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Walk the talk: Immersing pre-service teachers in the learning of ICT tools for knowledge creation

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This paper traces the evolution of the design framework for the use of technology in a teacher education program in a Singaporean university. This course focuses on developing student teachers' capacity for the use of ICT in teaching and learning. We report our two-level reflection: one that focuses on the trajectory of the course design, and one that reflects on the university faculty's pedagogical practices when conducting this course. The goal of this course in the last decade has transformed from a focus on technology skills to pedagogical and knowledge creation. The current goal of the course is to develop student teachers' pervasive use of technology tools to collaborate, design, reflect and think critically. The challenge for the faculty in a teacher education higher learning institute is to design a course that would present opportunities for student teachers to experience the technology tools as learners themselves so as to become teachers who will be doyens in designing technology tool integrated learning. We contend that the experiences of technology tools help to deepen the student teachers' knowledge about technology integration. As student teachers experience technology tools in tandem with theory, the immersive experience may translate into designing apt technology-integrated lessons for their learners.

Introduction

This paper reports our journey on the use of information and communication technology (ICT) to support teacher education in the Learning Sciences and Technologies academic group, National Institute of Education (NIE), Nanyang Technological University, Singapore. NIE is the official teacher education institute for teachers across subject disciplines and across levels, from primary to junior college. Since the 1980s, the use of ICT in education has been a compulsory course taken by student teachers in NIE. This paper traces the evolution of this ICT course in its intent and instructional approaches. It elucidates our trajectory in the last decade (2000-2010), which can be broadly represented in three phases: a focus on developing student teachers' technology skills, a focus on developing student teachers' competency in designing technology-integrated lessons, and the current form that provides opportunities to engage our student teachers in knowledge creation with Web 2.0 tools.

While there are researchers who lamented about the limited academic use of computer technology in university (e.g., Selwyn, 2007), there are others who championed innovative approaches to the use of ICT in higher education. For example, engaging students in practice activities using laptops (Barak, Lipson & Lerman, 2006; Chompu-Inwai & Doolen, 2006), course related software (Barak et al., 2006), and real world projects (Kolar, Sabatini & Fink, 2002). Our journey in NIE is unique in two ways: the

focus on pedagogical applications and the two-level reflection. Given that NIE is a teacher education institute, our key focus has been on the pedagogical dimension of ICT use. In addition, it is a two-level reflection because we need to develop in our student teachers, necessary ICT pedagogical skills and knowledge, while at the same time, reflect on and improve our own pedagogical practices with the use of ICT. In this paper, we will first foreground the first level reflection, that is, how we design the ICT course for our student teachers, including how we align the course to developments to policy changes. Our second level reflection focuses on our own practices with ICT applications, which change in tandem with technological advances and our gradual shift from instructional design to learning sciences.

The ICT journey: Major milestones

Tracing the trajectory of ICT use in NIE, there were three significant milestones. Table 1 shows the changes in ICT use over a decade and the associated expected outcomes for student teachers.

Table 1: Trajectory of NIE's ICT use over a decade

	Focus on skills (2000-2003)	Technology-integrated lessons (2004-2009)	Knowledge creation with Web 2.0 (2010-current)
Expected student teachers' competencies	• *microLESSONS* • Instructional design	• Learner-centred lesson packages • Knowledge of a suite of tools	• Web 2.0 • Learner-centred lesson ideas and artifacts
Tools used in NIE	• Learning management systems • *PowerPoint*	• Learning management systems • Discussion board • *PowerPoint*	• E-learning hub • Learning management systems • Blogs • *Google Docs*
Pedagogical approach	• Lecture	• Faculty modelling • Lecture • Collaborative learning • Self-directed learning	• Reciprocal teaching • Self-directed learning • Faculty modelling • Lecture • Participative

The first milestone (2000-2003): Focus on skills

During this period of time, the prevalent teacher training approach focused on technology skills (Galagan, 1999; Johnson, 1988; Rogers, 2000). ICT integration studies (Dawson & Heinecke 2004; Jaber & Moore, 1999; Manternach-Wigans, 1999; Wetzel, 2001) revealed that teachers wanted access to computers and resources to enhance their confidence through familiarity with relevant hardware and software, with the assumption that planning to integrate computers into the classroom would naturally ensue.

In addition, the goals of the local ICT policy permeate the curriculum. The first *Master Plan* (mp1) for ICT in Education was instituted in 1997 and lasted till 2002. The four goals of the plan were to (i) enhance linkages between school and the world around it; (ii) generate innovative processes in education; (iii) enhance creative thinking, lifelong learning and social responsibility; and (iv) promote administrative and management excellence in the education system (MOE, 2011). Professional development in ICT

integration took the form of training every teacher in the service with core skills in teaching with ICT. These goals shape our curriculum content, particularly in the development of tutorials (called *microLESSONS*) and skills in choosing relevant instructional materials.

Influenced by the above factors, NIE's ICT course in the early 2000s focused on the development of ICT skills of student teachers. The underlying assumption was that student teachers, when equipped with relevant ICT skills, coupled with an awareness of the various instructional strategies, will be competent designers of ICT integrated lessons. The course was entitled *Introduction to Instructional Technology*. A learning management system (LMS) was used as a medium to deliver the course materials and to communicate with student teachers. Course content was delivered via *PowerPoint* slides.

Student teachers were expected to demonstrate their competencies through the design of a computer-based lesson (CBL) as part of their assignment. *PowerPoint* became the main tool for content delivery. Ensuring student teachers' acquisition of relevant technology skills, they were taught how to create *PowerPoint* slides. They demonstrated their skills and knowledge application in designing a *PowerPoint*-based lesson, called *microLESSONS*. Student teachers were first introduced to two broad categories of instructional approaches: *teacher-centred* versus *student-centred* approaches. They engaged in discussion of the different learning theories with an emphasis on student-centred learning. *microLESSONS* are small units of instructional materials that harness the power of ICT to teach specific objectives (Divaharan & Wong, 2003). The small, 'bite-sized' instructions were meant to be self-sufficient for teachers to use within larger lesson units.

In the creation of *microLESSONS*, student teachers needed to incorporate various computer features (e.g. animation, graphics, sound and interactivity) to enhance the teaching and learning process within a classroom. A range of instructional activities such as simulations, games, and problem solving activities were incorporated. The development of *microLESSONS* offered student teachers opportunities to think and apply their pedagogical knowledge. Student teachers were expected to show a transition from teacher-directed instruction to a more constructivist mode of learning in their lesson design.

Tools and pedagogies

Intent on equipping student teachers with relevant instructional approaches and ICT skills, access to resources and materials to learn the ICT skills were provided via the LMS. Faculty lectured and demonstrated technology skills such as CD-ROM use, locating relevant CD-ROM and Internet resources, and evaluating CD-ROM and Internet resources.

During this period, faculty's use of ICT for instruction was largely to communicate and share resources and materials via the LMS. *PowerPoint* was used as a medium to store and deliver content. Opportunities were provided for student teachers to learn and apply their technology skills in designing *PowerPoint* based teaching and learning materials, having observed faculty modelling of teaching using *PowerPoint* based resources.

The second milestone (2004-2009): Technology-integrated lessons

During this period of time, the prevalent ICT training approach focused on putting the learner at the centre of all activities that were designed. The course adopted the attributes of meaningful learning as characterised by Jonassen, Howland, Marra and Crismond (2008), which include active learning (learner is manipulative and observant); constructive (learner is articulative and reflective); cooperative (learner is collaborative and conversational); authentic (learning context is complex and real life); and intentional (learning is goal directed).

Similarly, the local ICT policy continues to exert its impact. The second *Master Plan* (mp2) for ICT in education was inaugurated in 2003 and lasted till 2008. The main goal of mp2 is that ICT will be pervasively and effectively used to enhance teaching and learning processes. Selected outcomes articulated in mp2 that are of relevance to NIE's teacher education program are (i) learners use ICT effectively for active learning; (ii) connections between curriculum, instruction and assessment are enhanced using ICT; and (iii) teachers use ICT effectively for professional and personal growth. The ICT course during this period was entitled *ICT for Meaningful Learning*.

Tools and pedagogies

As in the past, the LMS continued to serve its role as a medium for communication with student teachers as well as to share resources and course materials with them. An additional technology tool that was utilised extensively with student teachers was the discussion board. With an emphasis on social construction of knowledge, student teachers were introduced to collaborative learning approaches. In view of mp2 outcomes requiring learners' use of ICT for active learning, student teachers were exposed to various pedagogical approaches which could be used to support ICT integration. Student teachers explored various pedagogical approaches, for example case-based learning, inquiry-based learning, project-based learning, resource-based learning, and game-based learning. Relevant resources and links to additional resources were uploaded into the LMS. Student teachers were engaged in online discussions, where they worked collaboratively to explore the various pedagogical approaches, and to relate ICT tools to the pedagogical approaches. These online discussions were facilitated by the faculty, who modelled facilitation and coaching skills for the student teachers. Faculty modelling of facilitation and mediation online was a key to the student teachers' learning the skills as they participated.

As part of the module assessment, student teachers were assessed on their ability to facilitate online discussions among their peers. Assessment of how they functioned as online collaborative teams to modify or create authentic interactive learning resources for engaging their learners was also carried out by the faculty. Both tutor as well as peer evaluations were introduced as part of the assessment component (Divaharan & Lourdusamy, 2002).

Given the need to instil independent lifelong learning skills, student teachers were required to showcase their ability to self-learn an innovative technology tool. Support for student teachers was provided through the provision of resources available for them via the LMS. For a selected number of tools, student teachers were provided start-up resources to learn. These were in the form of self-help videos and tutorials. Student teachers, who explored tools beyond the options given, were guided by the faculty (Divaharan & Koh, 2010; Koh & Divaharan, 2011).

The third milestone (2010-current): Knowledge creation with Web 2.0

With continuous influence from policy changes and student teachers competencies, the current curriculum is yet another endeavour towards preparing them for the teaching fraternity. The goal of the current course to nurture our student teachers to become 21st century teachers skilled at using technology for facilitating school learners' knowledge creation.

The third *Master Plan* (mp3) for ICT in education was instituted in 2009 and will end in 2014. The main goal of mp3 is to foster in learners the competencies of self-directed learning (Tan, Divaharan, Tan & Cheah, 2011) and collaborative learning (Chai, Lim, So & Cheah, 2011) through the effective use of ICT. Concurrently, the plan aims to develop learners to be discerning and responsible ICT users. Among the enablers is the capacity for the teachers to plan and deliver ICT-enriched learning experiences for students to become self-directed and collaborative learners, as well as to become discerning and responsible users of ICT (MOE, 2011).

Tools and pedagogies

The use of ICT incorporation was underpinned by a framework termed *Dimensions of Meaningful Learning*. The framework is represented by five aspects of what we deem as appropriate attributes of meaningful learning in the Singapore context. This was achieved by appropriating characteristics of meaningful learning advocated by Jonassen et al. (2008). To accomplish greater alignment between our curriculum and the IT Master Plan 3 laid out by the Ministry of Education, Singapore, self-directed and collaborative learning were incorporated as part of the five dimensions. As a result, the five dimensions of meaningful learning are: *Engaging prior knowledge, Learn by doing, Real-world context, Self-directed learning* and *Collaborative learning*.

To provide a truly meaningful learning experience and to appreciate the unique disposition of NIE, and taking into consideration student teachers' ICT competencies, it was pertinent to provide a learning framework where student teachers will be able to experience the use of the various ICT tools as learners themselves before they are adept of applying the knowledge and experience to design lessons.

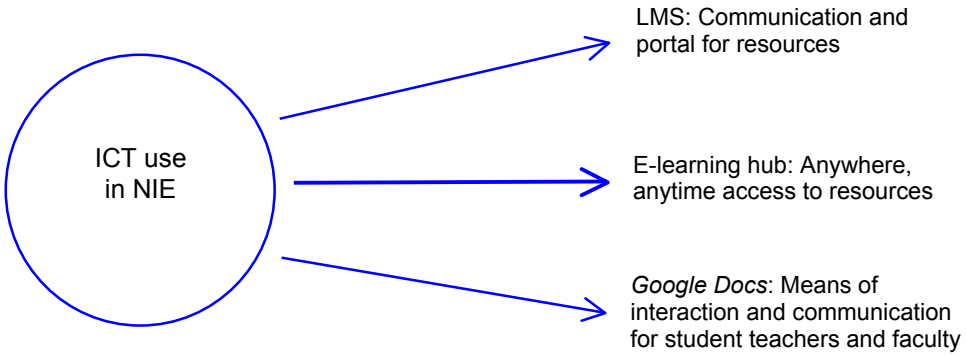

Figure 1: Overview of ICT use in the current course

ICT assimilation into the course can be categorised in three broad spectrums. Figure 1 provides an overview of the adoption of current ICT practices.

Dissemination of information and communication with student teachers took place via the LMS. Sending emails, course instructions and reminders were through the LMS. The e-hub was a new conception and addition to the ICT course. The intent was to make available course resources and materials to student teachers at all times. All course materials and resources were stored in the e-learning hub. Figure 2 shows a screen capture of the e-learning hub and Figure 3 shows the core materials screen. The e-learning hub made provisions for student teachers to be self-paced learners with the ability to access the materials and resources to explore and learn.

Figure 2: E-learning hub

The e-learning hub encompassed core course materials, videos resources, animations to provide visual understanding of concepts and additional reading references. Core materials section contained the essential course resources. These were classified under the five *Dimensions of Meaningful Learning* as well as *Lesson Planning* and *Cyberwellness*.

Encouraging self-directedness in student teachers

To encourage self-directed learning, student teachers were provided self-learning materials for a repertoire of technology tools and this was delivered in the *Technology Enabled Lessons* (TELs) section of the e-hub. Figures 4 and 5 shows how a game based learning TEL looks like. These are self-paced materials, where student teachers can learn them on their own and clarify doubts during tutorials.

Figure 3: Core session materials

Figure 4: TEL access page

Expanding beyond course relevant resources, student teachers had access to videos of school ICT use, additional web resources and open resources which were accessible to them via the 'Resources' section of the e-hub, as shown in Figure 6.

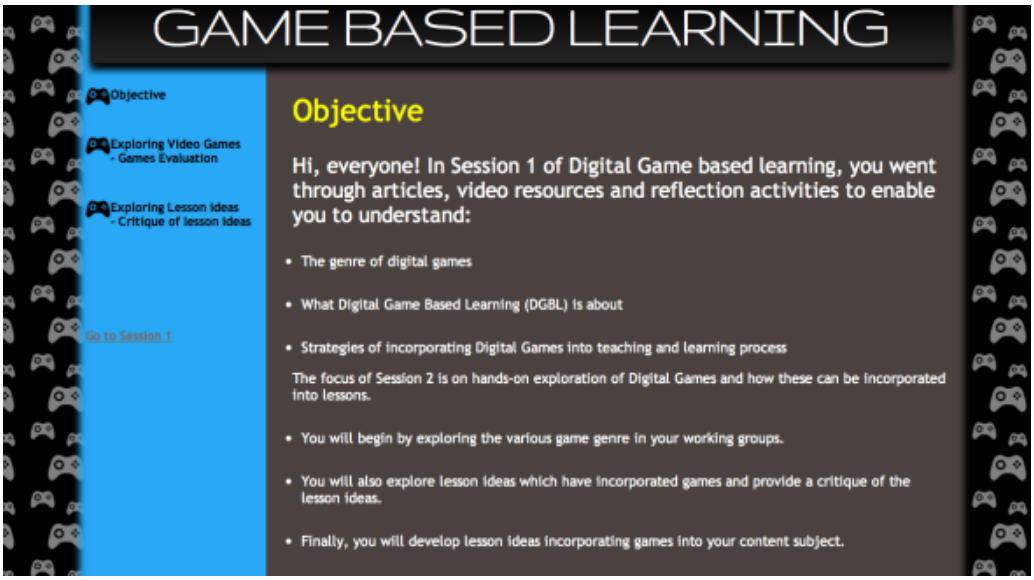

Figure 5: An example of a TEL

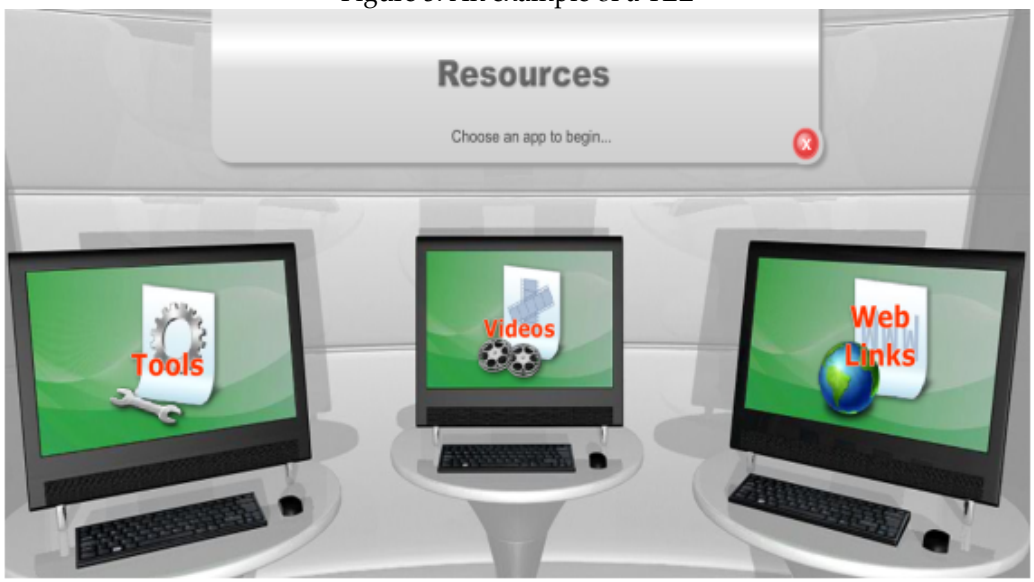

Figure 6: Resources page

Engaging prior knowledge and real world contexts through blogging

Summarised by the National Academy of Sciences book on *How students learn* (Donovan & Bransford, 2005), one of the fundamental principles of learning that is important for teaching is to draw connections to learners' prior knowledge. The rationale for engaging learners' prior knowledge is to facilitate deep learning for transfer to other contexts. For student teachers, it is important for them to elicit their prior conceptions of teaching and to make connections with new information.

Contemporary research on learning has argued that learning tasks situated in some real-world situations are not only better remembered but also facilitates transfer of learning to new contexts (Jonasssen et al., 2008). The rationale for real-world contexts is to bring to fore the importance of designing learning environments that are as authentic as possible for meaningful learning to take place.

To make provisions for this knowledge creation, student teachers were assigned tasks during their *Enhanced School Experience* (ESE). During ESE, student teachers are in school under the guidance of a teacher mentor. They experience what it takes to be a teacher. Student teachers were asked to blog their experiences and observations of ICT use in schools, and to reflect on mp3 and its application in teaching and learning. These blogs were to be shared with their peers as well as their tutors. Blogs were a good platform for student teachers to journal their observations and their opinions. Sharing of their individual and personal perceptions helped them to learn from each other and to expand their view points as they read their peers experiences from the various schools. During the first tutorial after their return from ESE, student teachers and faculty engaged in discussions drawing on the perspectives shared in the blogs. The use of blogs encouraged the student teachers to capture snapshots of the ICT integrated learning environment in schools and created opportunities for them to learn through engaging prior knowledge and making connections to real-world knowledge (school and classroom contexts).

Learn by doing and collaborating via *Google Docs*

The focus of the dimension *Learn by doing* is to introduce to the student teachers the participative nature of learning (Sfard, 1998). *Learn by doing* emphasises what practitioners do in the real world. For student teachers, the key is to help learners establish connections between school knowledge with knowledge used in the real world. The curriculum addresses the dimension of Learn by Doing by having student teachers understand what *learn by doing* means and its importance for meaningful learning to take place.

Google Docs was chosen as a platform for student teachers to embark on their collaborative learning discussions. Activities, discussions, peer feedback as well as faculty feedback was provided via the *Google Docs* platform. A culture of sharing was mooted so that they will be encouraged to learn from their peers (Divaharan & Lim, 2010) and to provide feedback to each other in the spirit of learning. Student teachers were able to tap into the affordance of the platform to engage in real time discussion, to provide feedback to each other, and to extend their learning beyond face to face tutorials. Faculty involvement was in the form of monitoring the student teachers' learning, stretching their knowledge creation by coaching them and providing feedback via the platform.

One such activity which encouraged *Learn by doing* was the involvement of student teachers in 'Reciprocal Teaching'. Student teachers were divided in groups and each group was tasked to explore one of the five *Dimensions of Meaningful Learning*. The student teachers were expected to use *Google Docs* as a platform to discuss, consolidate learning, and to be prepared to teach their peers the dimension that they had learnt. Tutors were monitoring, scaffolding their learning in the background such that the learning becomes a meaningful experience for the student teachers.

The combination of the various ICT tools ensued in an anytime and anywhere continuous learning experience for the student teachers. However, to ensure that effective learning experiences were shaped, the delivery of the course was underpinned by the above-mentioned five *Dimensions of Meaningful Learning* as articulated by the course.

Reflection on our applications of ICT to support teacher education

As we engage in second level reflection on our own practices in supporting student teachers learning with ICT, we identify three key influences that shape our decisions and actions. They are our beliefs and philosophy about the pedagogical applications of ICT, the proliferation of Web 2.0 tools in teaching and learning, and finally, the necessary epistemological shift in tandem with Web 2.0 tools.

Our beliefs and philosophy: Harnessing the learning sciences for knowledge creation

The field of the learning sciences "draws on multiple theoretical and research paradigms for the human sciences so as to understand the nature of and conditions of learning, cognition and development" (Barab, 2004, p. 16). One such study of human cognition includes learning in relation to forms of technology (Duffy, 2004). Evidenced in the trajectory we have taken, it is our belief that it is no longer sufficient to have our student teachers being effective in using technology, which represents a narrow focus on technology skills competency. We believe in developing them to be teaching professionals who understand the nature of cognition, so that they can appropriately harness technology to help school learners learn better. Hence, the shift in our curriculum during the period of mp2 to have student teachers learn collaborative learning approaches and various pedagogical approaches to support ICT integration in teaching and learning.

In fact, as shown in the third milestone in tandem with the mp3, we created various opportunities for student teachers to make sense of their learning experiences. They range from drawing on the e-hub resources as they participate in reciprocal teaching during the face to face sessions. During reciprocal teaching, groups are required to (1) make sense of the principal learning resources, (2) include additional research if need be, and (3) contextualise their reciprocal teaching, using examples from their prior experiences. These conditions are to provide opportunities for peer learning during the face to face sessions, whilst the instructors steer the discussions towards deeper learning. In addition, the intent of the TELs sessions is for student teachers to experience the affordances of various ICT tools and more importantly, to make sense of their experience in regard to the *Dimensions of Meaningful Learning* framework. Such sense making has been argued by Darling Hammond et al. (2008) to be one of the key principles of learning facilitating application and transfer to new situations.

Ultimately, towards the goal of developing 21st century student teachers, it is in our belief that student teachers, in order to help school learners construct knowledge, should be knowledge creators themselves (UNESCO, 2008). They should not only be able to appropriate current effective ICT integration practices into their teaching and learning repertoire, but also be able to solve novel and ill-structured problems in their endeavours. Our role then is to provide rich and meaningful experiences for them to make sense of current practices as well as to explore new ways of meaningfully engaging school learners.

Complementing Web 2.0 and knowledge creation

The advent of Web 2.0 has brought about a phenomenon that current and future curriculum design cannot ignore. As Brown and Adler (2008) argued, Web 2.0 technology has created a culture of participatory learning called *learning 2.0* wherein the focus is "learning to be through enculturation into a practice as well as on collateral learning" (p. 30). Compared to more traditional web technologies, Web 2.0 applications are easy to create, combine, publish, and share, thus empowering people to participate as content producers. In the context of NIE, we are increasing the use of Web 2.0 (e.g. *Google Docs*) in our pedagogies of teacher training. Through the integration, our student teachers are not just mere recipients of information but are now empowered to build knowledge (UNESCO, 2008).

In the context of the current curriculum design, such a participatory learning culture is congruent with what we believe in. It is in the motivation of having our student teachers understand the meaningful learning framework as a didactic academic exercise, and go further in being able to apply their learning meaningfully in new situations. In fact, it is in our vision that with this education they experience, they can transform the more traditional teaching and learning practices into a participative culture. We contend that the integration of Web 2.0 with our experiential pedagogical approach can bring about a more deep-rooted system intervention in the teacher education system.

That said, we are very mindful of the criticism of integrating Web 2.0 technologies in institutes of higher education for teaching and learning. We are cognisant of the fundamental contradictions between institutional cultures that adopt conventional pedagogies, and media cultures that leverage open and participatory spaces for collective participation. Related to this issue of cultural clash, Rollett, Strohmaier, Dosinger and Tochtermann (2007) posit that "as soon as we exploit Web 2.0 applications for organization purposes, and for that reason define concrete aims and impose structure, there is the danger that the very character of Web 2.0 might get lost in the process" (p.106). To ensure that there is internal consistency in the curriculum, professional development has been conducted for staff conducting the ICT course. In these sessions, rationales of curriculum design as well as implementation strategies were shared and discussed.

Web 2.0 as epistemology shifters

Moving forward, we envisage that we will be increasing our use of Web 2.0 tools. To prevent us from being embroiled in the cultural clash between the spirit of Web 2.0 and the institutional structures, we appropriated the paradigmatic differences outlined by Lim, So and Tan (2010) to articulate how we draw on Web 2.0 as epistemology shifters. According to Lim et al. (2010), e-learning 1.0 and e-learning 2.0 can be contrasted along the dimensions of technological, social and epistemological (Table 2).

Table 2: Shift in student teachers' epistemology

Dimension	e-learning 1.0	e-learning 2.0
Technological	Closed structure	Open structure
Social	Bounded participation	Fluid participation
Epistemological	Epistemology of possession	Epistemology of practice

First, with respect to technological dimensions, they contend that e-learning 1.0 is mainly based on closed structures around content delivery while e-learning 2.0 brings a diversity of open systems designed for social networking (Lim et al., 2010). Translating this to the context of the current curriculum, we hope that through the use of Web 2.0 technologies, faculty are made more cognisant on the ways to encourage continuous interaction and collaborative learning opportunities. Faculty who are successful with the use of Web 2.0 engage student teachers meaningfully and are able to meet their learning needs.

Next, on the social dimension, e-learning 1.0 focuses on self paced instruction in isolation while e-learning 2.0 puts learners at the center of a knowledge creating community. Aligned with our appropriation of a participative culture for knowledge creation, the use of Web 2.0 is to emphasise ways of social engagement, media literacy practices, and goal-oriented content creation. Student teachers and faculty learn that learning is no longer about regurgitation but in production of knowledge in context. Also, production is seldom done individually but often leveraged on the strengths of the social.

Finally, on the epistemological dimension, there is a shift from the metaphor of possession to participation. As we now live in a participatory, knowledge-creating culture, how we learn, what kinds of knowledge we access, and how we evaluate knowledge sources become central questions to reconsider in education. According to Jenkins (2006), "ways of knowing may be seen as distinctive and personal as what kinds of knowledge we access, but as knowing becomes public, as knowing becomes part of the life of a community, those contradictions in approach must be worked over if not worked through" (p.44). So drawing on Web 2.0 tools incorporated in the curriculum, opportunities arise for faculty to discuss with student teachers about the shift, including importantly, just how such a shift in learning brings about benefits for our school learners, and the associated implementation issues that can occur.

Conclusions

The theme for this special issue is ICT for accessible, effective and efficient higher education. As an academic group in a teacher education institution that is responsible for developing student teachers' capacity on the use of ICT for teaching and learning, we need to consider the three-prong tenets of accessibility, effectiveness and efficiency from both the perspectives of our student teachers as well as our own. Specifically, we see that these tenets undergird our pedagogical approach as we educate our student teachers on the applications of ICT, and at the same time, serve as useful heuristics as we reflect on our own pedagogical use of ICT to support teaching and learning.

In essence, our course design went through three major changes. In early 2000, the goal of the ICT course was to prepare student teachers with relevant ICT skills and associated instructional approaches. In mid-2000, the focus of the course was on social construction of knowledge. Hence, the course featured collaborative learning and the use of discussion forum. We developed the relevant skills needed by student teachers to manage both face to face ICT integrated learning environments as well as online environments. By late 2000, the focus had shifted to knowledge creation with Web 2.0. The current design framework of the course was underpinned by the five *Dimensions of Meaningful Learning*, which include (i) Engaging prior knowledge; (ii) Learn by doing; (iii) Real world knowledge; (iv) Collaborative learning; and (v) Self-directed learning. These dimensions were introduced as considerations for student teachers when

designing technology integrated lessons. In order to truly comprehend these aspects of learning, and to be able to apply them effectively, the student teachers were taken on a learning journey of a repertoire of technology tools enabling them to apply the knowledge acquired to design technology integrated lessons to replicate similar experiences for their learners. In sum, the use of ICT tools shifted from a content delivery tool (*PowerPoint*), to learning management and collaborative tool (LMS and discussion forum), and finally to the current form of integrated suite of technologies, including Web 2.0 technologies.

Reflecting on our journey, our own beliefs and philosophy has changed, from that of developing instructional design skills among our student teachers to that of developing their knowledge creation capacity. At the same time, we are conscious of the prevalence of Web 2.0 tools that makes ICT accessible to learners of all ages. As we harness the Web 2.0 for knowledge creation, we are cognisant of the necessary epistemological shift so that these tools can be used effectively to support the eLearning 2.0 paradigm that is open in structure, fluid in its social membership, and entailing learning through participation in a community.

Moving forward, we are watching a few potential developments. First, what is the level of new media literacy among our students and student teachers? As student teachers enter our program, what is their level of new media literacy and how could that impact their learning? Second, the shift in participatory metaphor of learning to the metaphor of learning to be, that is, learning as identity development. How do we help our student teachers develop their identity as a teacher and how could technology facilitate this process? Third, what are the new opportunities offered by Web 3.0 technologies? What would Web 3.0 technologies look like and what educational affordances do they offer? Regardless of the outcome, our experience shows that constant reflection on our beliefs and epistemological assumptions is necessary to harness the potential of technologies for their effective use in education.

References

Barab, S. (2004). Using design to advance learning theory, or using learning theory to advance design. *Educational Technology*, 44(3), 16-19. [verified 5 Dec 2011] http://lacunagames.org/research/onlinemanu/papers/barab_2004_ls_ist.pdf

Barak, M., Lipson, A. & Lerman, S. (2006). Wireless laptops as means for promoting active learning in large lecture halls. *Journal of Research on Technology in Education,* 38(3), 245-263.

Brown, J. S. & Adler, R. P. (2008). Minds on fire: Open education, the long tail, and learning 2.0. *EDUCAUSE Review,* 43(1), 16-32. http://net.educause.edu/ir/library/pdf/ERM0811.pdf

Chai, C. S., Lim, W. Y., So, H. J. & Cheah, H. M. (2011). *Advancing collaborative learning with ICT: Conception, cases and design*. Singapore: Ministry of Education, ETD. [verified 5 Dec 2011] http://ictconnection.edumall.sg/ictconnection/slot/u200/mp3/monographs/advancing%20collaborative%20learning%20with%20ict.pdf

Chompu-Inwai, R. & Doolen, T. L. (2006). A methodology for studying the impact of laptops in engineering. Paper presented at the 36th ASEE/IEEE Frontiers in Education Conference (San Diego, CA, 27-31 October). http://fie-conference.org/fie2006/papers/1700.pdf

Darling-Hammond, L., Barron, B., Pearson, P. D., Schoenfeld, A. H., Stage, E. K., Zimmerman, T. D., Cervetti, G. N. & Tilson, J. L. (2008). *Powerful learning: What we know about teaching for understanding*. San Francisco, Jossey-Bass.

Dawson, K. & Heinecke, W. (2004). Conditions, processes and consequences of technology use: A case study. *Technology, Pedagogy and Education,* 13(1), 2004. http://dx.doi.org/10.1080/14759390400200173

Divaharan, S. & Koh, J. H. L. (2010). Learning as students to become better teachers: Pre-service teachers' IWB learning experience. *Australasian Journal of Educational Technology*, 26(Special issue, 4), 553-570. http://www.ascilite.org.au/ajet/ajet26/divaharan.html

Divaharan, S. & Lim, C. P. (2010). Secondary school socio-cultural context influencing ICT integration: A case study approach. *Australasian Journal of Educational Technology,* 26(6), 741-763. http://www.ascilite.org.au/ajet/ajet26/divaharan-2.html

Divaharan, S. & Lourdusamy, A. (2002). An attempt to enhance the quality of cooperative learning through peer assessment. *Journal of Educational Enquiry,* 3(2), 72-83. http://www.ojs.unisa.edu.au/index.php/EDEQ/article/viewFile/542/412

Divaharan, S. & Wong, P. (2003). Student-centred learning: *microLESSONS*. In S. C. Tan & A. F. L. Wong (Eds), *Teaching and learning with technology: An Asia-Pacific perspective* (pp. 32-46). Singapore: Pearson.

Donovan, M .S. & Bransford, J. D. (Eds.) (2005). *How students learn: History, mathematics, and science in the classroom*. Washington, DC: National Academies Press. http://www.nap.edu/catalog.php?record_id=10126

Duffy. T. M. (2004). Theory and the design of learning environments: Reflections on differences in disciplinary focus. *Educational Technology,* 44(3), 13-15.

Galagan, P. A. (1999). Special report: Interactive distance learning. *Technical Training*, May, p.2.

Jaber, W. E. & Moore, D. M. (1999). A survey of factors which influence teachers' use of computer-based technology. *International Journal of Instructional Media,* 26(3), 256-266.

Jenkins, H. (2006). *Convergence culture: Where old and new media collide*. New York: NYU Press.

Johnson, V. (1988). *An exploratory case study describing the long-term residual effect of the computer integrated instructions in-service (CI-3) project.* Unpublished doctoral dissertation, University of Oregon, Oregon.

Jonassen, D., Howland, J., Marra, R. M. & Crismond, D. (2008). *Meaningful learning with technology* (3rd Ed.). Pearson, New Jersey.

Koh, J. H. L. & Divaharan, S. (2011). Developing pre-service teachers' technology integration expertise through the TPACK-developing instructional model. *Journal of Educational Computing Research,* 44(1), 35-58. http://dx.doi.org/10.2190/EC.44.1.c

Kolar, R. L., Sabatini, D. A. & Fink, L. D. (2002). Laptops in the classroom: Do they make a difference? *Journal of Engineering Education,* 91(4), 397-401. http://www.jee.org/2002/october/743.pdf

Lim, W. Y., So, H. J. & Tan, S. C. (2010). Elearning 2.0 and new literacies: Are social practices lagging behind? *Interactive Learning Environments,* 18(3), 203-218. http://dx.doi.org/10.1080/10494820.2010.500507

Manternach-Wigans, L. K. (1999). *Computer technology integration in Iowa high schools: Perceptions of teachers.* Unpublished Doctoral Dissertation, Iowa State University, Iowa. [verified 5 Dec 2011; 11.7 MB] http://www.eric.ed.gov/ERICWebPortal/contentdelivery/servlet/ERICServlet?accno=ED437902

MOE (Ministry of Education, Singapore) (2011). *The ICT connection*. [viewed 23 Sep 2011]. http://ictconnection.edumall.sg/cos/o.x?c=/ictconnection/pagetree&func=view&rid=715

Rogers, D. L. (2000). A paradigm shift: Technology integration for higher education in the new millennium. *Educational Technology Review,* 13, 19-27, 33. http://editlib.org/d/8058

Rollett, H., Lux, M., Strohmaier, M., Dosinger, G. & Tochtermann, K. (2007). The Web 2.0 way of learning with technologies. *International Journal of Learning Technology,* 3(1), 87-107. http://dx.doi.org/10.1504/IJLT.2007.012368

Roschelle, J. M. Pea, R. D., Hoadley, C. M., Gordin, D. N. & Means, B. M. (2000). Changing how and what children learn in school with computer-based technologies. *The Future of Children,* 10(2), 76-101. http://futureofchildren.org/futureofchildren/publications/docs/10_02_FulJournal.pdf

Selwyn, N. (2007). The use of computer technology in university teaching and learning: A critical perspective. *Journal of Computer Assisted Learning,* 23(2), 83-94. http://dx.doi.org/10.1111/j.1365-2729.2006.00204.x

Sfard, A. (1998). On two metaphors for learning and the dangers of choosing just one. *Educational Researcher,* 27(2), 4-13. http://dx.doi.org/10.3102/0013189X027002004

Tan, S. C., Divaharan, S., Tan, L. & Cheah, H. M. (2011). *Self-directed learning with ICT: Theory, practice and assessment*. Singapore: Ministry of Education. http:ictconnection.edumall.sg/ictconnection/slot/u200/mp3/monographs/self-directed%20learning%20with%20ict.pdf [viewed 23 Sep 2011].

UNESCO (2008). *ICT competency standards for teachers*. [viewed 23 Sep 2011]. http://cst.unesco-ci.org/sites/projects/cst/default.aspx

Wetzel, K. (2001). Preparing teacher leaders - A partnership that works, part 2. *Learning & Leading with Technology,* 29(3), 50-52.

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