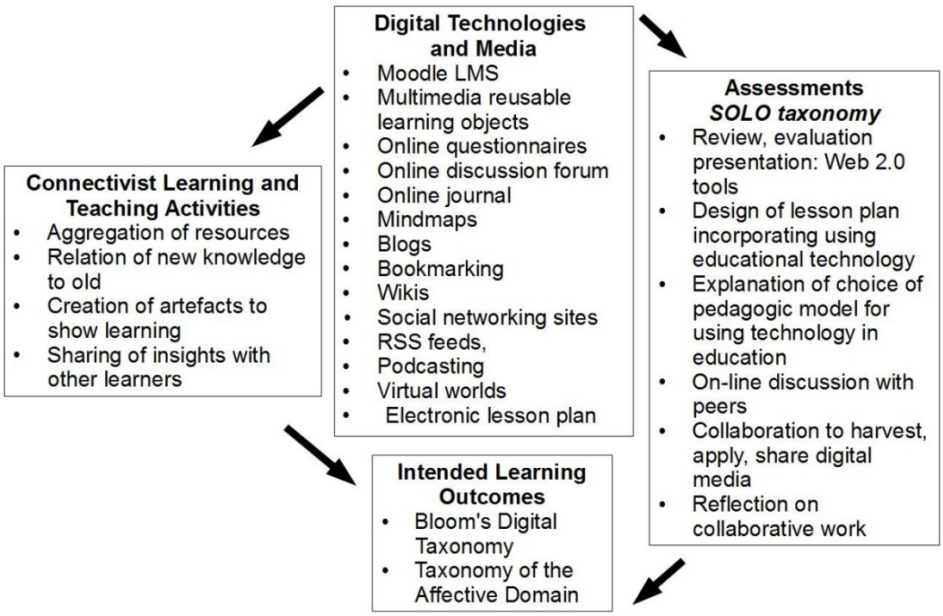

Figure 1. Constructive alignment of course components

Implementing the Course

In this paper, we discuss our experiences of teaching the MEd112 course in October, 2010 (in Portuguese), and in June, 2011 (in English). The former had 15 students, and the latter had 14. For this module students attended ten three-hour learning sessions and completed several individual and pair assignments in their own private study time. Classroom sessions involved actual work with education technologies, and students were expected to each have a laptop computer that could connect to a wireless network. The learning sessions were a mixture of lectures, pair and team work, demonstrations and other activities.

All course material was made available on Moodle, an open-source learning-management system. Moodle has gained popularity among higher-education establishments for hosting a variety of learning activities such as discussion forums, electronic journal writing, adaptive quizzes, collaborative wikis and workshops for peer evaluation (Cole 2005). It enables course management, assessment, communication, adaptive learning, content delivery and tutor support, and offers facilities for feedback and for tracking student progress (Everett 2001). Moodle is founded on social-constructionist epistemologies of teaching and learning, and Moodle activities enable learners to reflect critically on their own learning, and to learn collaboratively by engaging others thoughtfully and empathically (Dougiamas & Taylor 2002, 2003).

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The MEd112 course provides an understanding of learning models and the impact that technology can have in terms of enhancing and enriching the learning process. The primary focus is on the application of teaching and learning strategies that integrate technology as a vehicle in the differentiation of curriculum. In addition, the module explores innovative technology applications such as Web 2.0 (O'Reilly 2005) and mobile technology, and how these apply, transform and challenge technology integration in education. The objectives of the course were to:

- familiarise students with the historical developments of technology in education, and with current and emerging tools and paradigms and their integration in teaching and learning.
- make students knowledgeable about:
  - learning theories underpinning technology in teaching and learning – the behaviourist, cognitive approach and constructivist approaches to teaching with technologies; and
  - models for teaching with technologies.
- enable students to use digital media and collaborative Web 2.0 tools, and to use Moodle to engage in online learning activities and lesson development.
- enable students to use technologies to conduct their own research and to review key studies in IT in education.
- make students aware of the social, ethical, human and legal issues of using technology.

Generally, we expected that, on completing the module, students would:

- have a good strategic and general understanding of the potential roles of technology in education, and how it can be adapted to enhance and enrich educational processes.
- be aware of the broad spectrum of computer technologies that are widely available and readily adaptable to educational settings and for research purposes.
- have actual experience of using several popular and well-regarded education technologies and a good understanding of their strengths and weaknesses in educational settings.
- be interested in pursuing strategic areas of technology integration and research in their own context and to submit a research paper (optionally) for an international conference or publication.

For their final project, the students use digital media to develop and present a lesson plan (Appendix A gives the details of the project that the students were asked to develop as a final assessment). They integrate digital tools in their lesson plans. They also collaborate in teams to harness and share digital resources. In-class and online discussions are held on the social, ethical, human and legal issues involved in the use of technology and on the historical development and future trends in technological advances. Teams debate topics such as benchmarking among plagiarism tools and which available e-learning technologies should be applied to learners with different learning styles. An optional assignment consists of the submission of a research paper that might lead to a student's dissertation. Additionally, in the Portuguese MEd112 course, students experimented with their own installations of the Moodle learning-management system.

Examples of specific learning outcomes drawn from Bloom's Digital taxonomy and some of the technology-related activity and tools the students used for the course are given in Table 1. Grading criteria for all the assessments were based on level differentiations according to the SOLO taxonomy.

Table 1. Learning Outcomes and Technology-Related Activities and Tools

Learning outcomes from Bloom's Digital Taxonomy	Technology-related activities and tools
Remembering: retrieving, recalling, recognising	Bookmarking using the browser and Web 2.0 tools; e.g. Diigo and Delicious.
	Searching using search engines and keywords.
	Social networking using Facebook
	Listing and labelling using word-processing tools (Word, OpenOffice, Google documents, Zoho)
	Quiz (Moodle) and ClassMarker
Understanding: constructing meaning, interpreting, summarising, classifying, comparing, explaining	Advanced Boolean searches using search engines

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	Blog journaling using Blogger
	Categorising and tagging using Delicious and Diigo.
	Commenting in an online forum set up in Moodle
	Subscribing to RSS feeds for personal interests
	Showing and explaining online and desktop-based graphic, video and audio tools; e.g. YouTube, PodBean
Applying: implementing, running, uploading, sharing, editing	Illustrating with graphics created in Paint, COLOURLovers, Tux Paint, Sketchcast
	Simulation using tool such as Second Life
	Organising photos, video and sound clips using SnackTools, Flickr
	Wiki editing in Moodle wiki
	Demonstrating Web 2.0 tools
	Creating presentations using PowerPoint, SlideShare, Prezi, Keynote
	Video conferencing using Skype and Facetime
	Setting up Moodle learning-management system with administrator privileges
Analysing: differentiating, organising, attributing	Mind-mapping using open source tools: FreeMind
	Using free reference managers: Zotero, Mendeley
Evaluating: making judgements based on criteria, critiquing work of peer	Posting and moderating comments in blogs and Moodle forums
	Reflecting in Moodle journals and blogs
	Critiquing lesson plans and peers' presentations according to set rubrics
	Collaborating in shared wikis, bookmarking sites and social networking sites
	Investigating and reviewing Web 2.0 tool
Creating	Publishing digital books using online tools: Tikatok, Blurb
	Creating digital flash cards: StudyBlue
	Creating lesson plans using digital media
	Writing reports using publishing tools: Google, Microsoft Office, Apple, Open Office
	Creating spreadsheets and charts: Excel, Google Sheet, Calc, Numbers
	Creating online surveys: Moodle questionnaire and Google forms

Insights from Teaching the Course

The MEd112 course gave us new insights into the challenges of teaching with technologies. We obtained feedback from a course-evaluation questionnaire, the journals that students wrote and informal chats with students. In this section, we trace our students' progress through the connectivist learning stages of awareness and receptivity, connection-forming, contribution and involvement, pattern recognition, meaning-making and praxis (Siemens 2006).

Awareness and Receptivity

In the early stages of the course, our students showed varying levels of awareness and receptivity of technologies. From an initial questionnaire we gave to students, we found that the level of technological skills and competencies were low. We decided to scaffold the learning extensively with help manuals and tutorials for various digital tools. The use of Moodle to provide links to web resources, YouTube videos and podcasts helped us give students access to relevant information. Our students welcomed the ease with which Moodle allows definitions and key terms to be shared in glossaries and for ideas to be shared in wiki pages. In the Portuguese MEd112 course, our students, who were full-time teachers, appreciated the facilities that Moodle provides for

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easily setting up quizzes, the wide range of provided questions and the automatic self-grading feature. However, we found that it was difficult for some of our non-native English speakers and older teachers to navigate and comprehend all the information relating to learning theories and pedagogical models that we expected them to read and understand.

Connection-Forming

Our students worked in pairs and in teams; they were expected to form personal connections or networks, and to share selected information that they had judiciously selected. Developing these skills was easier for some students than for others. While some were familiar with social-bookmarking sites and RSS feeds, others found it challenging to engage with new technologies. We found that Google Docs and Facebook were popular choices for the teams to communicate and share ideas and resources. Students showed commendable contribution to and involvement in all the course activities. The sharing of ideas and digital resources for teaching and learning motivated many of the students to apply these tools in their own classrooms. It was particularly pleasing to see "experts" spontaneously teach others who were interested in a particular tool.

Contribution and Involvement

Connectivist learning environments encourage the collaborative negotiation of multiple viewpoints, perspectives and opinions. We found that the discussions in the online forums were initially dominated by a few students. Contributions from students of Asian background were often limited to concurring with others. However, as the course progressed, it was interesting to see the increased self-confidence and open expression of views from previously reticent students.

Pattern Recognition and Meaning-Making

Connectivist learners are expected to recognise emerging patterns and trends related to information and knowledge creation (Siemens 2006). In their lesson plans, all the students were able to relate digital technologies to their own teaching contexts. The lesson plans demonstrated the use of pedagogic models and learning taxonomies. Some of the students shared their lesson plans with their colleagues at their institutions, and one student even published a research paper (Zelia & Negreiros 2013) based on their work during the course.

Praxis

We found evidence of metacognition, active reflection and critical evaluation in students' journals and blogs about their experiences. From these writings, we identified learner anxiety in terms of unfamiliarity with digital tools, and concerns about group work. We also traced how fear of using new technologies was transformed to increased confidence and even enjoyment. Following are some writing extracts from students that exemplify these findings. To protect their privacy, the extracts do no name the students. Extracts in Portuguese have been translated by the second author.

Metacognition on the Learning Process

> *Throughout school, I always dreaded group work because I knew other group members would rely on me to get things done, and if that were the case, I would rather just work by myself. That is not to say that my group members did not contribute, but I felt that they were counting on me to take initiative and make decisions.... Maybe it's my fault. Maybe I'm too aggressive and take initiative too quickly. Perhaps if I take a step back and try to facilitate, rather than dictate, then others would be more at ease and play a greater role.*

Active Reflection about Class Activity

> *(Translated from Portuguese): The discussions raised during the theoretical sessions were extremely useful, forcing us to reflect and rebuild our role as future teachers: What kind of students will ultimately be produced? Better, different or worse when compared with the previous generations? How to combat failure and social exclusion in schools through the use of IT? Future libraries: paper books vs. digital books….*

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Critical Evaluation of the Course

> *This module was the last one to complete, so [because] it coincided with the end of the school year...the time that each of us could allocate towards the course was limited. Yet, it was extremely useful and interesting, which made me look forward to every class. I liked the practical component of the course, which I will now be able to use for my own classes, while the theoretical component was an important step in consolidating the theory learnt throughout the year, as well as my own ideas about learning and teaching. I'd also like to recommend that this course take place sometime in the first semester, as a lot of the material could be extended to the other modules, greatly benefiting the students.*
>
> *(Translated from Portuguese): Reflecting now on my teaching practice in the use of new technologies, I believe that this course has awakened in me a strong desire to further explore this vast digital resource, confirming our work as teachers and facilitators of learning. Certainly, definitions such as blended learning, blog, learning object, Web taxonomies, content creation, multi-channel communication, forum, wiki, Web 2.0, Flick, Second Life, hyperlinks and semantic web, just to name a few, became part of my vocabulary. Yet, as regards the quiz and survey, in my opinion, I do not recognise these assessment instruments as credible since the true inquiries can be replaced by others during the execution.*

Learner Anxiety with New Technologies

> *Aside from learning that others are way ahead of me in technology and, obviously, that I am so far behind, I learn that even with their unselfish sharing what they know, I still find difficulty most of the time catching up and it is really frustrating – but definitely challenging somehow, and quite fulfilling when I am able to finally manage to do [so]. In this process, I am with the help of my team mates and even members of other teams enjoying the [challenge] of having to explore new things. As a result, my having to work in and with a team does not only make me realise that I am learning so much from them, it has also made me feel guilty that I could not contribute much. Well, I am just hoping, though, that their seeming willingness to share their know-how on digital technology truly comes from the heart.*
>
> *(Translated from Portuguese): The exploration of the Web 2.0 tool was a real challenge, mainly because it was not easy to select from a wide range of available tools the one that pleased the group. MyEbook was our choice. Oddly, our choice even influenced our professor to launch…an ebook under this platform. How to exploit this capability in order to give some "real authors" meaning to our "real students" will also be an appealing idea in our near future.*

Concerns about Group Work

> *Working with my team is both challenging and interesting. It is challenging because all four of us are not familiar with many new technological aspects, which makes it very hard for us to complete tasks on time. [It is] interesting in a way that we enjoy and try to have fun while working together on assigned task instead of complaining about what we don't know and how to complete the task. Moreover, what I admire about my teammates is that nobody looks down at others for not knowing certain things. Instead, we try to help each other whatever way we can.*

Transformation of Fear of New Technologies

> *Most of us are trying something new, and we just were enjoying the session as we [were] discovering something new every time we press[ed] a button. It has been an enjoyable session as I am forced to learn/explore something that I would not be exploring if not for this project. It is like trying to discover something that has been there all the time, waiting for me to find it.*

Reflections on the Course

The dramatic rise in use of digital media has changed the way learning and teaching is taking place, and has led us to rethink the way we teach with digital technologies. This paper has presented the theoretical design of a course that introduces educational technologies to students studying for a master's in education, and that is grounded in learning theory for the digital age. The paper has described the use of learning and assessment

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taxonomies and the alignment of learning outcomes, teaching and learning activities and assessments in the course. We have shared our insights of how the course design has enabled the learners to learn using technologies.

In our connectivist-based course, we found that the level of awareness of digital media varied amongst students, as did the level of receptivity towards integration of technology in teaching. These factors in turn affected the learning connections, the contributions that students made in class and the involvement in group projects. Our students had more success in recognizing emerging patterns and trends and incorporating some of the new technologies into their lesson plans. During the course, the students demonstrated a high level of metacognition of their learning process, active reflection on the course activities, and critical evaluation of the course structure. They also exhibited learner anxiety when faced with situations where they had to work with new technologies and not all students were comfortable with group work because of their lack of knowledge of new digital media.

Fear, anxiety and concern, as well as the skill of the teacher are known to be major determinants of the effectiveness of technology integration into the curriculum (Bitner & Bitner 2002; Gardner, Discenza & Dukes 1993). Though it is heartening for us to see our students exhibiting signs of increased confidence and enjoyment in using technologies, it is also known that the learning path in a connectivist environment increases in complexity as the learners explore and expand their personal learning (Siemens 2006). We note that factors that affect our course design have corresponded with some of the hindrances mentioned in the literature: lack of development time and budget, unreliability of technology infrastructure and institutional readiness and the need to develop new professional and technological competencies on our part to deal with learner support and anxieties (Reeve, Herrington & Oliver 2004; Siemens 2006). Another concern that we have mentioned is corroborated by findings (Kop 2011; Terry & Jon 2011) that in connectivist environments for learning, the direction of learning is influenced by a few technologically savvy or outgoing students, while learning is hindered for learners who are not self-directed or who do not possess high levels of creative and innovative thinking.

Our work has implications for future practice and policy at our institution. We have learned that:

- the level of awareness of digital media and receptivity towards integrating technology in teaching affects the process of learning with technologies;
- attention should be paid to learner anxiety with technologies when introducing teachers to new digital media; and
- collaboration, negotiation and conflict-solving skills should be encouraged to resolve online and face-to-face group work for learning with technologies.

Our future work is to:

- specifically attend to learner anxiety with technologies at the start of the course by introducing more scaffolding measures and personal interventions from the teacher;
- discuss collaboration, negotiation and conflict-solving skills amongst student teams to reduce the concerns that we have noted about group work (both online and face-to-face); and
- systematically document and evaluate the transformative thinking processes we have observed and thereby contribute to the discourse on learning with educational technologies.

In conclusion, creating and implementing a theory-based course for learning and teaching with technologies is a challenging procedure. We have, together with our students, emerged with a deeper understanding and appreciation of the role and impact of educational technologies in the classroom.

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Appendix A

Details of the project students were asked to develop as a final assessment

You are expected to choose a topic that you currently/would like to teach, or have taught in the past, and create a lesson that incorporates the use of education technology. In a lesson plan, explain your choice of a pedagogic model for using technology in your lesson. The lesson is to be developed at www.blogger.com or any other shared space of your choice. For the lesson you may refer to the digital publishing rubric at: edorigami.wikispaces.com/file/view/digital+publishing+rubric.pdf . For the lesson plan you may use the validating information rubric at: edorigami.wikispaces.com/file/view/validating+rubric.pdf.

The lesson plan is to address the following questions:

1. What is the scope of the topic, and what learning outcomes do you have for the students?

2. What pedagogic approach will the lesson plan be founded on, and how will demographic and other learning characteristics of the students be considered?

3. How will the content be divided among the learning sessions, and what is to be covered in each session?

4. What learning media and other technology materials will be provided to students to supplement classroom work to support better learning?

5. What criteria (rubrics) will you use to assess the performance of students taking the course?

6. What specific assignments, tests and other assessment tasks will be incorporated within the course and how do they relate to the learning objectives?

You will be assessed on your ability to:

- Create a written lesson plan based on taxonomy-based learning outcomes and assessment criteria.

- Design a lesson incorporating the use of educational technology founded on a well-known pedagogic model.

- Integrate learning media and content in a learning space of your choice.

The following criteria will be used to grade your project:

- Excellent: You have shown clear attainment of all learning outcomes, complete and comprehensive understanding of the pedagogic content, with development of education-technology design skills and initiative to an extremely high level.
- Good: You have shown substantial attainment of most learning outcomes, showing a high level of understanding of the pedagogic content, with development of educational technology design skills to a high level.
- Satisfactory: You have shown sound attainment of some major learning outcomes, with understanding of most of the basic pedagogic content and development of relevant skills to a satisfactory level.
- Poor: You have shown some attainment of a range of learning outcomes showing a basic understanding of and minimum development of relevant skills.
- Unacceptable: You have shown no attainment of the learning outcomes; work was not presented or was plagiarised.

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