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Integrating ICT into Teacher Education Curriculum

Case Studies on in Asia

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FOREWORD

Information and communications technology (ICT) holds promise in providing not only anywhere and anytime access to knowledge, but also equal opportunities for networking and communications that allow knowledge sharing, participation, and lifelong learning. In realization of the huge potentials of ICT in education, governments have heavily invested on developing their respective ICT in Education Plans and on bringing various ICT equipment and resources into schools. Alongside these investments, the role and capacity of teachers have become more critical than ever – the challenge is how to enable teachers not only to overcome the technology barriers but also to empower them to integrate appropriate technology into the teaching and learning process.

As UNESCO Director-General Irina Bokova emphasized, "Technology can be a powerful education multiplier, but we must know how to use it. It is not enough to install technology into classrooms – it must be integrated into learning. Nothing can substitute for a good teacher. It is not technology itself that empowers people – empowerment comes from skills and knowledge."[1]

It is within this context that the two phases of the *Next Generation of Teachers* Project (Next Gen) funded by Japan Funds-in-Trust (JFIT), were implemented. The Project was designed to build the institutional capacity of teacher education institutions (TEIs) and Ministries of Education in 15 countries from the Asia-Pacific region in designing and providing training courses on ICT-pedagogy integration, thereby preparing the next generation of teachers to enhance the process of teaching and learning by utilizing ICT judiciously in the classroom.[2] This was done through 1) engaging Deans and TEI faculty members in planning and creating an ICT-based teacher training environment, 2) guiding TEIs in their curriculum review and development of ICT-related education courses, 3) implementing capacity building workshops for teacher educators on designing, providing and managing teacher training activities on ICT-pedagogy integration, and 4) tapping the TEI network to serve as Resource Centres to ensure that publications (books and CDs) of UNESCO Bangkok reach the target audience.

In addition, the Facilitating Effective ICT-Pedagogy Integration Project, funded by Korean Funds-in-Trust (KFIT), aimed to create an enabling environment for student-centered use of ICT through Project-Based Learning and Telecollaobration. From 2010 to 2012, UNESCO Bangkok was able to train and guide teachers and teacher educators from 155 schools and over 25 TEIs in seven countries on designing, implementing, monitoring and assessing collaborative projects. Subsequently, the Project was also able to establish and strengthen partnerships among these country-level TEIs and local schools that have proven to be mutually beneficial. Along the same line, the KFIT International School Project (KISP) was implemented to provide at least 200 teacher educators, teachers, and students from six countries an opportunity to expand their boundaries and collaborate with other groups internationally. These interdisciplinary and inter-cultural projects have been showcased and documented as innovative practices in various regional fora and serve as implementation cases for the Regional Guide on Project-Based Learning and Telecollaboration that TEIs and schools can use in designing lessons that effectively integrate ICT in teaching and learning.

1 Speech given during the Opening Ceremonies of the Asia Pacific Ministerial Forum on ICT in Education 2012.
2 Next Gen Scaling-Up Programme. http://www.unescobkk.org/education/ict/ict-in-education-projects/training-of-teachers/next-generation-of-teachers-project/next-gen- scaling-up-programme/ retrieved from the UNESCO Bangkok website, 10 August 2011.

In support of these efforts, UNESCO Bangkok has gathered case studies of pre-service teacher education programmes designed and implemented by TEIs from seven (7) countries, namely Australia, China, Republic of Korea, Philippines, Singapore, Thailand, and Viet Nam. These Education Technology courses are meant to equip pre-service teachers with the relevant knowledge, skills, and tools to appropriately and effectively use ICT in enhancing the learning experiences among students.

We hope that this collection of courses, with varying treatments and focus areas, will provide readers with sufficient background and motivation to pilot or enhance their respective teacher education curriculum to better equip the next generation of teachers.

Gwang-Jo Kim
Director
UNESCO Bangkok

INTRODUCTION

Each of the seven collated case studies involved a teacher-education course in Educational Technology, more specifically, an ICT-related course for pre-service teachers as well as for the retraining of teachers. The collection presents differences and similarities in the approaches taken in preparing student teachers in the use of ICT for teaching and learning.

The cases show diverse perceptions across institutions on when and how to integrate ICT in the teacher education curriculum. For example, the ICT-related course is a first year compulsory course for Edith Cowan University Australia and for Thailand's Rajabhat Mahasarakham University, but is an elective course for Korea National University of Education where pre-service teachers can sign up for the course any time. The other countries have their pre-service teachers signing up for similar courses at different levels of the programme.

All the case studies reported that they provided lecturers with opportunities to work on and try out the revised curriculum and relevant courses within the respective institutions. As these efforts are seen by the institution to be a testing of ideas, it is not surprising that most of the cases "captured" only a class or section of the pre-service teacher programme for the study.

While all participating countries attest to the rapid advancements in technology and the ever burgeoning number of software applications, it is evident from the cases that pre-service teachers can function well when they collaborate amongst themselves and do proper simulations and, if possible, apply their knowledge and skills in authentic situations.

What happened at each institution?

Australia's Edith Cowen University revamped its existing "Learning with Technology" course from one that depended mostly on direct instructional strategies of PowerPoint, computer-based learning to one that applies constructivist paradigms and subscribes to the potential of ICT in mediating, sharing, and expressing concepts and ideas across the Web. It is presented as an example of a well-intended and well-planned technology-enhanced course as a response to a massive or huge intake of first-year students from a variety of backgrounds so that they can properly or formally be "acquainted with the art and science of ICT integration into their learning and teaching practices". The pre-service teachers have, by way of projects, touched base with the current trends of ICT in education and had the opportunity to test out instructional management issues with actual school students.

South China Normal University employs its "Computers in Education" course to develop a systematic approach to enhancing pre-service teachers' skills and knowledge in foundation principles, computer-assisted/managed instruction and learning, and research on computer-based education applications. The assessment mode of the course was changed from a tail-end examination to one of a continuous nature that encourages student teachers to work as a team and collaborate especially through the Blackboard platform. In addition, they get to try out their skills in actual school situations. It showcases many positive effects to their students who take the course and presents a very promising documentation of real experience that could effectively impact on policy reform or new open education policy that supports innovation, openness, and technology-enabled/enhanced education not only in China but possibly in other countries of the Asia-Pacific Region.

Korea National University of Education selected one class to try out a variation of its long running "Theory and Practice for Instructional Media Development" course. The course focuses on the development of visual, audio, video, animation materials for various presentation modes including games or online delivery. Using a wide variety of software and freeware, the pre-service teachers can further improve their skills in technology integration. The case study showcases the various benefits and transformational outcomes among pre-service teachers in the areas of appreciation, comprehension, and attitudes or values for technology integration in teaching. The 2-credit course, upon reflection, is considered heavy and thus the instructor had adjusted the assessment to commensurate with the teaching-learning demands.

The Mindanao State University-Iligan Institute of Technology of the Philippines developed and nurtured two Educational Technology courses for third year trainee teachers. For their course application, they were immersed in actual classroom situations to apply their newly acquired skills and to test out their portfolios in practical teaching. The case likewise discussed the trial approach of having in-service teachers mentor pre-service teachers for these classroom sessions. Results of the experience showed that further study needs to be done to enhance the pre-service teachers' and in-service teachers' mentor/mentee collaborations to maximize mutual benefits.

Singapore's National Institute of Education offered its course "ICT for Meaningful Learning" for the case study. Encompassing concepts of meaningful learning, cyberwellness, and technology-enhanced learning, pre-service teachers have to present the collaborative group projects that they developed in the form of Lesson Packages, along with lesson plans and their justifications for selecting specific learning tools and technologies.

Thailand's Rajabhat Mahasarakham University offered the required course "Innovation and Information Technology for Education" that trains first year students on the applications of ICT in teaching and learning through various Internet/Web resources and applications. The course is taught entirely through a campus-wide network through which students access content, collaborate on learning, and in e-discussions monitored by course conductors as the course proceeds. Students may also meet face-to-face in their interactions and collaborations. One of the projects requires groups of four students to present their final assignment through the net. This first year course attempts to equip students for subsequent courses that may be more and more digitalized.

Viet Nam's Hanoi National University of Education case study focuses on a course "Applying ICT in Biology Education" using a blended learning model in which face-to-face training is supported with online learning via NiceNet. The course taps the power of shared inquiry and group work, in an ICT-rich blended learning modality. It presents a concrete example of a conversion of what is a squarely and effectively science teaching, into a smart and fun way of science teaching. The 340 pre-service teachers had activities involving, amongst others, mining the Internet, creating multimedia resources, using video-production software, and integrating ICT into contents to improve instruction and learning.

Conclusion

All in all, the cases demonstrated the viability of tweaking existing Education Technology courses to be more adaptive to the needs of the current realities towards better integration of contents with ICT and their subsequent application in real world environments. The case studies in this collection are worthwhile considerations for any institution to explore beyond the cases' outcomes

for their own requirements. It must be noted that the prevalence of web contents had impinged on the need for changes and responses in curriculum design and revamp. Institutions need to proceed with caution and determination as burgeoning contents and applications demand that educators and institutions be more circumspect of their choices and solutions in the digital world.

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Reviewers

Building pre-service teachers' ICT in education competencies at Edith Cowan University (Australia)

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Abstract

It is a challenge for teacher educators to shift pre-service teachers away from traditional pedagogical beliefs towards constructivist approaches in an ICT-enhanced learning environment (Lim & Chan, 2007). At Edith Cowan University, an ICT-infused course in the Bachelor of Education (K-7) programme provided pre-service teacher with opportunities to adopt constructivist instructional approaches in the design of multimedia learning packages and in the documentation of their experiences in schools. This paper examines the development and implementation of the course. The course aimed to enhance pre-service teachers' confidence in developing ICT-based learning packages based on constructivist principles, and to provide them with a better understanding of how ICT might be used to enhance teaching and learning.

1. Institutional context/background

1.1 Introduction to the school of education at Edith Cowan University

The School of Education at Edith Cowan University (ECU) has been the major provider of teacher education in Western Australia for over 100 years. Today the school is widely recognized for having incorporated innovative technological and pedagogical practices into its teacher education programmes. School graduates are recognized for their ability to combine theoretical knowledge of education and management with the practical competencies required of a teacher or a school leader. As a large and well-established teacher education provider, the school has excellent facilities and offers a wide range of specializations. It continually updates its programmes by drawing upon solid research.

The school offers various pathways to become a teacher. Its Bachelor of Education and graduate Diploma of Education programmes are offered in three campuses – Mount Lawley, Joondalup and Bunbury. In the Bachelor of Education programme, the pathways are Early Childhood Studies, Primary, K-7, and Primary to Middle. In the Graduate Diploma of Education programme, the school offers pathways in Early Childhood Studies, Primary and Secondary education. The secondary education course includes specializations such as Design and Technology, Digital Media, Drama, English, Home Economics, Mathematics, Music, Physical Education, Science, Social Science and Visual Arts. Minors are available in the same specializations and in Catholic Education, Dance, and Health. Since 2010, all of these programmes are offered in either on-campus or residency mode. On-campus mode provides for classes on campus and practicum in schools. Students undertaking the residency mode spend the majority of their time in schools under the mentorship of experienced teachers, and their remaining time on campus.

1.2 Context of the development of the ICT-related curriculum

It is a challenge for teacher educators to shift pre-service teachers away from traditional pedagogical beliefs towards constructivist approaches in an ICT-enhanced learning environment (Lim & Chan, 2007). Most pre-service teachers' prior learning experiences were in school classrooms that adopted traditional instructional practices. As a result, many students hold traditional pedagogical beliefs when they join the pre-service teacher education programme. Student-teachers holding traditional beliefs tend to perceive teaching as the dissemination of information, and learning as a passive activity. They may expect to perform minimal task management and may hold little responsibility for their own learning. This contrasts with constructivist pedagogical beliefs whereby teaching is perceived as a process of guiding and facilitating students in the process of knowledge construction, and learning is perceived as the active construction and reconstruction of knowledge. The latter approach is consistent with today's knowledge societies and economies, in which students are expected to be active seekers and constructors of knowledge, engaged in learning that involves the discovery and transformation of complex information. Yet it should also be noted that traditional and constructivist beliefs are not to be treated as a dichotomy. The stance of this case study is to promote more constructivist approaches that encompass not only dynamic engagement with concepts, theories and the making of meaning, but also self-regulated learning and personal agency.

A series of learning tasks has been developed in which ECU provides pre-service teachers with opportunities to adopt constructivist teaching and learning approaches in the design of multimedia learning packages and the documentation of their experiences in schools. ECU is aware that pre-service teacher education programmes play a crucial role in preparing quality teachers and it grooms student-teachers to be change agents, role models and ICT champions in schools. This paper documents the development and implementation of one course, *Learning with Technology* (ICT1100), a core course in the Bachelor of Education (K-7) programme.

Two key challenges in designing an educational technology course are the diversity of ICT competencies among pre-service teachers and their lack of pedagogical knowledge and strategies to use ICT. Students who are more ICT competent may become bored when too much time is spent on basic ICT-related instruction and may perceive that they are already capable of using ICT effectively for teaching and learning. Students with lower competence in ICT may give up if not enough instruction is given and may then lack the confidence to use ICT in classrooms. To cater to the diverse needs of pre-service teachers there is a need for educational technology courses to create a meaningful context that allows participants to critically examine their own pedagogical beliefs and explore the application of ICT in a more constructivist learning environment.

2. ICT-related course/curriculum

The author had experience teaching the Learning with Technology (ICT1100) course in 2006. The course had an intake of some 200 first-year students from a variety of backgrounds, including fresh high school graduates, high school graduates with a few months of teaching experience, and high school graduates with non-teaching work experience. The course ran over 36 hours (over one semester and for 12 credit units) and aimed to acquaint students with the art and

science of integrating ICT into their learning and teaching practices. At the end of the course, the pre-service teachers were expected to be able to:

- Demonstrate competent use of common ICT tools such as word processors, presentation packages, mind-mapping tools, spreadsheets, the Internet and communication technologies such as email and web browsers, and basic digital video equipment
- Employ a range of ICT tools in the planning and implementation of teaching and learning activities across the curriculum
- Identify and explain the significant issues related to the implementation of ICT in learning environments.

2.1 Development process

The course underwent significant revision and refinement just prior to 2007. Before that year, the pedagogical strategies deployed were based on a lecture-tutorial format whereby teacher educators organized, arranged and presented specific disciplinary content knowledge, and pre-service teachers attended lectures and prepared for tutorials after lectures. Such an arrangement limited the opportunities for interaction and dialog between teacher educators and pre-service teachers. More important, it limited the latter's hands-on learning and just-in-time learning experiences. The mode of assessment was consistent with the methods of delivery; cognitive teaching-learning-oriented. Pre-service teachers' projects included lesson plans for computer-based learning (CBL) packages, PowerPoint presentations for direct instruction, and production of traditional teaching and visual aids. Most projects adopted didactic teaching, drill and practice, and tutorial-based approaches.

With the goal of introducing more constructivist approaches, in 2006 the course team, consisting of a coordinator and four other teacher educators, started examining models of professional development. The team aimed to develop pre-service teachers to be active and independent learners, and to support them in their learning processes; it also had the goal to provide them with meaningful ICT-mediated learning experiences that linked theory with practice. Over a two-month period in 2006, the team reviewed the existing curriculum, and assessment and feedback for the course, and developed the new ICT1100 course for the academic year 2007. See Table 1 for the course outline for 2007.

2.2 Course outline

Table 1: ICT1100 course outline at Edith Cowan University

2.2.1 Course provider		
Institution: Edith Cowan University	Faculty/School: School of Education	Programme: Bachelor of Education (K-7) 2007
2.2.2 Course title: ICT1100 – Learning with technology		
2.2.3 Course Type		
Compulsory for students in certain teacher education programmes (including BEd K-7)		
2.2.4 Target audiences		
Year 1		
2.2.5 Credit and degree		
Number of credits: 12 Degree(s) to be obtained: (B.Sc, BA, etc.): Bachelor of Education		
2.2.6 Course learning objectives		
After completing the course, students should be able to: • demonstrate competent use of common ICT tools such as word processors, presentation packages, mind-mapping tools, spreadsheets, internet and communication technologies such as email and web browsers, and basic digital video equipment; • employ a range of ICT tools in the planning and implementation of teaching and learning activities across the curriculum • identify and explain the significant issues related to the implementation of ICT in learning environments.		
2.2.7 Resources		
Significant references: Barron, A. and Orwig, G.W. 1997. *New technologies for education: A beginner's guide. Englewood, CO: Libraries Unlimited.* Cotton, E. G. 2000. *The online classroom: Teaching with the internet (4th ed.) Bloomington, IN: ERIC.* Cummins, J. and Sayers D. 1997. *Brave new schools: Challenging cultural illiteracy through global learning networks. New York: St Martin's Press.* Curriculum Corporation. 1998. *Linking the learning areas: Technology education. Carlton, VIC: Author.* Fleer, M. and Jane, B. 1999. *Technology for children: Developing your own approach. Sydney: Prentice Hall.* King, T. (Ed). 1997. *Technology in the classroom: A collection of articles. Cheltenham, VIC: Hawker Brownlow.* Knapp, L. R. 1996. *Restructuring schools with technology. Boston: Allyn and Bacon.* Roblyer, M. D. 2000. *Ten first steps on the Internet: A learning journey for teachers. Upper Saddle River, N.J : Merrill.* Roblyer, M. D. and Edwards, J. 2000. *Integrating educational technology into teaching. Upper Saddle River, N.J: Merill.* Ross, T. W. and Bailey, D. B. 1997. *Technology-based learning: A handbook for teachers and technology leaders. Cheltenham, VIC: Hawker Brownlow.* **Serials and journals:** • Educational Computing and Technology • Educational Technology • Electronic Learning • Information Technology in Childhood Education Annual • Journal of Computing in Childhood Education • Journal of Educational Computing Research • Journal of Educational Technology • Learning and Leading with Technology • Technology and Learning • The Computing Teacher		

Websites:

- ActivatED: Online Education Resource for Teachers in the ACT: http://activated.det.act.gov.au/learning/elt.htm
- Advancing Education through ICT: http://www.naace.org
- Australian Curriculum Studies Association Inc.: http://www.acsa.edu.au
- Curriculum through ICT (Department of Education and Training, WA): http://www.eddept.wa.edu.au/curriculumict/pl/innovators.htm
- Edutopia: The George Lucas Educational Foundation: http://www.edutopia.org
- Information & Communication Technologies Research: http://ictresearch.edna.edu.au
- InnovatED, Innovations in Education: http://www.innovated.gov.au/Innovated/html/i01.asp
- International Society for Technology in Education: http://www.iste.org
- Landmarks for schools: http://www.landmark-project.com/index.php
- Measuring Digital Opportunities for America's Children: http://www.contentbank.org
- Queensland Government Department of Education and Arts: Discovering New Technologies: http://education.qld.gov.au/smartclassrooms/strategy/tsdis_newtechn.html
- World Village: Family Friendly Internet: http://www.worldvillage.com

Personal access to hardware:

- A thumb drive (also called a key drive or a compact USB flash drive) to store and transfer data.
- A mini DV tape to record video.
- A headset, including earphones with microphone.

2.2.8 Course topics

	Learning activities	Instructional strategies	Delivery modes
Current ICT Issues	Mass Lecture	Lecture	Face-to-Face and Online Video and Resources
Learning and ICT	School-based Activities, Workshop and Discussion	Hands-on, Data Gathering, Use of ICT Tools	Face-to-Face with Online Sharing
Ethics and Copyright	Mass Lecture	Lecture	Face-to-Face and Online Video and Resources
Design Principles	Workshop- and School-based Activities	Hands-on, Constructing of Websites, Development of Resources	Face-to-Face and Online Video and Resources
Evaluating Digital Resources	Workshop- and School-based Activities	Hands-on, Problem- and Case-based Learning	Face-to-Face and Online Video and Resources
Global Learning Tools	Mass Lecture and Workshop-based Activities	Lecture and Hands-On	Face-to-Face and Online Video and Resources
Management of ICT Tools	Mass Lecture and School-based Activities	Lecture and Data-Collection and Observations in School	Face-to-Face and Online Video and Resources

2.2.9 Course assessment

Categories	Description	Weight (percentage)	Note (if any)
Research on a Significant ICT Issue	Multimedia Group Presentation (20%) Individual Blog Summary (20%)	40%	• Professional knowledge • Use of ICT to present and structure ideas • Ability to work in and contribute to group task • Wider reading and referencing skills
School-based Project and Website	ICT-based School Project (30%) Website Structure and Design (10%) Management of School-based Project (10%) Software and Hardware Competency (10%)	60%	• Professional knowledge applied to school project • Management of school-based project • Use of ICT to present ideas in website • Software and hardware competencies in context
Total		100%	

2.2.8 Course topics and instructional strategies

The course was designed around a mixture of face-to-face and online activities. Activities were designed to facilitate the enhancement of the pre-service teachers' ICT competencies as well as their ability to make pedagogically informed decisions on how to use ICT in classrooms to assist their students' learning. The activities included hard (templates, rubrics, examples) and soft (adaptive to individual needs) scaffolding by tutors, the establishment of a peer mentoring system, the implementation of a school project, reflection tasks (through journals and blogs), and a final report in the form of a website.

Among the 'hard' scaffolding elements provided were templates to provide feedback and to assess the pre-service teachers' work. Rubrics used to assess assignments were utilized throughout the course to establish task expectations and to ensure that evaluation processes were consistent, transparent and valid (see rubrics in Appendix I). Instructions on how to use certain applications were available for download on the course website (see Appendix II for instructions about creating a hyperlink to the mind mapping tool, Inspiration). Prototype letters for distribution to school teachers and parents of children regarding their involvement in the school project were made available to the pre-service teachers before the school project assignments were designed (see Appendix III). The pre-service teachers used these letters as their first point of contact with their school participants.

The course also included a range of soft scaffolding strategies that provided the pre-service teachers with both learning and teaching models to support their development as a teacher. Exemplars of previous pre-service teachers' assignments were shared during lectures and workshops. Additionally, the various teaching and learning strategies used during the lectures and workshops (such as explanation, modelling, peer-tutoring and generative teaching strategies) were frequently focused upon as teaching points. As such, the actual strategies employed by the teacher educators in the course became a set of resources for the pre-service students to draw upon during their practicum experiences.

The various hard and soft scaffolding examples were designed to support the pre-service teachers to build upon their current skills and knowledge, and to provide solid examples and frameworks on which to base their own analyses, observations, and documentation of practical teaching and learning strategies during their practicum experiences.

Peer mentoring among pre-service teachers

In order to best utilize the range of abilities amongst the course participants, those with higher-level ICT skills were invited to participate in a peer mentoring system which took place throughout the semester. It was anticipated that the pre-service teachers with more advanced ICT skills would gain practical teaching experience by sharing their skills and knowledge with their peers, especially when they employed generative teaching strategies. It was also anticipated that the pre-service teachers with less advanced skills would benefit by learning from their peers. Such peer-to-peer learning and teaching was expected to reinforce and support the teaching and learning strategies being provided by the tutors and lecturers.

Peer mentoring sessions were organized in formal and informal ways. In addition to the regular lectures and workshops offered, adjunct workshops were offered to pre-service teachers who self-nominated as requiring additional assistance. Approximately three to four of these additional workshops were held. The workshops were designed to provide opportunities for low-key

instruction by tutors and the peer-mentor pre-service teachers. Instead of being offered as "remedial" classes, the workshops provided opportunities to develop a community of practice and a community of learners who were working together to improve each other's skills. The workshops' content was drawn from the pre-service teachers' requirements and included topics such as electronic file management, practical use of educational technology (digital cameras, video cameras, movie-making software), project management, and procedures for downloading files safely from online sources. The teaching and peer-mentoring processes employed were also transferred to the regular weekly workshops, which enabled the peer-mentors to further develop their teaching skills while allowing their less skilled colleagues to gain from the experience.

From theory to practice: Implementation of ICT projects in schools

To create links between the theoretical and practical components of the course, the pre-service teachers were required to design a practical school project. The primary aim was to engage school students from kindergarten to Year 7 in using ICT to enhance their learning in one or more curriculum areas. This task was deemed a manageable and effective way for the pre-service teachers to implement their own projects whilst also contributing to the learning of students in their practicum schools. Each pre-service teacher had been allocated a local school earlier in the year which they had been attending one day per week for six months before their school project began. The pre-service students were thus familiar with the staff, students, context, culture, and resources of "their" school. Furthermore, the classroom teachers in the local schools were familiar with the school project specifications due to their involvement as partners in the Bachelor of Education course. As a result, valuable guidance, monitoring, and motivation were provided to the pre-service teachers by the classroom teachers in the schools. Such support structures enabled the pre-service teachers to contribute to the life of the school and to gain valuable experience in negotiating the design and management of an authentic learning project within a realistic context.

The design of the school-based task was driven by the need to create a purposeful learning experience which took place over a 4-6 week period and which utilized the available resources at the school. Guidance was provided by tutors, resource materials and through advice from previous students about how to design, implement, and evaluate the project. Examples of school projects designed by the pre-service teachers included the production of electronic school newsletters, electronic storybooks, video and audio interviews, animations which portrayed health and safety issues, electronic documentation of science projects and online publishing of children's stories, poems, and creative writing.

In many reported cases, the pre-service teachers also assisted some of the school teaching staff to extend their ICT expertise.

2.2.9 Course assessment

The mode of assessment was developed to be consistent with the learning activities. The pre-service teachers were expected to design, construct and present projects that engaged their students. Collaborative, simulation and problem-based projects that drew upon socio-cultural theories of learning were encouraged. Drill-and-practice projects that drew upon traditional theories were strongly discouraged. The mode of assessment was formative in nature. A total of 40% of the assessment was allocated to group research and presentation, and to individual blogs. A total of 60% was allocated to the creation of a website that served as a digital repository for

reflective journals, school projects and related artifacts and collection of products to demonstrate students' ICT competencies. Although the projects might be considered by many as a form of summative assessment, the emphasis on the process of development provided a good balance between summative and formative assessment. Formal and informal progress reports were integrated into the course before the summative assignment was due. Students had to justify their choice of media, describe and analyse their development processes, and evaluate their projects. For more details of the assessment and rubrics, please see Appendix I.

The design, implementation and evaluation of the school project afforded regular and structured opportunities for the pre-service teachers to reflect upon their roles as developing teachers and to evaluate their progress. Pre-service teachers were required to complete an electronic journal, an "e-journal", which documented their progress throughout the course of study and during the school project. They were required to maintain and contribute to an online blog in which they recorded analytical comments about their first assignment in the course (group research and presentation about a significant issue related to the use of ICT in teaching and learning contexts).

These activities were built upon one of the central principles of the BEd (K-7) programme, of which ICT1100 is one part, which is articulated as the need to focus on reflection, critical analysis, research and informed judgment. The link between reflection and action was integrated into the course and the school project by providing the scaffolded activities for the pre-service teachers to reflect upon their contribution to the course, their role in the school project and their developing ICT and teaching skills.

During these journal-type reflection activities, the pre-service teachers were encouraged to actively and regularly reflect on both pedagogical and technical issues related to their school project and their progress in the course in order to facilitate new understandings of varied teaching situations. The pre-service teachers were also encouraged to document their emotional responses to the course activities.

The outcomes of the school project and the pre-service teachers' reflections throughout the course were reported in a website which was the major component of the course assessment. In the website, the pre-service teachers documented the process they undertook to plan, implement and evaluate the project. In order to demonstrate how the project addressed their students' particular learning needs, the pre-service teachers aligned specific learning outcomes to related learning activities which were then assessed using the original learning outcomes as guiding criteria. The pre-service teachers also gathered data from their peers, teachers and the pupils in their practicum classes about their performance as a teacher and project manager. This information was gathered using tools such as written questionnaires, video interviews, attitude inventories, mentor-teacher reports, work samples and self-observations.

At the end of the semester, each of the pre-service teachers presented their websites to the students and teachers in their practicum classes, as well as to their university peers and tutors. The websites were then assessed according to the following criteria (please refer to Appendix I about course assessment for percentage allocation of each criterion):

- project design, implementation and evaluation of school project report
- website structure and design
- professional management of school-based project and university course
- ICT software and hardware competency.

3. Outcomes: benefits and challenges

3.1 Benefits

There was no pre-planned data collection for this course. The discussion of pre-service teachers' learning outcomes in this section is based on informal communication with the pre-service teachers and their reflective journal entries.

Although the pre-service teachers were subjected to the same experiences in the course, not all shared the same perceptions of the role of ICT in teaching and learning. In general, pre-service teachers agreed that they had gained a better understanding of the opportunities provided by ICT for enhancing teaching and learning. Some of these opportunities included the use of ICT as an information tool, constructivist tool, and situating/contextualizing tool.

Most pre-service teachers identified ICT as an information tool that could provide a diverse source of easily accessible information for students to explore issues of interest to them. They felt that students no longer relied solely on information in textbooks and from the teacher, but could consider alternative sources of information from different perspectives. They believed that ICT as an information tool catered better to their students as the information might be presented in varied ways using different multimedia elements.

Many of them also identified ICT as a situating tool that would provide their pupils with a context for the concepts or theories under study. They felt that the multimedia elements (colorful graphics, videos and sound) provided opportunities for authenticity in instruction to simulate real-world problems and cases.

However, only a handful of pre-service teachers said that ICT could be used as a constructivist tool. For instance, one pre-service teacher said that students could search the World Wide Web (WWW) for information, enter and analyse data mediated by a spreadsheet application, and represent the relationships and ideas symbolically or visually. Using a presentation tool (such as Powerpoint), these ideas might then be presented to the class or community.

There was some evidence that a number of pre-service teachers demonstrated a change in pedagogical orientation when they expressed dissatisfaction with the traditional teaching approaches they had observed in schools. This might suggest that these pre-service teachers would more likely be receptive to new teaching approaches. For example, one pre-service teacher reflected in her journal entry that her pedagogical beliefs changed from traditional to constructivist after her unsatisfying experiences during her teaching practicum in the school, and her more fulfilling learning experiences in the ICT1100 course.

3.2 Challenges and solutions

Only a handful of pre-service teachers reported that they had experienced a change in pedagogical beliefs from traditional to constructivist. A key reason for this might be that Learning with Technology (ICT1100) was a short, one-off learning experience. Other reasons might include that pre-service teachers were not given enough opportunities to use ICT for teaching real students in the classroom. Extensive field experience may be an essential element in testing pedagogical beliefs and reflecting upon successful and unsuccessful teaching practices. Without such experiences, the course learning tasks might be perceived as just another assignment to pass, or to achieve a good grade. The pre-service teachers were perhaps more concerned about meeting the assessment criteria than they were engaged in the learning process.

Some pre-service teachers reflected on potential barriers hindering them from adopting constructivist teaching practices. These included the lack of a conducive school environment, a lack of time, and a lack of readiness among students for constructivist teaching approaches. Although the pre-service teachers might or might not experience these barriers in their past or future teaching activities, such perceived barriers might prevent them from adopting constructivist teaching approaches. Some pre-service teachers perceived that certain aspects of the current education system, such as the emphasis on examination and a crammed curriculum, might encourage teachers to rely on traditional teaching approaches.

The pre-service teachers perceived that teachers had limited teaching time. They found that a lot of time was required to design constructivist activities. They believed that it was "time-consuming" to implement constructivist lessons, as students would need time to explore, make mistakes and formulate solutions. Some concluded that constructivist instruction would take up too much time and was impractical.

Most pre-service teachers felt that students were not ready for constructivist instruction as they were already "molded" to learn in a traditional learning environment. They believed that students in general were not self-directed and were used to being "spoon-fed". Because of the perception of students as passive and lacking in self-regulation, they felt that students were not ready for constructivist learning. Moreover, they commented that a constructivist classroom might be "too chaotic" or difficult to handle. Unless these perceived barriers are addressed, pre-service teachers may end up adopting traditional teaching approaches over constructivist approaches.

4. Conclusion and further implications

While teachers play a pivotal role in the learning environment, they are often not consulted concerning changes to teaching/learning procedures. Teachers' needs under changing conditions have to be continuously assessed and activities to satisfy these have to be developed. Such needs are often quite diverse. This requires the designers of teacher education courses to recognize and utilize the full range of teacher abilities. Very often, pre-service teacher education programmes focus more on basic ICT competencies and less on the use of ICT for teaching and learning.

This paper has shared how an ICT in education course builds pre-service teacher capacity for the use of ICT in classrooms, and has reflected upon the implications for the design of educational technology courses. Teacher educators and other education stakeholders may reflect upon these accounts, lessons learnt and recommendations, and formulate their own strategies or activities to build teacher capacity for using ICT in the classroom.

Although the educational technology course may have acquainted the pre-service teachers in the art and science of using ICT for teaching and learning in classrooms, it should be noted that the pre-service course is not the end of the professional development of teachers in the use of ICT. Regular scheduled professional development opportunities keep teachers aware of the need to enhance their ICT integration practices, and keep them current with the ever-changing face of ICT.

References

Lim, C. P., & Chan, B. C. 2007. Micro lessons in teacher education: Examining pre-service teachers' pedagogical beliefs. *Computers and Education,* 48(3), 474-494.

Appendix I: Course assessment

Assignment 1 — 40%
Research on a significant ICT issue

Assignment 2 — 60%
School-based project and website

Competency-based tasks

In order to complete this course successfully you are required to demonstrate competence using various software and hardware. These tasks can be demonstrated through participation in all classroom activities and through the completion of your assignments.

Assignment 1: Research on a significant ICT issue — 40%

Part 1: Multimedia group presentation (20%)

As part of the group presentation section of this assignment, you are required to:

- **Form a group** of 4-6 students and negotiate with each other about how to approach the topic. Negotiate group roles and responsibilities, expectations, problem solving approaches, as well as deciding on where, how and how often to meet up together. During your workshop in Week 1, your group will choose a broad issue* to investigate for Assignment 1. You and your group will then be required to work out what aspect of the topic to focus upon.
- **Create a 3-5 minute multimedia presentation** (including text, sound, graphics, etc.) with your group which demonstrates information and perspectives on the issue, as well as ideas on how this issue applies to practical classroom teaching and learning situations. You may use any software available on the presentation computer in the workshop room to create this presentation (e.g., PowerPoint, MovieMaker, slideshow software, etc.). The group presentation is due in one of the workshops in Weeks 4, 5, 6, 7, 8 or 10. Please take care not to use copyright material and remember to reference all sources of information used when preparing the presentation.
- **Upload the group's multimedia presentation** (or a summary of the group's presentation) to the "Assignment 1: Issues Presentations" section on the Discussion Board on the ICT1100 BlackBoard website (one copy per group) before the end of the day your presentation is due; and
- **Send an individual email** (one email from each individual group member) directly to your Tutor reflecting upon, evaluating and marking your own and other group members' contributions to the group's collaborative processes. Please download and complete the "Teamwork mark" document from the Assignments section of the ICT1100 BlackBoard site and attach this to your email. This email is confidential and is due one week after your presentation is due. [Remember to email the website address of your blog from Part 2 of this assignment in your email.]

Part 2: Individual blog summary (20%)

This section of the assignment requires you to work on your own to create an online blog (a "web log") in which you are requested to:

- **Create an online blog** (e.g., www.blogger.com) in which to record your ideas and research about the issue you are researching. Also keep an electronic backup document (e.g., a Word document) which records all of your online entries.
- **Make 2-6 blog entries** throughout the semester (before your assignment is due) to demonstrate the research processes you use to find out information about the issue you are researching. These blog entries could include descriptions of how you have found out information (online searches, library visits, discussion with other professionals, etc.), resources used, problems you may have encountered, as well as ideas you have had about how to collate, edit and prepare your final summary about the issue.
- **Make a final blog entry** which provides an 800-1000 word summary of the research you have completed on this issue. This work should be completed individually by each group member, demonstrating an individual perspective on the issue. Remember to focus on how your ideas could be applied to practical teaching and learning situations. Blog summaries which are very similar to other group members may receive lower marks than more original summaries. The final blog entry should include an introduction, some explanatory paragraphs and a conclusion, followed by a list of end-text references which match the in-text references. Remember to prepare this as a professional document and write in third person format. The final blog should be finalized one week after your multimedia presentation.
- **Email the web address of your blog** within the evaluation email (see Part 1 of the assignment) that you send your Tutor one week after the multimedia presentation.

*Choose an issue from this list (allocation of topics will occur during the Week1 Workshop):

- Blogging in K-7 classrooms
- Using podcasts in K-7 classrooms
- Using Wikipedia, Wikidictionary and other Wiki products in K-7 classrooms
- Using PowerPoint to assist children's learning and thinking processes in K-7 classrooms
- Using technology to teach specific aspects of the K-7 curriculum (your group can nominate a learning area to investigate e.g. science, mathematics, music, etc.)
- Use of the Internet to learn and collaborate beyond the K-7 classroom
- Issues around web access and use in K-7 classrooms
- Using online web quests, scavenger hunts and puzzlemakers in K-7 classrooms
- Using technology with students with special needs and abilities in K-7 classrooms (e.g., learning difficulties, talented and gifted, children who are able to speak more than one language, etc.)
- Evaluating software in K-7 classrooms

These issues are related to the dimensions of the Competency Framework for Teachers from Eastern Goldfileds College (http://www.egc.wa.edu.au/Portals/0/docs/SAIS/TEACHER%20COMPETENCY%20FRAMEWORK.doc):

- **Dimension 1:** Facilitating student learning
  Engage students in purposeful and appropriate learning experiences
- **Dimension 2:** Assessing student learning outcomes
  Monitor, assess, record and report student learning outcomes

- **Dimension 3:** Engaging in Professional Learning
  Reflect critically on professional experiences in order to enhance professional effectiveness
- **Dimension 4:** Participating in curriculum policy and programme initiatives in an outcomes-focused environment
  Participate in curriculum policy and programme teamwork
- **Dimension 5:** Forming partnerships within the school community
  Establish partnerships with students, colleagues, parents and other caregivers

Assignment 1 Rubric			ICT1100, 2 Semester 2006	
Topic: Research on a Significant ICT Issue			Name:	
Part 1: Multimedia Group Presentation				
Criteria	Not yet competent	Competent	Highly competent	
Demonstration of professional and practical knowledge using relevant resources	Some or little demonstration of knowledge of main ideas about issue. Resources used tended to be of one type only. Application to practice needs to be clearer or based on both teaching and learning.	Clear demonstration of knowledge of main ideas about issue. Resources used were relevant and varied. Practical implications for teaching and learning were considered.	Extensive demonstration of knowledge of main ideas about issue. Wide range of seminal resources used. Application to teaching and learning considered in a variety of contexts.	8
	0 – 3.9	4 – 5.5	5.6 – 8	
Use of ICT in presentation (including presentation and BlackBoard upload)	Limited or inappropriate use of ICT. Concepts in presentation were partially linked or presented separately. Design principles not always evident.	Appropriate use of varied ICT to present issue. Concepts in presentation were linked. Evidence of basic design principles.	Extensive and appropriate use of varied ICT to present issue. Concepts were integrated throughout presentation. Refined use of design principles.	8
	0 – 3.9	4 – 5.5	5.6 – 8	
Group work, self evaluation, reflection	Self-evaluation was descriptive rather than analytical. Evaluation of group members' contributions lacked detail. Feedback from group members was mixed.	Analytical self-evaluation noted successes and areas for improvement. Detailed evaluation of group members' contributions. Feedback from group members was positive.	Self-evaluation comments were analytical and showed professional knowledge. Detailed evaluation of group members' contributions. Group members appreciated leadership and contributions to group processes.	4
	0 – 1.9	2 – 2.7	2.8 – 4	
Sub-Total – Part 1				20
Part 2: Individual Blog Summary				
Demonstration of professional and practical knowledge using relevant resources	Some or little demonstration of knowledge of main ideas about issue. Resources used tended to be of one type only. Application to practice needs to be clearer or based on both teaching and learning.	Clear demonstration of knowledge of main ideas about issue. Resources used were relevant and varied. Practical implications for teaching and learning were considered.	Extensive demonstration of knowledge of main ideas about issue. Wide range of seminal resources used. Application to teaching and learning considered in a variety of contexts.	8
	0 – 3.9	4 – 5.5	5.6 – 8	
Presentation and structure of ideas	Information is presented in a partially appropriate manner. Ideas require improved sequencing. Some difficulty discerning key information from extra detail. Topic is partially clear with some links to main and supplementary ideas.	Information is presented within an appropriate format. Ideas are presented logically. Structure clearly indicates key information with sufficient detail. Topic is linked to most of the main and supplementary ideas.	Information is presented within a refined and appropriate format. Structure includes key information which is clearly defined and supplemented by detail. Topic is clearly linked to main and supplementary ideas.	6
	0 – 2.9	3 – 4.1	4.2 – 6	
Evidence of wider reading to support conclusions and use of APA referencing	Few basic references used to support ideas. Research processes partially described. In-text and end-text APA referencing not used or used inappropriately with a number of errors.	Appropriate type and range of references used to support ideas. Research processes clearly described. In-text and end-text APA referencing has been used and is mainly consistent with very few errors.	Extensive range and variety of references used. Research processes described in detail with analysis. References are cited using APA in-text and end-text referencing, with hardly any or no errors.	6
	0 – 2.9	3 – 4.1	4.2 – 6	
Marks deducted for low standards of spelling, punctuation and grammar				0
Sub-Total – Part 2				20
Assignment 1 Total				**40**
Comments				
Tutor:			Workshop group:	

Assignment 2: School-based project and website 60%

Graduate attributes assessed

- Professional knowledge
- Awareness of political, social and ethical issues
- Use of technology/information literacy
- Enterprise, initiative and creativity
- Workplace experience or applied competencies
- Problem solving/Decision making

Due: Present your website on CD-ROM to your peers and your Tutor in the final Week 12 workshop. At the end of your presentation, hand the CD-ROM directly to your Tutor. Your assignment should be finished before the beginning of the Week 12 workshop.

Learning Criteria for assignment 2 (see assignment 2 marking rubric for more details):

- Professional knowledge applied to school project
- Professional management of school-based project
- Use of ICT to present and structure ideas in website structure and design
- Software competency

This assignment is to be completed individually. Much of your work for this assignment will be completed during the weekly workshops and will also be discussed in the weekly lectures. Examples of this assignment will be shown in the lectures and some workshops. It is crucial that you attend the workshops and lectures in order to gain a full understanding of how your knowledge and skills can be transferred to your work for this assignment. Please ensure that all material included in your assignment is of a professional, copyright-free nature.

Assignment 2 involves the development of a website that:

(a) describes and evaluates an ICT project you have developed with school children

(b) demonstrates your ability to structure and design electronic material

(c) is the result of your professional management of the school-based project and your involvement in the course across the semester

(d) demonstrates your competent use of software and hardware encountered in the course.

These four components of the assignment are now explained in more detail.

(a) ICT-based school project (30%)

As part of assignment 2, you are required to:

- **Design an ICT-based school project** in consultation with your Mentor Teacher. It can be developed as a new project or used to enhance ongoing learning with the whole class or a group of children. The project can take a variety of forms such as the development of a newsletter, a video of a play, the production of a short story, electronic storybook, etc. It is intended that the children in your classroom participate and use as much of the technology as possible. Your report should clearly indicate the level of child participation. Above all, the project should be

designed in such a way that it can enhance and support the learning that the Mentor Teacher has already planned for the students in the class. To ensure confidentiality of the children's identities, please do not use the school's name in your assignment and change the children's original names to pseudonyms (substitute names).

- **Present a plan (using PowerPoint) of your school-based project** during the Week 5 workshop to your peers and your Tutor. Your peers and your Tutor will provide you with feedback to further develop your project.
- **Implement and evaluate the ICT-based school project** that you work on with a group of children at your practice school/center. The focus should be on engaging the children with technology. When you prepare the website to describe and evaluate the school project, you should also demonstrate your own ICT skills. The website is a method to report on how you planned, implemented and evaluated the project.
- **Present** your assignment to your peers and your Tutor in the Week 12 workshop.

(b) Website structure and design (10%)

The structure and design of your website will impact on how well your ideas are communicated. During the semester, the lecturer and the tutors in the course will provide you with regular advice about web design and information design. There are also readings available that will assist you with your decisions about how you structure and design your website. Remember that sometimes "less is better" when trying to decide on how many "bells and whistles" to include. Above all, your website should be based on consistent structure and design, clearly presented information and easy navigation.

(c) Professional management of school-based project and learning in ICT1100 (10%)

The manner in which you manage the school-based ICT project is a reflection of your own professional development as a teacher. In order to manage your project well, you will need to consider how to approach and solve problems that may arise in a professional, proactive manner, how to manage your time wisely and how to ensure you keep on track throughout the semester. Use your E-journal to record your progress within the course and the processes you adopt to design, implement and evaluate your school-based project. Remember to keep records of permission letters given to and received from your Mentor Teachers and the parents of the children in your class. By attending, participating in and being prepared for the weekly ICT1100 lectures and workshops, you will also be demonstrating your professionalism as a teacher and a learner. Lastly, always remember to backup your work in at least three ways to ensure your school-based project and your work in ICT1100 runs smoothly.

(d) Software and hardware competency (10%)

Your website should demonstrate your competence in using the various software and hardware used in the course during the semester. Instruction on using the various software and hardware used in this course begins in the first week of the semester.

Timeline for assignment 2:

Week	Your responsibilities
1-2	Negotiate project with Mentor Teacher. Begin planning project. Check equipment and technology at school available for use. Distribute permission letters.
5	Give PowerPoint presentation showing your project plan to a small group in your workshop. Adjust project based on peers' and Tutor's feedback.
3-7	Implement project with a group of children at your prac school. Your project should be completed no later than Week 8.
8-11	Finalise web pages to create website. Send thank you message to school and children in the class (if you have not already done so) to thank them for their input to the project.
12	Submit completed website assignment on CD-ROM during the final workshop – you will be required to do a 5-minute "show and tell" to your workshop group in Week 12. You are required to submit this assignment on a CD-ROM in a labelled CD-ROM case. Please do not glue labels to your final CD-ROM as these can make the discs difficult to read. Keep a back up of the CD-ROM that you submit as your final assignment.

Project management: This assignment should be likened to a project for which you should consider yourself as the "Project Manager" – plan your work, implement your plan, monitor your own progress and bring the project to completion within a given timeframe.

Challenge: This assignment involves a certain amount of challenge. Some people even find it frustrating, especially when technological problems are encountered. During the process of this assignment, we encourage you to reflect on how you respond to challenging or frustrating learning situations, and how this knowledge can be used to further understand the nature of learning (your own learning and your students' learning). At all times, consider your own role and how you can become a problem solver, instead of a problem magnifier when you encounter challenges. As teachers, we need to develop ways to deal with technological inconsistencies or glitches (sometimes referred to as "Plan B").

Getting help: If you encounter problems with technology in the course, first of all, consider how you could address the problem. Also remember that many of your colleagues are talented users of technology and you may be able to collaborate with them to solve problems that arise. Your Tutor can also assist you to solve your problems.

Problems: Please do not leave problems until the last minute. Problems that are addressed early in the course or early in the process of this assignment tend to remain small whereas problems that are not addressed until the end of the course tend to grow into larger problems that cause unnecessary stress for you, your Mentor Teacher and your Tutors.

Assignment 2 Rubric			ICT1100, 2 Semester 2006	
Topic: School-based Project and Website			Name:	
Criteria	**Not yet competent**	**Competent**	**Highly competent**	
School project report, including: (1) Introduction and description of the project; (2) description of the project and how it was negotiated and implemented; (3) learning outcomes addressed, implemented and assessed; (4) children's degree of engagement with ICT; and (5) evaluation of project and personal reflections	School project was partially described and analyzed. Some sections required more detail. Project report needs to focus more on children's engagement with the project. Little or no evidence of wider reading to support decisions made during the semester.	School project was described and analyzed. All or most sections included appropriate levels of detail. Project report focuses on children's engagement with the project. Evidence was provided of wider reading to support decisions made during the semester.	Extensive consideration given to description and analysis of school project. All sections included extensive and appropriate levels of detail. Focus on children's engagement with the project provides basis of website. Extensive evidence was provided of wider reading to support decisions made during the semester.	
	0 – 14.5	15 – 20.5	21 – 30	30
Website structure and design, including: (1) structure of website and project is clear and consistent; (2) design is appropriate, assists with communication; (3) backgrounds and graphic elements are appropriate and don't interfere with text; (4) sitemap of website is available and accurate; and (5) navigation is clear and links are functional	Website structure and design is partially clear and consistent. Some text, backgrounds, graphics and other elements require refinement. Sitemap is not available or requires some modification. Navigation is not fully clear and some links are not functional.	Website structure and design is clear and consistent. Text, backgrounds, graphics and other elements are appropriately placed. Sitemap is available and accurate. Navigation is clear and links are all or mostly functional.	Website structure and design is clear, consistent and creative, reflecting advanced design skills. Text, backgrounds, graphics and other elements are skilfully placed to enhance communication. Sitemap is available, accurate and linked. Navigation is refined and all links are functional.	
	0 – 4.9	5 – 6.9	7 – 10	10
Professional management, including: (1) time and task management; (2) problem solving; (3) record of progress using E-journal; (4) storage of ethical documentation such as permission letters; (5) attending, participating and being prepared for weekly lectures and workshops; and (6) regularly backing up your work.	Management of school project and ICT1100 course work has been limited and/or problematic due to issues related to time and task management, problem solving approaches, documentation of progress and project, workshop contributions or backing up processes. E-journal entries were not analytical or required more detail.	Management of school project and ICT1100 course work has been effective due to effective time and task management, problem solving approaches, documentation of progress and project, workshop contributions and backing up processes. E-journal entries were both descriptive and analytical.	Management of school project and ICT1100 course work has been highly effective due to effective time and task management, preventative problem solving approaches, documentation of progress and project, workshop contributions and backing up processes. E-journal entries were analytical and showed evidence of wider reading.	
	0 – 4.9	5 – 6.9	7 – 10	10
Software and hardware competency, including use of: (1) wordprocessing, concept mapping and spreadsheets; (2) presentation software; (3) graphics and video software; (4) referencing software; and (5) CD-ROM burning software.	Limited or lacking use of software and hardware used throughout the course. Skills taught in the course are not all evident.	Appropriate use of software and hardware used throughout the course. Evidence of skills taught in the course.	Extensive use of software and hardware used throughout the course. May show some additional skills beyond those taught in the course.	
	0 – 4.9	5 – 6.9	7 – 10	10
Please note: 5 marks will be deducted for students who do not make a presentation in the final workshop session.				0
Assignment 2 Total				60
Comments				
Tutor:		Workshop group:		

Appendix II: An example of instructions for students

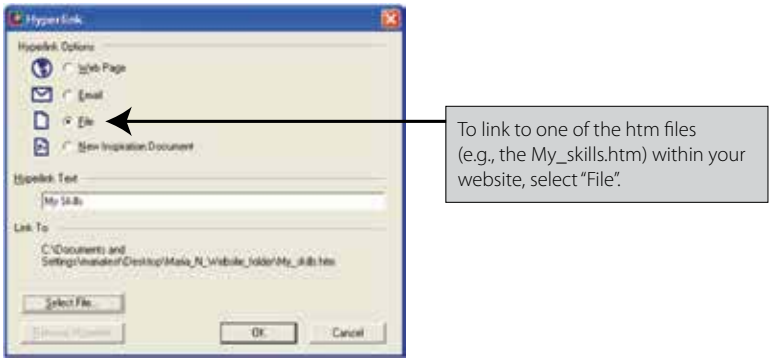
Creating hyperlinks in inspiration

To make your website map linkable to other areas of your website, you can create hyperlinks from the text in the various shapes you have created on your website map in Inspiration. This process is best left until the end of your website development when your website structure is stable and you have finalised all the details of your website map. Otherwise, you may find yourself redoing the hyperlinks.

Step 1: Select the text you wish to link from

Step 2: Link to a "File"

When you click on the "Hyperlink" button at the top of the screen, you will see a dialogue box like the one below.



Step 3: Choose the file of the webpage you wish to link to

Then navigate to the file you are linking to (e.g., the My_skills.htm file) by clicking on "**Select File**". Highlight the file, click on "**Open**" and "**Save**".

You will then notice that the text in your Inspiration shape will have a line underneath it to indicate it's hyperlinked to another file.

Step 4: Save the Inspiration file as an html file

When you save your Inspiration webmap as an .html file (File/ Export as html), check that the link still works by testing it within a web browser such as Explorer. It is not essential that you complete Step 4 today.

Appendix III: Sample letter to parents

Information letter to parents/guardians

Collection of work samples and digital images
For University assignment

You are invited to give permission for your child to participate in this project, which is being conducted as part of the requirements of a University unit. Details about the unit are given below:

Unit Code: ICT1100
Unit Name: Learning with Technology
Unit Coordinator: Maria Northcote
School: Education at ECU, Joondalup
Contact details: (08) 6304 5957 m.northcote@ecu.edu.au

The purpose of the project is to collect copies of children's work samples, photographs and digital images of children participating in learning activities. The work sample copies and images of the children will only be used in written and electronic University assignments to demonstrate my understanding of children's learning and teaching processes using technology, in primary classrooms. They may, with your consent, also be included in my professional portfolio to demonstrate my ability to enhance learning outcomes in a school environment.

If you choose to give permission for your child to participate in this project they will:

- Participate in normal classroom activities, such as working in groups or individually at their daily classroom activities. They may be photographed or videoed during these activities and their classroom work may be copied for samples. Their name will be removed from all work samples.
- Participate in creating work samples using electronic equipment such as digital video cameras, digital stills cameras, and computers. Their name will not be included on work samples copied for the University assignment.

The information will be used to complete the requirements for the unit of study noted above, and only the student(s) and the unit coordinator will have access to the information. Any information or details given for this study will be kept confidential and will only be used for the purposes of this project. Your child will not be identified in any written assignment or presentation of the results of this project.

Participation in this project is voluntary. If you choose to allow your child to participate, you are free to withdraw consent from further participation at any time without giving a reason and with no negative consequences. You are also free to ask for any information which identifies your child to be withdrawn from the study.

If you have any questions or require any further information about the research project, please contact:

Unit Coordinator: Maria Northcote

Contact details: (08) 6304 5957 or m.northcote@ecu.edu.au

Pre-service Teacher/University Student:

Contact details:

A practicum-based ICT course in higher education: a case study integrating design, implementation and evaluation (China)

Jianhua Zhao

Abstract

The *Computers in Education* course at South China Normal University (SCNU) is a compulsory course for undergraduates majoring in Educational Technology. The objectives of the course are to help students to master the basic theories of computer-assisted education and to gain the basic skills to apply computer-assisted education in teaching practice. The course content includes the latest achievements and progress in computer-assisted education. A new teaching model (COP) which incorporates activity-based classroom teaching, online learning and project-based learning has been applied in this course. Students are required to take part in a 12-to 15-week computer-assisted education teaching practicum in primary or middle schools. Three years of teaching the course has shown that *Computers in Education* can meet the requirements of computer-assisted education for pre-service and in-service teacher education. Teaching activities and teaching practicum applied in this course could be used to improve students' learning, motivations, and capacity-building in the use of computers in teaching-learning.

1. Institutional context/background

1.1 Introduction to South China Normal University

South China Normal University (SCNU), situated in Guangzhou province, was established in 1933. SCNU has three campuses, namely Guangzhou Shipai campus, Guangzhou University City and Nanhai campus, covering approximately 509 acres and holding about 29,000 full-time students, 1000 international students and 2,000 experts and scholars well known at home and abroad. Diverse programmes in a wide range of subjects have been offered by SCNU featuring the uniqueness, openness and comprehensiveness, such as philosophy, economics, law, education, literature, history, science, engineering, and management, agriculture and medicine. Three multifunctional information libraries cover 88,000 square meters and house a collection of over 3.5 million books.

SCNU has a long history and good tradition. As a comprehensive university, SCNU focuses on teacher-education and training, and contributes herself to training qualified teachers and professionals with a sense of responsibility, critical thinking and innovation. In order to build herself into a first-rate university, the university also actively participates in international communication and cooperation, and till now, it has set up links with dozens of universities and educational organizations from over 20 countries and regions. A more harmonious and open environment for both teaching and academic research has been built up for further development in SCNU.

Introduction to school of information technology in education

The School of Information Technology in Education (SITE) at SCNU was established in 2002. The school has formed a systematic talent training programmes for bachelor, master, PhD and to postdoctoral. In 2011 the school included some 1,530 students, including 18 PhD candidates, 242 master's degree candidates and 1,270 undergraduates.

The Department of Educational Information Technology in SITE has developed national instructional programme and created a series of national textbooks in educational technology, which has contributed greatly to the development of educational technology in higher schools and universities in China.

Educational Technology in the department of Educational Information Technology, a key discipline in Guangdong Province and China as well, has been strengthening its competence to undertake major scientific research projects and awarded six national teaching awards since 1989. The aim of the undergraduate programme in Educational Technology is to develop specialist personnel for government, enterprises, schools and education systems. Students systematically learn basic theories, methods, skills and knowledge and how to analyse and solve practical problems using modern information technology.

Teacher education programmes at SITE

In addition to the undergraduate and postgraduate programmes in Educational Technology, SITE has offered various ICT-related training courses for pre-service and in-service teachers, which lasts 2 or 4 months. Those courses are listed in Table 1.

Table 1: ICT-related courses for pre-service and in-service teachers

Title	Duration	Participants	Credits
Competency-building of ICT in education	2 months	In-service teachers	2
Research Methods of ICT in education	4 months	Pre- and in-service teachers	4
Teaching ICT: Theories and Methods	4 months	Pre-service teachers	4
ICT Integration: Methods and Assessment	2 months	In-service teachers	2
Classroom Management	2 months	Pre- and in-service teachers	2
Student and teacher behaviors	3 months	Pre- and in-service teachers	3
Creating effective PPT slides: Methods and Cases	1.5 months	Pre- and in-service teachers	1.5
Online learning: Methods and Assessment	2 months	Pre- and in-service teachers	2

1.2 Context of the development of the ICT-related curriculum

Computers in Education is a course which can best embody ICT in Education and the experience of teaching and learning accumulated in *Computers in Education* can facilitate the design improvements and the development of ICT-related courses/curriculum. As a National Demonstrated Bilingual Teaching Course (NDBTC) developed in 2007, *Computers in Education* follows the COP (Classroom-teaching, Online learning, and Project-based learning) teaching model. 426 undergraduate students registered the course and successfully completed the course. The course not only helps students to master principles, methods, and application in computer-assisted education, but also strengthens students' abilities to solve practical problems and lays a strong foundation for their teaching practicum.

2. ICT-related course/curriculum

2.1 Development process

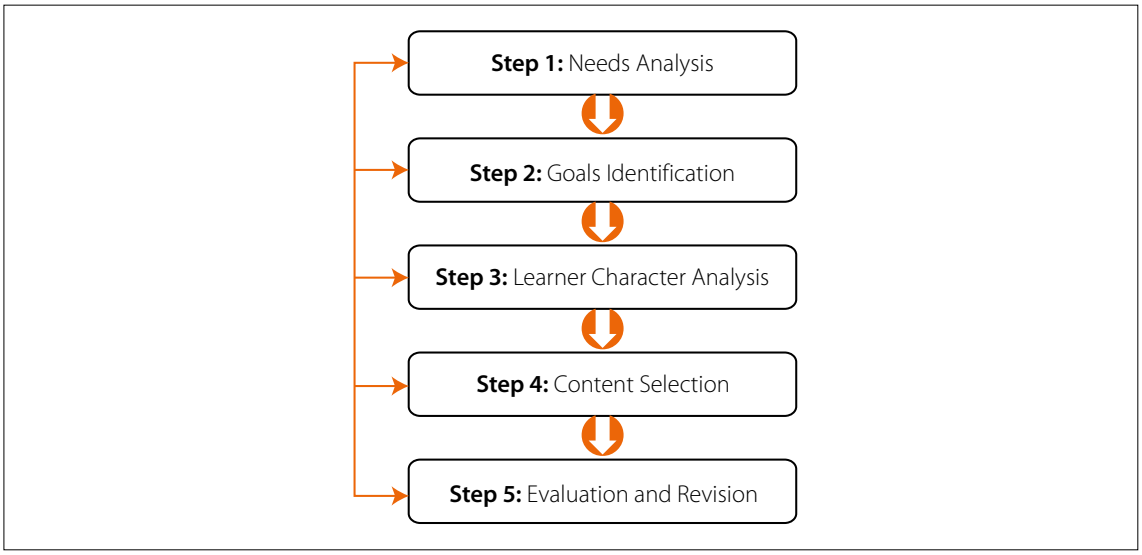
The processes involved in the development of the course included five principle steps; needs analysis, goals identification, learner character analysis, content selection, evaluation and revision activities (see Table 2 for an overview).

Table 2: Course development process

	Activity	Responsible person(s)	Duration	Output
Step 1	Needs analysis	Prof. Zhao	1 month	Report
Step 2	Goals identification	Prof. Mu	1 week	Paper
Step 3	Learner character analysis	Dr. Chai	2 weeks	Paper
Step 4	Content selection	Prof. Zhao	4 months	Textbook
Step 5	Evaluation and revision	Prof. Mu	1 month	Report

Throughout the five steps, the team teachers cooperated to complete the development process. The flow of the course development is shown in Figure 1.

Figure 1: The flow of the course development



2.2 Course outline

An overview of the course is shown in Table 3.

Table 3: Course overview

2.2.1 Course provider		
Institution: South China Normal University	Faculty/School: School of Information Technology in Education	Department: Educational Technology
2.2.2 Course title: Computers in Education		
2.2.3 Course Type		
Compulsory for all students in the pre-service teacher education programme		
2.2.4 Target audiences		
Year 3		
2.2.5 Credit and degree		
Number of credits: 3 Degree(s) to be obtained(BSc, BA, etc.): BSc		
2.2.6 Course learning objectives		
After completing the course, students should be able to: 1) master the basic theories and methods of computer-assisted education 2) master the skills and methods of designing, developing and applying computer-assisted educational software 3) master the skills and methods of application and evaluation of computer-assisted education 4) master the basic methods of applying computer-assisted education in classroom.		
2.2.7 Resources		
(1) Reading materials: • He, K. 1997. Computer-based Education. Beijing, Higher Education Press. (Required) • Simonson, M. R., and Thompson, A. 1997. *Educational computing foundations*. Columbus, New Jersey: Pearson Education. (Required) • Geisert, P. G., and Futrell, M. K. 1995. *Teachers, computers, and curriculum: Microcomputer in the classroom*. Boston: Allyn and Bacon. (Recommended) • Alessi, S. M., and Trollip, S. R. 1991. *Computer-based instruction: Methods and development*. Englewood Cliffs, New Jersey: Prentice Hall. (Required) • Maddux, C. D., Johnson, D. L., and Wills, J. W. 2001. Educational computing: Learning with tomorrow's technologies. London: Allyn and Bacon. (Recommended) (2) Manuals: Zhao, J. and Mu, S. 2007. *Learning guide.* (3) Learning environments Students will be required to register in Blackboard. (4) Learning media Digital projection, computer, Internet access		

2.2.8 Course topics

	Learning activity	Instructional strategy	Delivery mode (media)
Topic 1: Foundation of Computer based Education (CBE): Concepts and Theories	Group discussion, online discussion, brainstorming, and case analysis	Blended learning, facilitation of student participation in learning process;	PowerPoint (PPT) slides; Blackboard
Topic 2: Computer Assisted Instruction (CAI)	Case analysis, face-to-face (FTF) discussion, online discussion	Case study, blended learning, project-based learning	PPT slides, Blackboard
Topic 3: Computer Assisted Learning (CAL)	Case analysis, FTF discussion, online discussion, design for mind map	Case study, blended learning, project- based learning	PPT slides, Blackboard
Topic 4: Computer Managed Instruction	Case analysis, FTF discussion, online discussion,	Case study, blended learning, project- based learning	PPT slides, Blackboard
Topic 5: Research on CBE Application	Case analysis, FTF discussion, online discussion, brainstorming	Case study, blended learning	PPT slides, Blackboard

2.2.9 Course assessment criteria			
Category	Description	Weight (percentage)	Note (if any)
Attendance	One credit will be recorded for each absence (limited to 5 credits).	5%	
Participation	Participation in online learning and group discussion	15%	The credits will be calculated according to the number and the quality of postings recorded through Blackboard.
Midterm	Essay	20%	
Final	Multiple choice quiz, open-ended questions in written examination	40%	
Project	Team project	20%	Each team member will get credits equally
Total		100%	

2.2.8 Course topics and instructional strategies

In order to facilitate students' understanding of the learning process, the research team compiled learning guides for the course. The course follows a blended learning model, combining classroom teaching and Internet-based learning in such a way that students are not left unaided in their study and in the meeting of course requirements. The instructional strategies in the course integrate a variety of strategies from practical teaching, project-based learning, blended learning, case studies, learning activity organization, teacher-student interaction, technology-supported teaching, and evaluation. In addition to the classroom teaching, the Blackboard learning management system is used by students to further discuss what they have learned after interacting with the teacher, to expand discussions, and deepen their understanding and knowledge.

The course is composed of five parts; 1) Foundation of Computer-Based Education (CBE): Concepts and Theories, 2) Computer Assisted Instruction (CAI), 3) Computer Assisted Learning (CAL), 4) Computer Managed Instruction, and 5) Research on CBE Application.

'Foundation of CBE, Concepts and Theories' provides a general introduction to basic models of CBE, environment and resources for CBE, and the ethics of computer-assisted education.

'Computer Assisted Instruction' introduces CAI, the design and development of CAI software, application of CAI, evaluation of CAI, and Intelligent Computer Assisted Instruction (ICAI).

'Computer Assisted Learning' (CAL) covers the constitution of a CAL learning environment, individualized CAL systems, Computer-Supported Collaborative Learning (CSCL), and Computer-Assisted Learning Community (CALC).

'Computer Managed Instruction' focuses on computer-managed instruction systems, classroom instruction information processing systems, and computer-assisted testing.

'Research on CBE Application' focuses on the promotion of individual development through CBE, CAI courseware and its assessment, and the development of CBE applications.

2.2.9 Course assessment

The components of course evaluation system include:

1. Student attendance. 5% of the total marks are assigned for student attendance. 1 point is subtracted for each instance of student absence. The student fails if he or she has been absent from the course too often. If this happens, the student has to retake the course.
2. Student participation. Participation in classroom discussion (group discussion) and online discussion covers 15% of the total mark. The frequency, quality, and scope of the student's participation are evaluated.
3. Midterm examination. Students take a midterm examination which makes up 20% of the total mark. Students are asked to write an academic paper with a self-selected topic of inquiry.
4. Final examination. A final examination paper includes explanation of terms, multiple-choice questions, true-or-false tests, short answer essay questions, and problem-solving questions involving critical thinking and higher order thinking skills. This accounts for 40% of the total mark.
5. Project-based learning. Students must complete a team project during their teaching practicum. They must design and develop teaching courseware, view/provide a video for teaching, design an assessment tool such as a questionnaire to assess the effects of their teaching, write an academic paper, and reflect on the actual teaching. This accounts for 20% of the total mark.

3. Outcomes: benefits and challenges

3.1 Benefits

In 2007 the course was updated and revised to reflect a more constructivist approach. This included improving and developing students' fundamental knowledge and competencies in CBE. A series of 21st century skills and competencies, such as social and communication skills, scientific inquiry, critical thinking, technology integration, problem-solving, independent thinking and decision-making were assimilated into the course. Students demonstrated their skills in these aspects during their teaching practicum in schools in the first half of their fourth year, through instructional design, classroom teaching, evaluation, and communication with in-service teachers.

After students completed the course, they were required to reflect on how the course benefited them and its effectiveness in relation to their life-long learning. Since 2007 the average score of the course assessment by students has been over 90, which demonstrated that the students were satisfied with the changes made in the course. Students have mentioned that the course has provided a positive foundation for their teaching practicum, including familiarizing them with actual teaching practice activities in schools, ICT integration, communication techniques, and socializing strategies.

3.2 Challenges and solutions

Some of the challenges faced in the design, implementation and evaluation of the course included:

1. An online learning environment was critical for the course. However, students' prior experiences involving online learning were largely limited to assignment submission and learning resources sharing.

2. Students did not want to participate in group learning because they thought it was not helpful. Most Chinese students hold similar beliefs because of examination-oriented competitive learning, and teacher-centered education. (Gu, 2003; Ji, 2005; Sun, 2001).
3. The teaching methods changed. As a consequence, the final examination could not be used as the sole course assessment and a new way to assess students' performance needed to be set up.
4. A number of schools were needed as partners for the teaching practicum. The challenge was to find enough and appropriate school partners.

To address these challenges, the following remedies were introduced:

1. Blended learning (Driscoll, 2002; Duhaney, 2004) was deliberately chosen as part of the course design. Students were offered both a classroom-based learning environment and a virtual learning environment (VLE). Although students were familiar with Blackboard, the survey results showed that they did not know how to apply it properly and did not know most of the functions offered by the VLE platform. In order to improve students' skills in online learning, a training course in online learning has been designed to provide technical orientation for students to engage their online learning more efficiently.
2. To engage students more deeply, team members engaged in group learning. Course teachers or facilitators explained to students the advantages of group learning, and helped them to experience how it works when carried out in the right way. This shifted student attitudes considerably. As the course progressed, students wanted to work more in groups.
3. The traditional and single examination was replaced by systematic, authentic assessment, with approval from the University Teaching Office.
4. A number of local schools agreed to accept students for teaching internships. Students made significant progress when they were actually engaged in teaching practice, and in return this has enhanced long-term partnerships between the university and schools.

4. Conclusion and further implications

When designing and developing an ICT-related course/curriculum, relevant conditions and needs must be taken into account, such as the emerging need for a good virtual learning environment, and adaptive and innovative teaching ideas and pedagogy. On the *Computers in Education* course creative teaching strategies were considered and implemented. Course organizers and facilitators realized that scaffolding and facilitating students' prior knowledge and willingness to participate in the technology-enabled learning process was of paramount importance because active and meaningful participation is an essential foundation for acquiring knowledge, practical experiences, desired ICT competencies and critical thinking. Another realization was that students must participate in the practical application of concepts and principles. There must be meaningful participation in real-life situations, in schools and during the teaching-learning processes. Moreover, when teaching approaches changed, the assessment approach should be adjusted too. The single examination practice of the old has now been replaced by a multi-assessment method.

Implications for better design and implementation of this course can be concluded as follows: (1) more flexible and responsive policies needed to guarantee the smoothness and success of

the innovations of the curriculum; (2) the practical application of the updated learning theories and creative activities needed to be encouraged in teaching practice; and (3) the innovative and effective teaching practicum needed to be strengthened to facilitate learners' deeper understanding of the knowledge and their capacity-building for 21st century.

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A project-based course for learning to teach with ICT: a case of pre-service teacher education (Republic of Korea)

Hyeonjin Kim, Ph.D.

Abstract

This case study explores a course titled *Theory and Practice for Instructional Material Development* offered by Korea National University of Education (KNUE). This optional 15-week course is one of the largest in KNUE, with around 600 pre-service teachers from various departments enrolling yearly. The two-credit course enables pre-service teachers to learn basic ICT tools and gain a sense of how to teach using technology. As the majority of enrollees are freshmen who lack knowledge and skills in both ICT and teaching, course projects are often initially challenging for them. This case study demonstrates how the course structure was designed and redesigned to enhance the confidence and engagement of freshmen pre-service teachers. The redesigned and updated course begins with an introduction to the theory and evaluation of on ICT instructional media and materials. The pre-service teachers' first project is to produce instructional digital images with a simple description of their pedagogical ideas. Subsequent projects involve the use of Microsoft Office PowerPoint, games, instructional movie clips, and web-based project materials. Projects last for two to three weeks, and the lessons learned in each project become the basis for further plans and projects.

1. Institutional context/background

1.1 Introduction to the Korea National University of Education

Korea National University of Education (KNUE) is located in Chungcheong province and opened in 1985. It is one of 11 teacher education institutions (TEIs) in Republic of Korea.

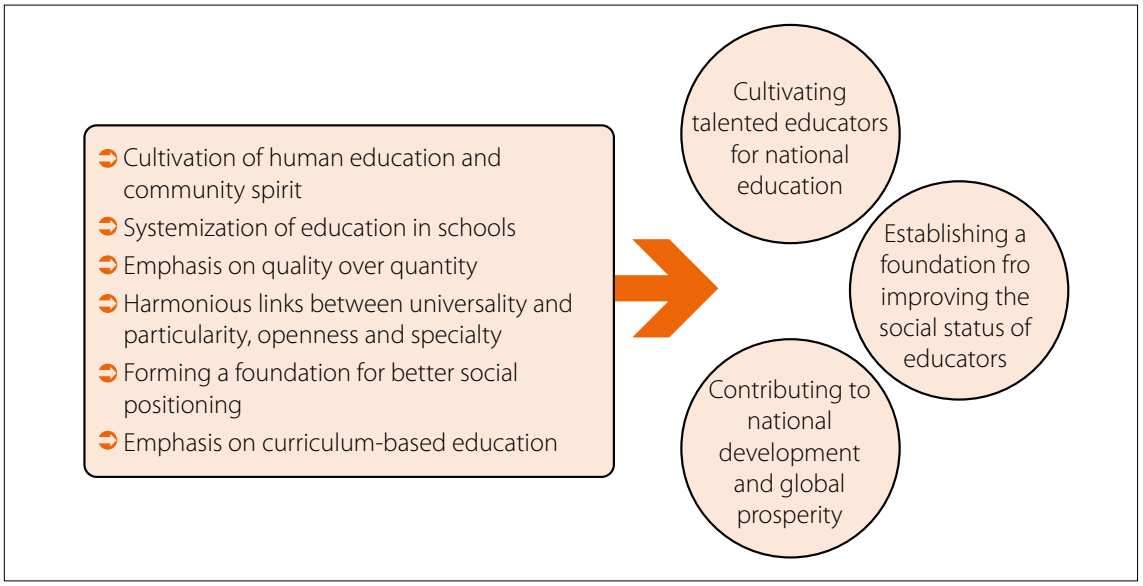
Figure 1: The logo of Korea National University of Education

KNUE is the only TEI that offers teacher education programmes for teaching in all levels of schools, from kindergarten to secondary, and that offers bachelor's, master's, and doctoral degrees. KNUE plays a very important role in public education and in teacher education in the country.

Educational philosophy

KNUE was established to educate pre-service and in-service teachers and to conduct research on education. Figure 2 illustrates the educational philosophy of KNUE.

Figure 2: Philosophy of Korea National University of Education



Source: www.knue.ac.kr

KNUE's educational philosophy focuses on the improvement of public education. It aims to cultivate talented educators for national formal education, to improve educators' social status, and contribute to national development and global prosperity.

Current status

Table 1 and Table 2 present the current status (2010) of faculty members and enrolled students at KNUE. All faculty members hold doctoral degrees in educational or non-educational subject areas.

Table 1: Status of staff by position

(As of 2010)

Classification	Number
President	1
Faculty	187
Affiliated school teachers	123
Administrative staff	220
Total	531

Source: www.knue.ac.kr

KNUE provides undergraduate and graduate programmes for teacher pre-service and in-service education. Most undergraduate students enter the university with high academic achievements in high school. Graduate students are mostly in-service teachers. The master's degree programme is implemented as part of national policy and some in-service teachers are seconded to KNUE to earn their master's degrees. The doctoral programme is similar to that provided by other universities and is availed of by both teachers and non-teachers.

Table 2: Numbers of enrolled students

(As of 2010)

Classification			Department (programme)	Number
Under-graduate schools	College I~IV (Teacher education programme)		23	2,283
Graduate Schools	Graduate School	Master's degree	20 (49)	729
		Doctoral degree	19 (48)	216
	Graduate School of Education	Master's degree	20 (50)	1,940
	Graduate School of Education Policy and Administration	Master's degree	1 (3)	147
		Doctoral degree	1 (3)	6
Total				5,321

Source: www.knue.ac.kr

Teacher education programme

The undergraduate school focuses on preparing future teachers. Table 3 presents the departments for teacher education at KNUE. College II, III, and IV in Table 3 are for secondary school teachers; as a result, the secondary teacher education programme at KNUE looks larger than the elementary education programme. However, the number of students in this department is comparable to the number of students in other departments.

Table 3: Departments for teacher education at KNUE

College	Department	Total
College I	Education, Early Childhood Education, and Elementary Education	3
College II	Korean Language Education, English Language Education, German Language Education, French Language Education, Ethics Education, Social Studies Education, History Education, and Geographic Education	8
College III	Mathematics Education, Physics Education, Chemistry Education, Biology Education, Earth Science Education, Home Economics Education, Technology Education, Computer Education, and Environmental Education	9
College IV	Music Education, Physical Education, and Arts Education	3

Source: www.knue.ac.kr

1.2 Context of the development of the ICT-related curriculum

The elective course *Theory and Practice for Instructional Material Development* has been offered to pre-service teachers by the Educational Technology Programme of the Department of Education since 1999. Pre-service teachers are required to take 21 credits in the category of general education. This course is offered as a two-credit elective when students were becoming interested in using ICT in both their daily lives and for future teaching. Since then the university has increased the number of sections in the course. Approximately six classes are now available each semester, taught by two to three instructors.

Each instructor implements the course based on a textbook, but instructors also have the flexibility to revise the course to some degree based on personal preferences and skills. Therefore, individual classes may address different types of tools (e.g., Dreamweaver vs. Namo for web editing) and activities (e.g., development of WebQuests vs. an online community). Pre-service teachers are generally familiar with ICT, but they generally do not integrate ICT into the school curriculum in pedagogical ways. They may use too much or too little ICT during their teaching. They benefit

from assistance in learning how ICT is best integrated into school curricula in regard to content, teaching methods, and cost, as well as student learning. This paper reports on the third semester implementation of the course, which resulted from revisions in the spring semester of 2008. In the first implementation, students acknowledged that they learned from the course, but they felt that the work required by the course projects was excessive. Accordingly, the instructor revised the course activities. Understanding the educational potential of ICT and gaining ICT skills for developing instructional materials remained the focus. The instructor hoped that the revisions would further assist pre-service teachers to gain a sense of integrating ICT into their future teaching and school curricula.

As ICT continues penetrating into Korean society, other similar courses have been offered at the university. These mainly focus on ICT for specific subject matters, while this course focuses more on ICT and pedagogy for all school-level pre-service teachers. Because pre-service teachers take this course in the first or second year of their programme, they gain a sense of ICT integration before taking their core subject courses. This paper explores how the course is designed and organized to facilitate pre-service teachers' sense of technology integration.

2. ICT-related course/curriculum

2.1 Development process

The process of developing the curriculum for this course varies for each instructor, as each organizes his or her class somewhat differently. Nevertheless, the processes share some commonalities, as summarized in Table 4.

Table 4: The process of developing the curriculum at KNUE

	Activities	Responsible person(s)	Duration	Output	Notes (if any)
Step 0	Deciding the rough specifications of the course, such as target students, course type, credit, etc.	Faculty member and administra-tive staff	A week or less	Specifica-tions of the course	(Not applied to this case because it was previously decided.) The course specifications will be clarified at the end of the development phase.
Step 1	Developing the textbook - Selecting topics for the semester (15 weeks), based on needs analysis - Writing and publishing the textbook	All instructors (Faculty members and part-time instructors)	A few months	Textbook	Publication of the textbook generally takes a long time. Before its completion, the new curriculum can start with handouts and resources. The textbook provides the baseline of the curriculum, but instructors can revise it.
Step 2	Deciding the focus of the course - ICT skills vs. pedagogical practice & theory	The instructor (the author)	A week or less	Educational purposes of the course	It is important to decide the focus of the course (e.g., learning ICT vs. learning to teach with ICT) because of limited time. The focus is decided, also based on the needs analysis, such as the ICT status of the K-12 schools, pre-service teachers' level of ICT skills and interests, etc.

	Activities	Responsible person(s)	Duration	Output	Notes (if any)
Step 3	Deciding the macro instructional model (e.g., CBA model) for the completion of the course purpose	The instructor (the author)	A week or more	The instruction-al mode with the macro structure of the class activity	Regarding the instructional model, this case adopted learning-by- experience in the context of teaching for situated learning. The curriculum developer needs to identify which models are most appropriate to the completion of the educational purpose.
Step 4	Deciding the detailed topics and designing the detailed class activities - Selecting topics from the textbook, including ICT tools - Developing detailed class activities & evaluation plan	The instructor (the author)	1 week or more	Course structure, including course projects (the subject of project & ICT tools) and evaluation plan	All activities for 15 weeks (i.e., a semester) should be identified based on the macro instructional model and the textbook.
Step 5	Developing course materials for 15 weeks and completing the syllabus - Developing presentation slides for lecture, activity templates, and evaluation tools - Developing sample outputs of the course project	The instructor (the author) and teaching assistant	2 weeks or more	Syllabus, along with a package of the course materials for the instructor and learners	Development of the 15-week course materials is time-consuming. The instructor is often developing the course materials right before the class. This is fine, but one should remember that development often takes more time than expected.
Step 6	Implementing, evaluating, and revising the course - Evaluating the course through interviews, surveys, and observations	The instructor & others	1 week or less	Student work, evaluating report, and revised course syllabus	After the first run of the course, the instructor carefully collects the data from the target audience and observations to evaluate the course. In this type of the course, the students may have a heavier workload than in a traditional lecture-based course. The instructor should be aware of students' engagement and learning.

2.2 Course outline

Table 5: Course outline

2.2.1 Course provider		
Institution: Korea National University of Education (KNUE)	Faculty/School: Hyeonjin Kim/The 1st College	Department: Education (Educational Technology Programme)
2.2.2 Course title: Theory and Practice for Instructional Material Development		
2.2.3 Course Type		
- Elective for all students of the university/college - Elective for all students in the pre-service teacher education programme		

2.2.4 Target audiences

(✓) Year 1 (✓) Year 2 (✓) Year 3 (✓) Year 4

Note: A student from any year level may enroll in the course since this is treated as an elective. Based on historical data, most of the enrollees had been from Years 1 and 2.

2.2.5 Credit and degree

Number of credits: 2
Degree(s) to be obtained: BA

2.2.6 Course learning objectives

This course aims to teach pre-service teachers ICT so as to understand the potential of ICT for teaching and to use it for development of instructional materials.

After completing the course, students should be able to:

1) understand the theories and features of digital instructional media
2) design and develop instructional materials by using ICT
3) understand the role and expertise of teachers in the information society

2.2.7 Resources

Textbook (required)	Baek, Y., Kim, H., Jung, J., Yun, S., Park, H., Choi, S., and Jung, D. 2009. *Development of Learning and Instructional Materials for Effective Lessons*. Seoul: Hakjisa. (in Korean)
Website	http://eteacher.knue.ac.kr (e-class LMS, accessible only by enrollees)
Place	Computer lab
Hardware and Infrastructure	20-25 computers (PC) with Internet connection (1 per student)
Software	Windows XP (OS), productivity tool (MS office), capturing tool (Open Capture), image editing tool (Photoshop), audio editing tool (Goldwave), & video editing tool (Movie Maker)
Handout	Templates, rubrics, website, etc. - PowerPoint Game: http://jc-schools.net/tutorials/ppt-games - WebQuest: http://webquest.org/index.php

2.2.8 Course topics

	Learning activities	Instructional strategies	Delivery modes
Topic 1 (3 weeks)	- Theories and cases of instructional media and materials - Practice 1: Evaluation of computer-based educational materials and websites	- Lecturing based on chaps. 1 & 9 of the textbook - Practice: "1) Evaluate a computer-based educational material or website based on the evaluation criteria 2) Develop the evaluation report in the format of the presentation material with image captures"	- S/W: Capturing tool (Open Capture), PPT presentation, & word processor - Textbook - Materials: evaluation sheets & website list
Topic 2 (2 weeks)	- Practice 2: Developing & editing digital images for teaching	- Lecturing based on chap. 9 of the textbook - Practice: "Edit an image by using some functions of Photoshop"	- S/W: Photoshop - Textbook - Materials: Sample editing image
Topic 3 (3 weeks)	- Project 1: Developing PowerPoint game	- Lecturing based on chap. 3 of the textbook - Conducting the project based on case-based activity (CBA): Scenario work–Case analysis–Plan–Development–Reflection	- S/W: All tools learned above and PowerPoint - Textbook - Materials: sample PowerPoint game materials, the cases of pre-service teachers
Topic 4 (2 weeks)	- Practice 3: Developing movie clips for teaching	- Lecturing based on chap. 4 & 6 of the textbook - Project-based activity: - "Edit a movie clip by using some functions of Movie Maker"	- S/W: Movie Maker - Textbook - Materials: Sample editing movie clips

Topic 5 (4 weeks)	- Project 2: Developing instructional website: WebQuest & Web-portfolio	- Lecturing based on chap. 10 of the textbook - Conducting the project based on case-based activity (CBA): Scenario work–Case analysis–Plan–Development–Reflection	- S/W: All tools and web authoring tool (e.g., Dreamweaver or blog tool) - Textbook - Materials: WebQuest website

2.2.9 Course assessment

Categories	Description	Weight (%)
Participation	Attendance, class discussion	10
Midterm	Multiple choice quiz and open-ended written examination	25
Practice Result	Submission of the products of three practices: - Practice 1: Evaluation of a computer-based material or website - Practice 2: Editing a digital image - Practice 3: Editing a movie clip	15
Project 1	Development of PowerPoint game material - Output: Instructional materials with a summary lesson plan and CBA report (i.e., reflection note)	20
Project 2	Development of WebQuest and web-portfolio - Output: Instructional materials with a summary lesson plan and CBA report (i.e., reflection note)	30
Total		100

2.2.2 Course title

The course title, *Theory and Practice for Instructional Material Development*, indicates that this course focuses on learning about ICT in education rather than on ICT skills themselves. Although this is a basic ICT course, teaching ICT in the context of education provides pre-service teachers with a sense of teaching with technology. The course focuses on both theory and practice. Without theoretical support, such as the pedagogical potentials of ICT and principles of development, students may concentrate only on ICT skills.

2.2.3 Course type

The course is offered by the Educational Technology Programme of the Department of Education and is a two-credit elective. Generally, courses of this type do not allow for extensive practice with different kinds of basic ICT programmes; thus, the instructor needs to carefully select the best programmes for the course.

2.2.4 Target audience

The target audience is basically all students from all departments in the university. However, in practice most enrollees are freshmen or sophomores because the course is an elective. Most enrollees do not have experience in teaching and lesson planning, although they may have different levels of ICT skills. The instructor is encouraged to investigate enrollees' prior knowledge and skills during the first class meeting.

2.2.5 Course learning objectives

The learning objectives focus on ICT skills and on how to use ICT as a pedagogical tool. The instructor needs to combine these two purposes rather than teach them in isolation.

2.2.6 Resources

Course resources include textbooks, handouts, websites, and software programs. The table of contents of the textbook shown in Figure 3 represents the basic structure of the course. The content of the textbook, such as ICT tools and functions, is continually updated according to the development of new technology.

Figure 3: The cover image and table of contents for the course textbook

Chapter 1: Introduction of learning and instructional material development
Chapter 2: Development of image materials
Chapter 3: Development of audio materials
Chapter 4: Development of video materials–recording
Chapter 5: Development of video materials–capturing
Chapter 6: Development of video materials–editing
Chapter 7: Development of animation materials–introductory level
Chapter 8: Development of animation materials–advanced level
Chapter 9: Development of presentation materials
Chapter 10: Development of instructional website and online community

2.2.8 Course topics and Instructional strategies

Table 6 presents details of the course topics and software programs. In the first implementation of the course there was too high a workload for students. The course was then reorganized into 'practices and projects'. Practices focused on learning ICT skills, while projects focused on technology integration. Practices included only in-class activities, while projects included in-class activities and home assignments. For practices, students were asked to submit the results of their in-class activities right after class. For projects, students were asked to submit the instructional materials for technology integration with brief lesson plans and CBA reflection reports. Through the projects, pre-service teachers could utilize the ICT skills they learned in the course and could gain a sense of technology integration into curricula and teaching. Figure 4 presents the reflection template in the CBA report.

Figure 4: Reflection template in the CBA report

- Why did I develop this PowerPoint game?
- Briefly describe my development process.
- What did I apply or adjust from tprevious students' cases for my project?
- What difficulties did I encounter?
- What are educational values and characteristics of ICT in my lesson plan? What obstacles could happen during implementation?

Course practices and projects are organized from simple to complex and integrated tasks so that pre-service teachers can use and reuse software programs. For example, pre-service teachers used progressively more advanced versions of PowerPoint software for different assignments of the course.

Table 6: Course details

Topic	Week	Topics and Major Software Programs
Topic 1	1	- Course orientation/student information sheet (survey) - Theories and cases of instructional media and materials
	2	- Theories and cases of instructional media and materials - Introduction to evaluation practices of computer-based instructional materials and websites
	3	- Practice 1: Evaluation of computer-based instructional materials and websites - S/W: Capturing tool (Open Capture), PPT presentation, Word processing
Topic 2	4	- Practice 2: Development and editing of digital images for teaching - S/W: Photoshop
	5	- Practice 2: Development and editing of digital images for teaching - S/W: Photoshop
Topic 3	6	- Project 1: Development of PowerPoint game - S/W: All tools learned above
	7	- Project 1: Development of PowerPoint game - S/W: All tools learned above
	8	Mid-term exam
	9	- Project 1: Development of PowerPoint game - S/W: All tools learned above
Topic 4	10	- Practice 3: Development and editing of movie clips for teaching - S/W: Movie Maker
	11	- Practice 3: Development and editing of movie clips for teaching - S/W: Movie Maker
Topic 5	12	- Project 2: Development of instructional website: WebQuest and Web-portfolio - S/W: All tools and Web authoring tool (e.g., Dreamweaver or blog tool)
	13	- Project 2: Development of instructional website: WebQuest and Web-portfolio - S/W: All tools and Web authoring tool (e.g., Dreamweaver or blog tool)
	14	- Project 2: Development of instructional website: WebQuest and Web-portfolio - S/W: All tools and Web authoring tool (e.g., Dreamweaver or blog tool)
	15	- Final Presentation: Sharing and reflection

2.2.9 Course assessment

Several assessment strategies have been used, including a paper examination, performance assessments with rubrics, and peer evaluations. A paper examination was implemented as a mid-term exam; it consisted of multiple choice and simple open-ended questions about theories and principles of ICT and instructional media. Students' practices and projects were primarily evaluated using rubrics, as presented in Figure 5.

Figure 5: Sample rubric: PowerPoint game project

Rubric for PowerPoint Game		
Dept.:	Name:	
* If one of the following individual questions is infracted, 2 points will be taken off per infraction.		
Area	**Criteria**	**Score**
Principles of instructional games	1. Are all elements (such as game scenario, game guidelines, materials, and lesson idea) identified? 2. Are expressions and words appropriate to the students' level? 3. Are learning goals and subjects appropriate to game-based learning? 4. Is the game structure appropriate to the achievement of learning goals? 5. Is there a balance between skills versus luck in winning the game? 6. Are students motivated emotionally and cognitively? 7. Feedback for incorrect answers should not be more interesting than one for correct answers. 8. Is there a description of the incentive or prize for winners? 9. Is there a conclusion page in the game material?	/25
Technical elements	1. Are there any problems in the following technical elements? a) Editing of digital images b) Hyperlinks c) Voice file d) Navigation design e) Animation	/30
Design elements	1. Is the style of text easy to read? 2. Is the size of text easy to read? 3. Does the color of the text contrast with the background color for legibility? 4. Is the color of images/graphics simple and consistent for legibility?	/15
Content elements	1. Is the content easy to understand? 2. Are sentences simple and easy to understand? 3. Are positive sentences used? 4. Are long texts or complicate images displayed gradually? 5. Is all content (including images) used without copyright violation?	/15
Reflection on project	Is the reflection clearly described in the CBA report?	/15
* Bonus: Creativity	1. Is there any new game idea other than a quiz? 2. Is there any new PPT function to the game structure?	/+4
Total		/100
Comments:		

3. Outcomes: benefits and challenges

3.1 Benefits

After the first implementation of this curriculum, the instructor analyzed the change in pre-service teachers' sense of technology integration over the semester. The findings indicated that pre-service teachers changed their knowledge, skills, and values for technology integration through course projects (Kim, 2011). That is, pre-service teachers started to understand the educational potential of technology and the various ways of using technology as a tool. For example, when they used PowerPoint software for making an instructional game material, they started to consider PowerPoint to be more than a presentation tool; it was an interactive learning tool which could be used for different educational purposes. Students' course evaluations also

indicated that they learned a significant amount about the use of ICT in education. However, some pre-service teachers still retained their initial beliefs on technology and considered technology to be separate from the school curriculum. A semester may not be enough to change people's beliefs. Further approaches need to be considered.

3.2 Challenges and solutions

After the first implementation, students provided both positive and negative comments regarding the course. Negative results were related to student workload; students thought that there were too many required projects and activities. Based on students' course evaluations and the instructor's observations, the course was revised for the second and third semesters. First, four projects were divided into two practices (simpler versions of projects), and two projects. Through this change, pre-service teachers were easily able to master ICT skills and then to complete their lesson plan projects. Second, the template of the CBA report as part of course projects became simpler. That is, the twelve reflective questions were reduced to five essential reflection questions. During the third implementation of the curriculum, students' course evaluations indicated that they thought the workload of the course projects was reasonable.

4. Conclusion and further implications

The course *Theory and Practice for Instructional Material Development* is a basic-level course for teaching with ICT. The purpose of the course is to ensure pre-service teachers comprehend the potential of ICT for teaching and develop ICT-related instructional materials. Students are expected to gain a sense of technology integration and of pedagogical thinking with ICT. Because the course is offered mostly for freshmen and sophomores, pre-service teachers are equipped early on with a sense of technology integration before they learn more about their core subject matters and before they have their practicum. The lessons learned and the solutions identified from this study could be used by other instructors of this course in applying the approaches in this case study to future offerings of this course.

References

Kim, H. 2011. Exploring freshmen pre-service teachers' situated knowledge in reflective reports during case-based activities. *The Internet and Higher Education*, *14*(1), 10-14.

Development of educational technology courses and their application in student teaching: case of Mindanao State University – Iligan Institute of Technology (Philippines)

Rhea D. Febro and Amelia T. Buan

Abstract

This case study explores the application of two educational technology courses at Mindanao State University – Iligan Institute of Technology. *Educational Technology 1* introduces students to educational technology and educational media, including the theories and principles behind their use and their development and utilization in the classroom. *Educational Technology 2* concerns the development of project-based learning unit portfolios that utilize ICT and web-enhanced learning activities. Students experience backward curriculum design through planning unit portfolios, during which they determine learning goals, planned assessments, and design activities. The development process involved continuous reflection and participation by the Educational Technology faculty using observations, course assessments, and responses to the results of pre-service teachers' implementation of ICT in the classroom. Both courses require partnerships with Department of Education schools. The positive effects of the partnership process extends to faculty development, curricular review of programmes, and policy-making.

1. Institutional background

1.1 Introduction to Mindanao State University – Iligan Institute of Technology, MSU-IIT College of Education

Situated in the southern part of the Philippines in the city of Iligan, the Mindanao State University – Iligan Institute of Technology (MSU-IIT) was established in 1968 as one of the ten campuses of the Mindanao State University system. The institute offers more than 115 undergraduate and graduate programmes, including 43 graduate programmes in fields including education, business, arts and humanities, engineering, information technology, the natural sciences, and mathematics. (www.msuiit.edu.ph/index.php)

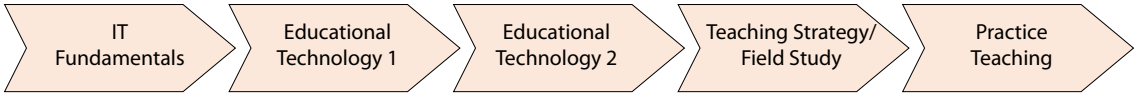
In 1985 the institute began to offer teacher education programmes through the establishment of the College of Education (CED). Over the following 26 years the CED has produced 5,394 graduates, most of whom have gone on to teach in primary and secondary schools. The college has been recognized as a Center of Excellence in teacher education by the country's Commission in Higher Education. One reason for this is the college's willingness to embrace technology.

1.2 Context of the development of the ICT-related curriculum

In 2004, sensitive to the needs of society and to the demands of teacher education programmes, the college produced a comprehensive plan to integrate ICT into the curricular programme. The plan was also a response to the creation by the Department of Education of National ICT Competencies for Teachers and to the issuance of the Commission on Higher Education (CHED) Circular Memorandum Order # 30 series of 2004 (CMO 30) on Revised Policies and Standards for Undergraduate Teacher Education Curriculum.

In the plan, MSU-IIT decided to go beyond the production of a single course in which students would improve their ICT skills. Instead, the development of skills was mapped into a number of courses in a ladderized fashion to ensure sustainability, as shown in Figure 1. The plan included the integration of ICT for education-related inputs from faculty development programmes, the addition of another Education Technology Course as mandated by CHED CMO 30, the provision of mechanisms for the continuity of ICT pedagogical knowledge during practice teaching and the encouraging of undergraduate research in this area.

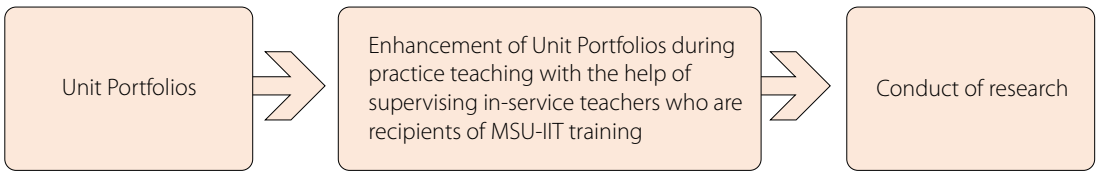
Figure 1: Mapping of ICT-related courses in pre-service curriculum



The CED formulated policies that included the improvement of ICT infrastructure, the creation of a Multi-Media Center with its own coordinator and staff, the creation of an ICT for Education Committee, the establishment of a community of learning and the adoption of action research. The community of learning ensured that Department of Education in-service teachers would be able to mentor and supervise pre-service students during practice teaching, especially in relation to ICT integration lessons.

Though several CED courses were infused with technology, two courses served as the core – *Educational Technology 1* and *Educational Technology 2*. *Educational Technology 1* introduces students to educational technology and the various educational media, including the theories and principles behind their use and their development and utilization in the classroom. *Educational Technology 2* focuses on the development of project-based learning unit portfolios that utilize ICT and web-enhanced learning activities. The portfolios that students create in these two courses can be used during practice teaching or in research subjects. This is shown in figure 2.

Figure 2: Utilization of EdTech2 course portfolios in practice teaching and research



2. ICT-related course/curriculum

2.1 Development process

The development of the educational technology courses is summarized in the table that follows. It should be noted that after the approval and implementation of the programme, the two courses followed cycles of review and improvement.

Table 1: Educational technology 1 and educational technology 2 development process

	Activities	Responsible person(s)	Duration	Output
Step 1	Approval of Curricular Programme Proposal and Review	College, institute, system wide curricular committee	2 months	Approved curricular offerings
Step 2	Revision of Course syllabus	All Education Technology faculty	1 day	Revised syllabus
Step 3	Faculty enhancement workshop to include review and creation of course materials	All Education Technology faculty	2 days	Course manual and course materials
Step 4	Course implementation	Faculty assigned	1 semester (54 weeks @ 5hrs/week)	Student work
Step 5	Course assessment	All Education Technology faculty	1 day	Assessment report as basis for review and revision

Before the courses were offered, a series of discussions and reviews took place that included college-wide and system-wide curriculum committees, with the results receiving final approval from the Board of Regents. Assigned faculty members were then requested to revise the course syllabus for contextualization.

The courses are subject to continual enhancement. Faculty members meet for an enhancement workshop before each semester starts to review the syllabi, based on the results of assessments and observations made during previous course implementation. Topics for inclusion in the workshop include the development of modules, worksheets, and instructional media. Enhancement workshops have also addressed assessment results that indicated modules that students thought were unnecessary, activities that needed more scaffolding materials for students to better understand the content, topics that needed to be simplified, and concepts that were confusing to students.

2.2 Course outline

- **Educational Technology 1 Course**

2.2.1 Course provider		
Institution: Mindanao State University-Iligan Institute of Technology	Faculty/School: College of Education	Department: Department of Professional Education
2.2.2 Course title: Educational Technology 1		
2.2.3 Course Type		
Compulsory for all students in the pre-service teacher education programme		
2.2.4 Target audiences		
Year 3		
2.2.5 Credit and degree		
Number of credits: 3 units Degree(s) to be obtained: Bachelor of Secondary Education, Bachelor of Elementary Education, Bachelor in Industrial Education		
2.2.6 Course learning objectives		
After completing the course, students should be able to: - Apply the theories, principles, and techniques in the selection, design, production, and utilization of instructional media. - Recognize the values of integrating instructional media in the curriculum and of using such media in instruction with utmost care and economy. - Use the different audiovisual equipment properly in classroom instruction.		

2.2.7 Resources

- Required Course Textbook: *Educational Technology 1 Textbook* (developed by EdTech Faculty of MSU-IIT)
- Print and non-Print media
- Intel Teach Getting Started Manual
- Intel Teach Help Guide
- WebQuest and Online treasure hunt samples available at http://fit-ed.org/teachingwiththeweb/index.htm

2.2.8 Course topic

Topic	Learning activities	Instructional strategies	Delivery modes (media)
Introduction to Educational Technology	Discuss educational technology, its scope and related terms; Dale's Cone of Experience; rationalization of the use of instructional media in the classroom. Trace the history of educational technology	Small group discussion, lecture, question and answer	Textbook PPT presentation Activity sheets MSU-IIT Online Learning Environment (Moodle) for submission of outputs
2-D, 3-D and Projected Instructional Media	1. Identify the different 2-D, 3-D, projection media and analyse their characteristics 2. Create 2-D, 3-D, projection media, analyse their characteristics and demonstrate their proper use	Reporting, lecture, question and answer, demonstration, project-making, peer evaluation, invite a resource person	• Textbook • PPT presentation • Activity sheets • Samples of: 2D instructional materials (chalkboards and whiteboards, bulletin boards, flannel/ velcro/ carpet/ magnetic boards, graphics (graphs, charts, diagrams, posters, cartoons, comics, maps, flip charts), flashcards, pictures and photos) *3D instructional* materials (specimens and objects, models and mock-ups, diorama, puppets) *Projection Systems* (filmstrip projector, slide projector, OHP, LCD projector)
Computers and the Internet	1. Discuss importance and characteristics of computers and the Internet 2. Create instructional materials using word processing, spreadsheets and multimedia presentation software	Pair and share, peer evaluation, project based learning, inquiry based learning, portfolio making	• Textbook • Intel Teach Getting Started Manual • PPT Presentation • Office Productivity Software • MSU-IIT Online Learning Environment (Moodle) for submission of outputs and discussion
Multimedia in the Classroom	1. Discuss audio and motion media in the classroom 2. Plan, design, develop and evaluation an instructional audio recording and video recording.	Reporting, lecture, question and answer, demonstration, practice, peer evaluation	• Textbook • Samples of: *Audio Media* (computers, audio recorders and headsets, audacity software) *Motion Media* (TV, motion pictures discs or tape, camcorder, video recording discs) MSU-IIT Online Learning Environment (Moodle) for submission of outputs

2.2.9 Course assessment		
Categories	Description	Weight (percentage)
Attendance		10%
Participation		10%
Prelim	Long Exam (Multiple choice, True-False or Identification, Essay) Team Projects (Creation of 2-D and 3-D instructional materials and Report on History of Educational Technolgy)	27%
Midterm	Long Exam (Multiple choice, True-False or Identification, Essay) Team Projects (outputs for Projected media) Individual project (wordprocessing, spreadsheets, and multimedia presentation)	27%
Finals	Team Project on Instructional Audio Recording, and video recording	27%
Total		100%

Source: MSU-IIT CED Ed105A-Educational Technology 1 Syllabus

• Educational Technology 2 Course

2.3.1 Course provider		
Institution: Mindanao State University-Iligan Institute of Technology	Faculty/School: College of Education	Department: Department of Professional Education
2.3.2 Course title: Educational Technology 2		
2.3.3 Course Type		
Compulsory for all students in the pre-service teacher education programme		
2.3.4 Target audiences		
Year 3		
2.3.5 Credit and degree		
Number of credits: 3 units Degree(s) to be obtained: Bachelor of Secondary Education, Bachelor of Elementary Education, Bachelor in Industrial Education		
2.3.6 Course learning objectives		
After completing the course, students should be able to: - Use productivity tools in creating lessons, instructional materials, and assessment tools - Develop unit plan using backward curriculum design where studentsthey determine learning goals, plan assessment and design activities - Explain student-centered approaches - Apply appropriate approach and technology tools in the development of technology-enhanced lessons that address Department of Education standards - Appreciate the latest trends in information and communications technology and its application to teaching and learning		
2.3.7 Resources		
- Classroom: Computer Laboratory with Internet Connectivity - Virtual Classroom: MSU-IIT Online Learning Environment (Moodle platform) - Blogging Sites - Social Networking Sites - Online Document Collaborative Sites - Social Bookmarking Sites - Wiki sites - Laboratory Manual: Intel Teach Essentials v2 and v10 pre-service edition with companion CD - Intel *Assessing projects*. http://educate.intel.com/en/AssessingProjects/AssessmentStrategies/ - Intel *Help Guide*. http://www.intel.com/education/helpguide/app.htm?cultureID=en-us&officeID=xp&skill - Intel. *Unit Plan Index*. http://educate.intel.com/en/ProjectDesign/UnitPlanIndex/GradeIndex/ - Online Treasure Hunt and WebQuests Index available at :http://fit-ed.org/teachingwiththeweb/index.htm		

2.3.8 Course topic			
Topic	Learning activities	Instructional strategies	Delivery modes (media)
21st Century Learning Approaches	1. Identify 21st century skills 2. Discuss characteristics of 21st century classrooms	Lecture-Discussion	PPT presentation
Web-Enhanced Learning Activities	1. Discuss social media for instruction 2. Develop online treasure hunts and WebQuests	Lecture-Discussion Online treasure hunts	PPT presentation MSU-IIT Online/Virtual Learning Environment forums
Instructional Design and Project Based Learning	1. Discuss PBL and backward curriculum design 2. Develop initial project ideas	Lecture-Discussion Think-Pair-Share Cooperative Learning	- PPT presentation, Internet, LCD Projector - Pictures - Activity Sheets - MSU-IIT Virtual/Online Learning Environment (Moodle) for online discussion and submission of outputs
Unit Design and Curriculum Framing Questions	1. Research effective assessment strategies 2. Write unit plan objectives, assessment and procedures 3. Draft & Critique Assessment Timeline 4. Create 'gauging student need' support material 5. Discussion on pedagogical issues on using technology in the classroom 6. Draft instructional procedure for the unit	Pair and Share Peer Evaluation Inquiry Based Learning	PPT presentation, LCD Projector Assessing Projects resources from Intel Teach website and CD Activity Sheets MSU-IIT Virtual/Online Learning Environment (Moodle) for online discussion and submission of outputs
The Internet to Support Learning	Examine and discuss copyright laws and fair use guidelines as they pertain to education Create Works Cited documents Explore Internet resources	Pair and Share Peer Evaluation WebQuest on Evaluating internet resources	Presentation on "How Technology supports Project Based Learning Activities" Video Presentation on Web 2.0 Tools for Learning
Creating student support materials and assessment instruments	Identify the appropriate technology tools to support student activities Create student samples (spreadsheet, publication Website, Wikis and blogs) to demonstrate learning Develop evaluation tools for the student samples Critique assessment tools and student samples Create support materials to scaffold student learning	Think-Pair-Share Online Treasure Hunt Activity on Creating student assessment instruments Pair and Share Peer Evaluation	Presentation on Student Sample and Assessment Tools Activity Sheet on Evaluating Assessment Tools Presentation on Scaffolding Materials Computers with Internet MSU-IIT Virtual/Online Learning Environment (Moodle) for online discussion and submission of outputs
Facilitating with Technology	Create presentations, documents, spreadsheets, or web-based resources to support a student-centered classroom Plan for and discuss unit implementation ideas Create management resources Prepare and showcase Unit Portfolios	Lecture-Discussion Peer feedback Pair and share	LCD Computers with Internet Online Evaluation Tool Activity sheets Course evaluation instruments MSU-IIT Virtual/Online Learning Environment (Moodle) for online discussion and submission of outputs

2.3.9 Course assessment		
Categories	Description	Weight (percentage)
Attendance		10%
Midterm	Portfolio (draft Curriculum Framing Questions, Objectives and Procedure, Assessment Timeline, Student Samples with corresponding assessment tools) Quizzes and Reflections Long exam (objective type)	45%
Finals	Portfolio (student support materials, teacher management resources, completed unit plan) Reflections	45%
Total		100%

Source: MSU-IIT CED Ed105B-Educational Technology 2 Syllabus

2.2.1 Course provider

The course provider for *Educational Technology 1* and *Educational Technology 2* is the Department of Professional Education. The department is responsible for identifying teachers for professional education courses. Most teachers identified for the course are also content specialists who can provide quality discussion of instructional materials suitable for the content. In both courses, the teachers model the appropriate use of instructional materials. They utilize inquiry and project-based approaches in delivering the course content through the use of online Treasure Hunts and WebQuest activities.

2.2.2 Course title

Educational Technology 1 introduces students to educational technology, the various educational media, theories that justify the use of these media, and principles involved in the development and utilization of these media. It trains pre-service teachers in the proper operation and use of different hardware like the overhead projector, slide projector, audio player/recorder, video camera, television and computers. The application of information and communications technology in education is experienced with the use of word processing, spreadsheet, and multimedia as productivity tools.

Educational Technology 2 focuses on the development of unit portfolios. Students utilize the latest information and communications technologies in the design and production of unit portfolios and in their use in the instructional setting. Students experience backward curriculum design in planning project-based lessons – in which they determine learning goals that then serve as a basis for planning assessments and which guide them in designing activities. The course exposes students to multimedia applications by teaching them to make use of the online learning environment, computer-based instruction (CBI), and online learning activities like Treasure Hunts and WebQuests.

Course pre-requisites and co-requisite

Educational Technology 1 course pre-requisites are IT Fundamentals and Child and Adolescent Development. A field study course on Technology in the Learning Environment is a co-requisite.

Educational Technology 2 course pre-requisites are *Educational Technology 1, Assessment of Student Learning*, and *Principles of Teaching* courses.

2.2.3 Course type

The two courses are curricular requirements for the Bachelor of Secondary Education, Bachelor in Elementary Education, and Bachelor in Industrial Education degree programmes as well as for the Certificate in Professional Education programme.

2.2.4 Target audience

The students for both courses are third year students. The first course is taken in the first semester and the second course is taken in the second semester.

2.2.5 Credit and degree

The course credit for each of the courses is 3 units. Both are five-hour-per week courses (two hours for lectures and three hours for laboratory activities), for a total of 90 hours per semester.

2.2.6 Course assessment

- Educational Technology 1 Course

Since the courses have an allotment for laboratory hours, assessments are usually based on laboratory course work. Laboratory activities for each topic have the following parts - Getting Ready, Carry Out, Look Back, and Showcase. All the laboratory activities are incorporated in the course textbook. (The textbook was a major output of the Enhancement Workshop for Education in Technology Courses in 2009.

Table 2: Educational technology 1 course topic and assessment

Week	Topics	Assessment
1	Orientation to the Course	-
2 and 3	Introduction to Educational Technology	Lab Activity on completing a table of various educational media and identifying which subject areas it can be applied to and its level in the Edgar Dale Cone of Experience
4 and 5	Two-Dimensional Instructional Media	Lab Activity where students in groups carryout a task of creating flannelboard/ charts/graphs/diagrams/flashcard/ or demonstrate a chalkboard activity appropriate for the identified topic, objectives and target audience. Rubric is used to assess output/performance
6	Three-Dimensional Instructional Media	Students carry out tasks creating 3D media appropriate for the identified topic, objectives and target audience. Rubric is used to assess output/performance
7, 8 and 9	Projection Systems	Students carry out tasks demonstrating the use of projection media appropriate for the identified topic, objectives and target audience. Checklist is used to assess output/ performance
10 and 11	Computers and the Internet	Students create teacher assessment handout using word-processing, curriculum preview using presentation software, and grade book using spreadsheets. Students follow the Plan, Do, Review and Share Process as they create these outputs. Rubrics are used to assess performance.
12 and 13	Audio Media	Student create audio recording using the audacity software. Rubric is used to assess output.
14 and 15	Motion Media	Students create an instructional plan for utilizing motion media. Checklist is used to assess output.
16 and 17	Video Production	Students create video production or clay animation. Checklists are used to assess the storyboard and movie.
18	Course Wrap-Up	

A sample of a laboratory activity is presented below.

You will be working on your project in a group. Some groups will prepare clay animation while others will work on video recording. Whichever is assigned to your group, follow the steps in the manual for video production or clay animation.

Getting Ready

Meet with your group mates and brainstorm about your assigned video. Decide on target objectives, target audience, and scenario. Write the script and submit on _____. Prepare the story board and submit on _____.

Carry Out

Follow the procedure in video production and clay animation.

Look back

Now it is time for you to look back on your output. To do this, reflect on the following questions:

Does the clay animation or video recording clearly reflect the attainment of objectives?

Have we made our output based on the highest standard criterion stated in the checklist?

Showcase

In this step, you will showcase your video to your classmates. In showcasing, you need to share the following:

1. Target audience 2. Learning objectives 3. Ask ideas on how to improve your video

Checklist for Video Recording

	Criteria	Yes	Partly	No
1	Objectives are clear.			
2	Treatment is concise but descriptive.			
3	Script is well prepared.			
4	Storyboard assists the visualizations on the content.			
5	Scenes are well rehearsed.			
6	Shots taken were planned carefully.			
7	Video content is relevant and interesting.			
8	Video shows originality (graphics, sounds, treatment of subject).			
9	Video shows exceptional creativity.			
10	Video reflects careful planning and production.			

- Educational Technology 2 Course

The content of the course includes topics from the Intel *Teach Essentials Course for Pre-service Curriculum* and Worldlinks' Web-Enhanced Learning Activities. The content from these courses addresses the requirement for each student to develop a thematic plan in integrating technology into teaching content.

Students follow a series of modules that contain instructions and information to create a project-based learning portfolio that contains a unit plan with corresponding student samples, student support materials, assessments, and teacher facilitation resources.

Table 3. Educational Technology 2 Topics and Course Assessments

Week	Topic	Assessments
1	Course Orientation	
2 and 3	Instructional Design and Project-based learning	- Rubric on Standards and Objectives - Reflection Log
4 and 5	Unit Planning and Student-centered assessment	- Rubric on Assessment Timeline - Reflection Log

Week	Topic	Assessments
6	The Internet to support teaching and learning	- Online Quiz on Fair Use - Checklist on Work Cited Document - Reflection Log
7, 8 and 9	Creating Samples of Learning /Project Outcomes from a student perspective	- Rubric on Assessment Tools and Student Sample - Reflection Log
10 and 11	Assessing Student Projects/ Formative and Summative Assessment	- Rubric on Scaffolding Materials - Reflection Logs
12 and 13	Planning Student Success/ Student Support and self-direction	- Rubric for assessment tools to help students become self-directed learners
14, 15 and 16	Facilitating with Technology/Teacher as facilitator	- Rubrics for presentations, documents, spreadsheets, or web-based resources to support a student-centered classroom
17 and 18	Showcasing of Unit Portfolios	Final Portfolio Assessment

In the *Educational Technology 2* course, students are also trained to do self-assessments and peer assessments. Below is a rubric on Curriculum Framing Questions that students use to reflect on their own output. A sample of a laboratory activity is presented below.

Table 4. Curriculum-framing questions rubric[1]

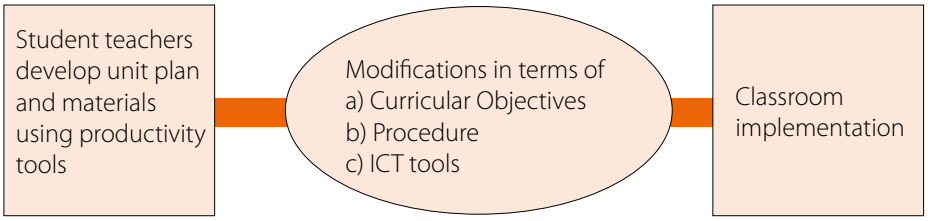
Essential Question (EQ) generates critical thinking			
My EQ is a thought-provoking question that crosses subject areas or topics within subject areas.	My EQ addresses a broad idea that crosses subject areas or topics within subject areas.	My EQ addresses the concepts of my unit rather than a big idea.	My EQ addresses the content of my unit.
Unit Questions (UQs) support learning goals			
My UQs are open-ended, clearly aligned with objectives, and require students to use higher-order thinking to develop conceptual understanding related to my unit.	My UQs are open-ended, aligned with objectives, and ask students to use higher-order thinking to develop conceptual understanding related to my unit.	My UQs are open-ended but are not clearly connected to objectives, higher-order thinking, or concepts specific to my unit.	My UQs have pre-determined answers or are too broad for my unit to focus understanding.
Content Questions (CQs) address important factual knowledge			
My CQs focus on key concepts to build factual knowledge. They have narrow and defined answers.	My CQs build factual knowledge and have narrow and defined answers.	Some of my CQs address factual understanding.	My CQs do not build factual understanding.
Curriculum-Framing Questions (CFQs) connect to each other			
My CFQs require students to use information from CQs to thoroughly answer UQs and think critically and creatively about the EQ.	My CFQs ask students to use information from CQs to answer UQs and think critically about the EQ.	My CFQs sometimes ask students to use information from CQs to answer UQs or to think about the EQ.	My CFQs rarely ask students to use information from CQs or to answer UQs or think about the EQ.

1 Adapted from Intel Teach Essentials Course Module v.10.1. Copyright © 2009 Intel Corporation. All rights reserved.

Application of educational technology courses during practice teaching

Learning is better retained when students are provided the chance to apply and continue the experience. As such, the Educational Technology faculty provided mechanisms for pre-service students to implement their unit portfolios and other outputs. Knowing that implementation would be difficult, the faculty formed a partnership with the City Schools division of the Department of Education that allowed in-service teachers to mentor pre-service teachers in implementing technology-based lessons. In-service teachers mentored the student teachers for example on modifications needed on curricular objectives, lesson procedures, and the appropriate use of ICT tools in actual classes.

Figure 3: Enhancement of developed unit plan for classroom implementation



Student teachers in the field have had varying degrees of success in implementation. Their extent of implementation was identified in a recent survey (Please see Annex) conducted during the first semester of AY 2011-2012. Results are discussed in the following section.

Table 5: Extent to which students effectively implement technology-based lesson

Statements	Mean Score	Description
The school was well resourced with the required technology	2.50	Moderately
Similar teaching strategies were already being used in the school (e.g. PBL, use of Essential question, group work, PDRS)	2.52	Moderately
The school encourages the integration of technology in the classroom.	2.38	Small Extent
Well prepared to implement technology based lesson	2.52	Moderately
Able to use the portfolio developed in Educational Technology Course	1.95	Small Extent
Able to adapt portfolio to make it suitable for the class	2.54	Moderately

Source: Questionnaire modified from Intel Teach Pre-service Post Practicum Survey Copyright 2011 Intel Corporation

It can be gleaned from Table 5 that although the presence of resources in schools was rated minimal to moderate, students, to a moderate extent, were able to revise their technology-based unit plans and adapt these to suit the classes they were teaching.

However students reported that they were able to use the materials that they developed only to a moderate extent. This may be attributed to the low level of encouragement they received from the schools to integrate ICT in classrooms.

Table 6: Extent of strategies to put into practice even without the use of technology

Statements	Mean Score	Description
Project based learning	2.37	Small Extent
Use of Essential Questions	2.74	Moderately
Students working in groups	3.31	Moderately
Use of rubrics and other assessment tools	2.71	Moderately
Use of backward curriculum design (Determine learning goals, Plan assessment and Design activities) in planning lesson	2.57	Moderately
Use of Plan, Do, Review and Share strategy	2.80	Moderately

Source: Questionnaire modified from Intel Teach Pre-service Post Practicum Survey Copyright 2011 Intel Corporation

Pedagogy is as important as technology in an ICT-integrated lesson. Thus, even with a lack of ICT, student teachers should be able to continue teaching by utilizing student-centered approaches learned in the *Educational Technology* classes. Table 6 shows that the student-centered strategies taught in the two courses were put into practice to a moderate extent, even without the use of technology.

The low mean scores in Tables 5 and 6 may be due to student teachers' short exposure (seven weeks) to the actual school environment. For the same reason Project-Based Learning (PBL) was put into practice only to a small extent, since PBL implementation needs time. Within this short duration, students needed to comply with other coursework requirements which were disproportionately heavy, thus leading to reduced opportunities to explore other means of handling classes like the use of ICT. In addition a number of practice schools could not provide support to the student teachers since the knowledge and skills among the in-service mentor teachers on ICT integration, PBL, and similar strategies were lacking.

Further, in MSU-IIT CED, the assignment of faculty members to supervise student teachers was handled by departments handling major subjects. These departments had a tendency to choose faculty who were not familiar with ICT integration and who thus could not encourage or support students assigned to them in this area.

The results from Tables 5 and 6 provided valuable data regarding the context for successful implementation and revealed that that there is more to be done not only about the content of the courses but about their practical implementation in actual situations.

3. Outcomes: benefits and challenges

3.1 Benefits

The two courses have equipped students with knowledge and skills in the proper selection, preparation, and utilization of instructional media. The unit planning in *Educational Technology 2* provided students with significant experience in backward curriculum design, which is also the framework used in the Understanding by Design approach promoted in Department of Education schools. This allowed students to become more prepared to teach in the schools after graduation.

3.2 Challenges and solutions

Identifying activities to corresponding content has been a significant challenge in the development of the courses. Faculty members tend to design a number of projects for students to give them more hands-on application in the preparation and utilization of instructional materials. If too many projects and topics are provided some may receive little coverage due to time constraints. Some topics may end up as only assignments – with the result that the "Getting Ready, Carry Out, Look Back, and Showcase" cycle in project creation cannot be completed.

In the *Educational Technology 2* course, faculty members were particularly challenged in providing guidance to student teachers and keeping track of their work to make sure that the procedures were clear, assessment was embedded, and PBL was incorporated.

Keeping up with recent technologies in education and ensuring that tools and equipment are made available in the university are also major concerns. Acquiring equipment is difficult due to funding constraints and bureaucratic procedures to be followed.

The application of the courses during practice teaching has not been entirely successful in some schools since the assigned in-service teachers cannot provide the necessary and appropriate support to pre-service teachers, since they themselves are not familiar with the project-based learning approach. Lack of knowledge on ICT integration by supervising faculty also deters some student teachers from even trying to implement their unit portfolios.

The regular conduct of enhancement workshops prior to course implementation has proved to be beneficial in addressing the challenges mentioned. The process allows teachers to discuss issues and concerns in their classes. Solutions are then formulated as a team. The syllabus and resources are constantly revised to address the needs of teachers and students.

In the recent curricular programme revisions for 2011, the *Educational Technology 1* course was paired with a field study-based course on *Technology in the Learning Environment*. The same faculty members supervised the additional course. The revision aims to ensure that students are able to see the application of instructional technologies and to connect what is taught with what is carried out in the classroom.

MSU-IIT should continue conducting capacity building training workshops in partner schools so that the number of supervising in-service teachers who can mentor student teachers on technology-integrated unit portfolio implementation will increase.

4. Conclusion and further implications

Observations from the implementation of the courses, feedback from faculty members, experiences in practice teaching sessions, course assessments, and the ICT integration practices of pre-service teachers who have taken the course have provided significant insights into how the content and delivery of the courses can be further improved. In addition, the participation of faculty team members (i.e. content and pedagogy specialists) as well as continued reflection on the course has allowed maximization of student learning and has made both courses responsive to the needs of the times.

It is believed that monitoring and providing support during the practice teaching phase assists pre-service teachers in the implementation of technology-based lessons in schools. Thus, faculty

members should maintain good working relationships with the supervising faculty members who handle the practice teaching phase, and with the team of in-service teachers who mentor the student teachers. This can be done by strengthening the existing partnership of MSU-IIT with Department of Education schools in terms of professional development trainings given to teachers. Special trainings and discussions targeted for supervisors and in-service teachers must be conducted for this purpose. The in-service teachers may also be invited to the enhancement workshops for the courses.

The positive effect of the development process for the courses is felt not only within the two courses' delivery but also in faculty development, curricular review of programmes, and policy-making.

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Teaching with the Web Resources retrieved at http://fit-ed.org/teachingwiththeweb/index.htm Copyright © 2004 Foundation for Information Technology Education and Development, Inc

Appendix 1: Survey questionnaire on application of education in technology courses during practice teaching

If you implemented technology based lessons, rate the extent to which the following factors helped you to conduct the lessons effectively.

	Not at all	To a small extent	Moderately	To a large extent
a) The school was well resourced with the required technology.				
b) Similar teaching strategies were already being used in the school (e.g. PBL, use of Essential question, group work, Plan Do Review and Share).				
c) The school encouraged the integration of technology in the classroom.				
d) You had been well prepared, through Intel Teach, to implement a technology based lesson.				
e) You were able to use the unit plan you have developed.				
f) You were able to adapt your unit plan to make it suitable for the class you are teaching.				

Where technology was not available, indicate the extent to which you were able to include the following strategies in the lessons you conducted.

	Not at all	To a small extent	Moderately	To a large extent
a) Project based learning				
b) Use of Essential Questions				
c) Students working in groups				
d) Use of rubrics and other assessment tools				
e) Use backward curriculum design (Determine learning goals, Plan assessment and Design activities) in planning lesson				
f) Use of Plan, Do, Review and Share strategy				

ICT for meaningful learning (Singapore)

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Abstract

The National Institute of Education (NIE) is the only pre-service teacher training institute in Singapore. The institute trains teachers across all subject disciplines. In the 1980s, *Information and Communication Technology (ICT) In Education* was a compulsory module within the Educational Studies group of subjects offered by NIE in various undergraduate and postgraduate teacher training programmes. Since then the course has shifted from taking a skills-based focus to an emphasis on the pedagogy facilitating the use of ICT for teaching and learning. This shift in focus was reflected in the change in the course title in 2010, to *ICT for Meaningful Learning*. The theoretical underpinnings of the course are based on five dimensions of meaningful learning. They are (1) Engaging prior knowledge (2) Learning by doing (3) Real world knowledge (4) Collaborative learning and (5) Self-directed learning. The course is aligned with Singapore's 3rd ICT Master plan (2009-2013) for Education, which emphasizes the use of technology for self-directed learning and collaborative learning. Student teachers are exposed to various pedagogical and instructional approaches and technology tools to enhance teaching and learning. They are taught to plan and integrate technology tools with the five dimensions in mind so as to avoid integrating technology for the sake of it. They learn a range of technology tools through technology-enabled lessons (TEL) that are relevant to their teaching subjects and to the pupil level they will be teaching after they graduate. Student teachers are assessed on their ability to design meaningful ICT-mediated activities to enhance pupils' learning experiences.

1. Institutional context/background

1.1 Introduction to the National Institute of Education

The National Institute of Education (NIE) is the sole teacher training institute in Singapore and trains all pre-service teachers, as well as heads of department, principals and leaders in education. It is an autonomous institution situated within Nanyang Technological University (NTU).

The first formal teacher education programme started in Singapore in 1950 with the establishment of a Teachers' Training College which offered a two-year Certificate in Education, conducted in English. New programmes were introduced over time and in 1971, the college introduced the Diploma in Education, a one-year postgraduate teacher education programme for bachelor-degree holders. In 1973, the college was renamed the Institute of Education, and a cadet teacher training programme was introduced. In this programme, student teachers spent half a day teaching in schools and returned to the institute for the other half of the day for lessons. The cadet programme was an 18-month programme and helped to fill the shortage of teachers in schools during that time. The next change in approach came seven years later in 1980. The institute reverted to offering a full-time one-year Diploma in Education for those already holding a bachelor's degree, and a two-year Certificate in Education for those without a bachelor's degree. In 1984, due to a demand for specialist teachers in physical education, a College of Physical

Education was inaugurated, which offered a two-year diploma programme in physical education. Leadership programmes to train school heads of department and principals were also started in the same year. Postgraduate degrees leading to master's and doctor's of Philosophy in Education were then offered, conferred by the University of Singapore (Chen and Koay, 2010).

In 1991, the Institute of Education and the College of Physical Education merged to form the National Institute of Education as an autonomous institute within NTU. Due to the direct relationship with NTU, the institute was able to offer undergraduate courses. It launched four-year Bachelor of Science with Diploma in Education and Bachelor of Arts with Diploma in Education degree programmes (it was later renamed as Bachelor of Science (Education) and Bachelor of Arts (Education) respectively). In tandem with the start of the undergraduate programmes, there was a rapid expansion in the recruitment of faculty staff to set up two additional schools, the School of Science and the School of Arts. In addition to the Masters in Education, the institution added the Master of Arts in Applied Psychology, Master of Arts in Instructional Design and Technology, and Master of Arts in Educational Management.

In 2000, NIE was relocated to the campus of NTU. As an autonomous institute, NIE has its own infrastructure and human resources, but it is governed within NTU's academic framework. It has a strong relationship with the Ministry of Education (MOE) and programmes are aligned to the national goals for education.

As the sole training institution for educators in Singapore, NIE offers a variety of training programmes. The courses offered can be broadly categorized as:

a. Pre-service teacher education programme leading to a Diploma in Education for non- graduates and Postgraduate Diploma in Education for students who already have a bachelor's degree.

b. Undergraduate programme leading to a Bachelor of Science (Education), Bachelor of Arts (Education) and Bachelor of Education degrees for in-service teachers.

c. Graduate programmes leading to masters degree by coursework and/or research, Ph.D. degree, dual Ed. D degree with the Institute of Education, London.

d. Leadership programmes to train subject heads, heads of department, principals, and school superintendents.

e. Professional development courses for teachers in various subject areas. Some of these courses are conducted off-campus while some courses are totally online.

Teacher education programmes for pre-service teachers

NIE has some special characteristics as a teacher education institution regarding its programmes, admission criteria, and the deployment of trained teachers. NIE constantly reviews its curricula and programmes and an extensive review was conducted during the period 2008 to 2009, titled the Programme Review and Enhancement (PRE) process. The objective of the PRE was to identify and chart future enhancements to keep abreast with the need to develop 21st century learners, a focus promoted in schools. The culmination of this review process was a proposal for a new model of teacher education for the 21st century, TE21 (Lim-Ratnam and Gopinathan, 2010). The TE21 model focused on "enhancements (that) reflect a holistic approach to strengthening teacher education at NIE, from initial teacher preparation to teacher professional development, in a manner that is relevant and responsive to the Singaporean educational landscape." (Lim-Ratnam and Gopinathan, 2010, pp. 212). Briefly, there were six areas of recommendation:

1. The Values3, Skills and Knowledge Model (V3SK) will guide the design and delivery of NIE's programmes. The three values are: learner-centered values putting school pupils as the focus of the teacher's work, teacher-identity values, and values of service to the profession and community.
2. Develop a framework of Graduand Teacher Competencies that will articulate a set of professional standards.
3. Strengthen the theory-practice nexus through reflective practices.
4. Extend pedagogical repertoire to enable teachers to teach in an innovative manner.
5. Develop an assessment framework that measures 21st century learning.
6. Enhance pathways for professional development of teachers.

For further review of the model, please refer to the website, http://www.nie.edu.sg/about-nie/teacher-education-21

Admission to NIE

All student teachers who enrol in the teacher education programmes at NIE are employed as untrained teachers in the national teaching service. They receive a salary and the MOE pays for all tuition and approved fees. (Students taking the four-year Bachelor of Science (Education) and Bachelor of Arts (Education) degree programmes receive a salary for the first two years and may receive a stipend during the third and fourth year, based on good academic performance.)

The application and selection process is dealt with by MOE. When a potential candidate wishes to become a teacher, he/she applies to MOE. It selects candidates based on academic qualifications, attitude, aptitude and manpower needs in the teaching service. Candidates who meet the academic qualifications are shortlisted for an interview with a panel comprising of MOE officials and school principals. Suitable candidates are sent to schools for attachment while waiting to be admitted to NIE either in August or January.

Teacher education programmes for pre-service teachers

Singapore, presently, does not have a nation-wide teacher certification licensure examination. A graduation certification from NIE is to be taken as a professional teacher certification for teachers to teach in Singapore's schools.

NIE offers different pathways to graduate as a teacher. The programmes offered for pre-service teachers can be classified under three categories, namely, the Postgraduate Diploma in Education, the bachelor degree programmes, and the Diploma in Education programmes.

Postgraduate diploma in education (PGDE)

This diploma enables a student teacher to teach in primary school (grades 1-6), secondary school (grades 7-10) and junior colleges (Grades 7-12). Candidates must possess a bachelor's degree, preferably in subject disciplines aligned with subjects taught in schools. However, professional degrees such as law, accountancy, and engineering are also accepted, as NIE offers content-upgrading courses after which students may be deployed to teach in relevant subject areas. For example, engineers may teach design and technology or physics or mathematics in schools after attending a further 30-60 hours of content-upgrading courses. There are four programmes

under this category, namely, PGDE (Primary School teaching), PGDE (Secondary School teaching), PGDE (Junior College teaching – for Grades 11-12) and PGDE (teaching of Physical Education).

Undergraduate programmes

NIE offers three undergraduate programmes for student teachers. The Bachelor of Science (Education) and Bachelor of Arts (Education) are four-year programmes that train student teachers to teach either in primary or secondary schools. Student teachers can either opt for a General programme, a Mother Tongue programme or a Physical Education programme. Admission criteria are based on the university's general admission criteria and subject-specific requirements identified by NIE. Applicants attend a selection interview to assess their attitude and communication skills.

Only non-graduate primary school teachers who are currently in the teaching service are eligible to apply for the Bachelor of Education programme. The programme is specially designed for candidates with classroom teaching experience (B Ed handbook, 2010). As the MOE is moving towards an all-graduate teaching force, this programme allows teachers to upgrade. The programme structure is flexible and the number of courses that teachers take depends on the previous courses they have taken.

Diploma in education

This two-year programme prepares student teachers to teach in primary schools. There are many tracks within the programme. The General track prepares student teachers to teach Mathematics, English Language, and one of the optional subjects Science and Social Studies. There are three specialized tracks. The first is for the teaching of the Mother Tongue at primary level (Chinese, Malay, Tamil). The second focuses on Art or Music. The third track covers the teaching of Home Economics at lower secondary level. In addition, there is a Diploma in Special Education which trains student teachers to teach in special schools. Student teachers who have performed well academically may join the bachelor's programme and continue study for another two years to graduate with a BA (Education) or BSc (Education). The Diploma in Education programme is slowly being phased out to prepare for a full-graduate teaching workforce and is expected to end in 2015.

Table 1: A summary of various teacher education programmes conducted in NIE

Programmes	Description of Programme	Length of programme
PGDE (Primary)	Trains student teachers to teach Mathematics, English Language and Science or Social Studies in primary school. Specialization track to teach Mother Tongue (Chinese, Malay, Tamil).	1 year
PGDE (Secondary)	Trains student teachers to teach two curriculum subjects in secondary school. Specialization track to teach Mother Tongue.	1 year
PGDE (Junior College)	Trains student teachers to teach one subject in junior college.	1 year
PGDE (Physical Education)	Trains student teachers to teach physical education either in the primary or secondary school.	2 years
Bachelor of Science (Education). Bachelor of Arts (Education)	Trains student teachers to teach either in the primary or secondary schools. Student teachers are required to study courses in Education Studies and two academic subjects.	4 years
Bachelor of Education	A part-time course for non-graduate primary school teachers. Teachers are required to attend the last semester full time for completion of the degree.	3.5 years (part-time)

Diploma in Education	Training of student teachers to teach in primary school. There are many tracks of specialization. Programme is being slowly phased out and is expected to end in 2015.	2 years
Diploma in Special Education	Training of educators from special schools and also for allied educators (learning support educators to help special need students in primary schools)	1 year

NIE's curriculum structure

The teacher education programmes in NIE incorporate pedagogical skills, content knowledge and personal development courses. A summary of the courses is given in Table 2.

Table 2: Curriculum structure for pre-service teacher training in NIE

Course	Description
Education studies	Student teachers will learn the key concepts and principles of education that are necessary for effective teaching and reflective practice in schools. They will also have the opportunity for in-depth study of some significant aspects of education (NIE, 2010). There are four courses under this category; • Educational Psychology I: Theories and Applications for Learning and Teaching • The Social Context of Teaching and Learning • Educational Psychology II: Teaching and Managing Diverse Learners in the Classroom • ICT for Meaningful Learning
Curriculum studies	Student teachers specialize in the methodology of teaching at either the primary school level, secondary school level or junior college level. These studies are designed to give student teachers the pedagogical skills in teaching specific subjects in Singapore schools (NIE, 2010).
Subject Knowledge	This group of courses aims to reinforce subject content mastery for primary school teaching. Student teachers in the primary track must offer Subject Knowledge courses aligned with their choice of CS subjects (NIE, 2010). For student teachers who are pursuing their bachelor degrees, they have to continue study further in the subjects during their last two years of study.
LEADS - Language Enhancement and Academic Discourse Skills	The course prepares student teachers with oral and written skills necessary for effective communication as teachers in the classroom and in their professional interaction with colleagues, parents and the general public (NIE, 2010).
Practicum – Teaching Practice	The aim of the practicum is to provide student teachers with the opportunity to develop teaching competencies in a school environment.
Group Endeavors in Service Learning (GESL)	All student teachers have to be involved in this project. GESL is a service-learning project which aims to provide the student teachers with the skills of conducting service-learning projects and a chance to be connected with the local communities.
Meranti Project	The Meranti Project is a MOE-funded personal and professional development programme specially tailored for student teachers (http://www.nie.edu.sg/office-teacher-education/meranti-project) The aim of this programme is to allow student teachers the opportunities to have a dialog with veteran teachers and school pupils so that they can have a better insight into the role of a teacher and to experience the core competencies of social and emotional learning.

1.2 Context of the development of the ICT-related curriculum

ICT for Meaningful Learning is a compulsory module in the Education Studies component of NIE's initial teacher training programme. Every year about 2,000 student teachers enrol in this course which is delivered by a team of about 30 faculty staff in the Learning Sciences and Technology (LST) Academic Group. The course evolved from a compulsory educational technology course conducted in the 1970s. It focused on the use and preparation of audio-visual materials for classroom teaching and covered topics such as the preparation of overhead transparencies, use of slide projector, film-strip projector and the making of charts. In the early 1980s when computers were introduced, the course slowly incorporated the use of computers, and consisted of two

components – computers and audio-visuals. Student teachers were required to learn about computer hardware, operating systems and the use of simple productivity software. They were taught how to evaluate computer-assisted instructional software for use in the classroom.

Since the late 1990s, the course has been aligned with national plans for ICT in education. In 1997, then prime pinister, Goh Chok Tong, announced a new vision for education entitled "Thinking School, Learning Nation" (TSLN), (Goh, 1997). This articulated the need to transform Singapore's education system in order to prepare the workforce to be knowledge workers. Based on the new vision, a number of initiatives were introduced into the education system, including the first five-year ICT for Education Master Plan (MP1) spanning the period from 1997-2002. To help articulate the goals, the MOE identified four key educational dimensions including: curriculum and assessment, acquisition and development of learning resources, building physical and technological infrastructure, and human resource development.

In order to align with the national ICT plan, the NIE set up an ICT steering committee. It was decided that from 1997 to 2000, all participants in ICT course would be provided opportunities to learn how to operate and set up a computer, become familiar with the menus and functions of the Windows operating system, acquire basic skills in word processing and be able to create simple PowerPoint presentations. From 2000, the course focus shifted from teaching of basic computing skills to an emphasis on learning with ICT. Topics included: the Windows operating system, the use of word processors for editing and process writing, teaching mathematical principles and concepts through the use of spreadsheets, evaluating and selecting appropriate multimedia software, designing lesson plans that incorporated the use of computer-based instructional materials, and managing learning in a computer laboratory environment.

In 2003, the second Master Plan for Education 2003-2008 (MP2) was launched with a focus on the pedagogical applications of ICT, and in particular, with engaging students in learning. MP2 encouraged the effective and pervasive use of ICT to enhance educational processes and structures. There were six desired outcomes in MP2 and they were all focused on instruction and assessment.

a) Pupils use ICT effectively for active learning
b) Connections between curriculum, instruction and assessment are enhanced using ICT
c) Teachers use ICT effectively for professional and personal growth
d) Schools have capacity and capability in using ICT for school improvement
e) There is active research in ICT in education
f) There is an infrastructure that supports widespread and effective use of ICT.

(ICT connection, 2012)

NIE's ICT curriculum shifted from a basic skill course to a pedagogical course which required student-teachers to design an ICT-based lesson. Course components included evaluating Internet websites, use of resource-based learning approaches, and exploring the use of learning objects for teaching and learning.

The third ICT Master Plan for Education 2009-2013 (MP3) was launched in August 2008. It focused on strengthening students' competencies in self-directed learning, engaging students in meaningful activities to achieve deeper learning, and collaboration skills through authentic activities. In the plan it was also proposed that mobile computing be used to enhance students' learning experience. Web 2.0 tools and applications were cited as tools for collaborative learning.

The current ICT course for student teachers was designed to align with MP3. It incorporates social media for learning, Web 2.0 tools, and social-constructivist approaches to teaching and learning.

2. ICT-related course/curriculum

ICT for Meaningful Learning prepares student teachers to focus on the design of meaningful learning activities mediated by ICT tools. These include the use of NIE's learning management system to download and upload documents, and the use of on-line forum for discussion, on-line assessment, and web-based collaborative tools for group work. Concept-mapping tools are used to record ideas or to brainstorm for ideas. Student teachers also analyse critical issues related to ICT- mediated instruction, such as managing an ICT-based classroom and cyberwellness. Student teachers are assessed on their skills and knowledge in designing meaningful ICT-mediated teaching and learning activities (NIE, 2010).

2.2 Development process: the process of course development is given in Table 3

Table 3: Course development process

	Activities	Responsible person(s)	Duration	Output
Step 1	Review international literature and official MOE documents (e.g. MP3 documents) on ICT for teacher education. Identify trends of ICT use in schools, and align these with NIE's and MOE's direction.	A committee is set up by the Heads of the Academic Groups (AG). This committee is chaired by a faculty appointed by the Head. The Chair of the committee works together with a co-chair and five other faculty members.	3 months	A series of statements gleaned from the literature and translated to goal statements.
Step 2	Analyse the goal statements and perform a mapping process to ensure that the statements are aligned with educational goals of the teacher educational programme in NIE.	Chair, co-chair and committee members. The chair will counter-check the document by cross validating it with the Head/AG.	2 weeks	Refinement of goal statements to align with overall goals of teacher education.
Step 3	Translate these goal statements into objectives. Craft assessment modes that will ensure that these objectives are met.	Chair, co-chair and committee members.	2 weeks	Documents with objectives and assessments.
Step 4	Identify tasks that can help to achieve these objectives.	Faculty staff who are responsible for specific units. Chair and co-chair will provide feedback.	2 weeks	Documents recording tasks
Step 5	Create a lesson unit which contains a sequence of activities to achieve each task that has been identified. Design activities and resource materials.	Based on agreed structure of design for activities, individual staff responsible for each unit will prepare materials.	4 weeks	Resource materials, activities, and instructions to users
Step 6	Validate content, activities, and materials to ensure they are in alignment with objectives and assessment modes.	Chair and co-chair to validate and give feedback.	2 weeks	Confirmed resource materials and activities
Step 7	Prepare tutor's guide and package materials to be delivered into portal or learning management system.	Individual faculty staff responsible for that unit.	2 weeks	Tutor's guides

2.2 Course outline

2.2.1 Course provider		
Institution: National Institute of Education	Faculty/School: Learning Sciences and Technologies Academic Group	Department: Learning Sciences and Technologies Academic Group
2.2.2 Course title: QED527 *ICT for Meaningful Learning* **(conducted from January to April 2011)**		
2.2.3 Course Type		
Compulsory for all students in the pre-service teacher education programme		
2.2.4 Target audiences		
Year 1		
2.2.5 Credit and degree		
Number of credit: 2AU Degree(s) to be obtained: (B.Sc, BA, etc.): BA (Edu); B.Sc(edu); PGDE; Diploma in Education		
2.2.6 Course learning objectives		
After completing the course, students should be able to: 1) analyse the affordances of ICT tools for ICT-mediated lessons 2) design ICT-related activities to engage learners in meaningful learning 3) manage an ICT-based learning environment (classroom, computer laboratory or outdoor mobile learning environment) 4) offer guidance to pupils on internet safety and cyberwellness		
2.2.7 Resources		
Videos, PowerPoint files, YouTube videos, e-learning packages (developed locally), textbook – ICT for self-directed and collaborative learning, Chai, C. S. & Wang, Q. (2010). lesson templates.		
2.2.8 Course topic		

	Learning activities	**Instructional strategies**	**Delivery modes (media)**
Topic 1: Introduction to Meaningful Learning & ICT MasterPlans	Group discussions, personal reflection	Personal reflection of what "ICT for meaningful learning" means.	2 Videos, Chapter 1 of text book, PowerPoint presentation, websites
Topic 2 and 3: Dimensions of Meaningful Learning (I) and (II):	Blended approach. Participate in group discussions and sharing of experiences.	Use video as an example and a focus for class discussions. Student- teachers to share their experiences in teaching using real-world examples. Concept and understanding of self-directed and collaborative learning.	Use ICT for personal and group note taking.
Topic 4: Cyberwellness	Cyberwellness e-learning module. Read, discuss, research and write a paper based on their learning.	A scenario was designed to allow student teachers to explore further cyberwellness issues, skills and strategies to help pupils be aware of this issue.	e-learning delivered through the LMS.
Topic 5: Lesson Planning (I) – Introduction to lesson planning (e-learning) Lesson Planning (II): Designing an ICT-based lesson.	Participate in e-learning which consists of a case-scenario quiz of eight questions. Critique an ICT-based lesson plan; and design an ICT-based lesson.	Content covered include: types of planning, procedures of lesson planning, steps of planning with detailed examples and descriptions. Sample ICT-based lesson plans are given and student-teachers are asked to identify elements which promote meaningful learning.	e-learning, quiz conducted via LMS. PowerPoint presentations, critique guidelines, template for lesson plan.
Topic 6: Technology-enhanced lesson (TEL)	Explore various technological tools suitable for teaching of subject and design a lesson incorporating the tool.	Student-teachers, as a group, will identify three TELs that are relevant to their teaching and to explore further the ICT tool identified.	Websites, PowerPoint presentations

2.2.9 Course assessment			
Categories	Description	Weight (percentage)	Note (if any)
Attendance	Compulsory		
Participation	Class and on-line participation	15%	Rubrics
Individual Assignment	Plan a lesson based on the dimensions of meaningful learning that incorporates cyberwellness issue.	45%	
Group Project	Design two TEL packages	40%	
Total		100%	

2.2.1 Course topics and Instructional strategies

ICT for Meaningful Learning is reviewed at the end of each academic year (May of each year). The curriculum committee meets to revise and improve the course curriculum. In January 2011 the course was divided into two parts.

Part 1: This extends for two hours per week for five weeks and is taken by all student teachers. The topics covered include:

- Topic 1: Introduction to Meaningful Learning & ICT Masterplans
- Topic 2: Dimensions of Meaningful Learning (I): Engaging prior knowledge and Real world knowledge
- Topic 3: Dimensions of Meaningful Learning (II): Learning by doing, Collaborative learning and self-directed learning
- Topic 4: Lesson Planning (I)
- Topic 5: Lesson Planning (II)

Part 2: This extends for two hours per week for six weeks. Student teachers in tutorial groups attend two of ten optional Technology Enabled Lessons (TEL). The list of electives is given in Table 5.

- Topic 6 – Technology Enabled lessons (TEL) and presentation.

Topic 1: Introduction to meaningful learning and ICT masterplans

Instructional Strategies: To contextualize the course, student teachers are given websites and materials related to the three ICT in Education master plans. Two videos are used as anchors for discussions. The first video is about the digital natives as learners and is titled 'Learning and Motivation in the 21st Century'. It is available at (http://www.youtube.com/watch?v=K_6GUx1Zx0w). The second video is titled 'Gearing up for the future' and is produced by the MOE. At the end of the session, student teachers are required to post their thoughts about the meaning of the topic on the discussion forum of the institute's learning management system.

Topics 2 and 3: Dimensions of meaningful learning (I) and (II)

Instructional Strategy: The lesson focuses on the five dimensions of meaningful learning: real world knowledge, engaging students' prior knowledge, learning by doing, collaborative learning and self-directed learning, in order to create lessons for meaningful learning. The video, 'EAST – A Way Forward: Tech Inspires Self Directed Learning' (http://www.edutopia.org/east-technology-lab-video) is used as an example to understand self-directed learning. A second video, 'Space Mission: Ice Moon' (http://www.futurelab.org.uk/resources/multimedia/video/Video279) illustrates

collaborative learning. Discussion activities are built around these two videos. Student teachers use either a concept-mapping tool or interactive-whiteboard to organize ideas and note-taking.

Topic 4: Cyberwellness

Instructional Strategy: Student teachers encounter an on-line scenario with a set of guiding questions to help them understand issues on cyberwellness. They are given four weeks to do research on four key questions: 1) What are the three top cyberwellness issues for your students? 2) How would you define each of the three issues? Provide an example of situations when your students might face the issues. 3) Why are these three cyberwellness issues important for your students to be able to handle? 4) Will they somehow affect their personal lives? Will they affect lessons or classroom management? Will they have other impacts on students?

Topics 4 and 5: Lesson planning (I) and (II)

Instructional Strategy: The following topics are covered in the e-lesson: types of planning, procedures of lesson planning, steps of planning with detailed examples and descriptions. In the face-to-face session, student teachers discuss and plan an ICT-based lesson based on the subjects they will be teaching in school.

Topic 6: Technology-enhanced lesson (TEL)

Instructional Strategy: TEL is divided into two categories, a) Computer as a teaching-learning tool and b) Computer as a social- media learning tool. The instructional strategies for this section depend on the TEL. Generally, for each TEL session, student-teachers explore the technology tool, see an example of how the tool can be used for teaching and design a TEL as a group.

2.3 Course assessment

The course has three components for assessment.

a. Class and on-line participation: 15 marks. This assessment uses a rubric as a guideline

Table 4: Students' participation assessment Rubric

Objectives	Not interested	Low performance	At or below average	At or above average	Exemplary performance	Earned points
Student's understandingof topic	1 point Shows little interest. Distracted by other events (e.g. mobile phones). Occasionally raises a point.	2 points Shows signs that s/he is thinking through active learning (e.g. note taking.	3 points Responds to questions, occasionally asks questions or raises a point.	4 points Gives some good points without much elaboration on points. Asks questions and provides ideas and opinions when solicited.	5 points Gives good points with clear explanations and elaborations. Asks thought-provoking questions and provides good answers	

Objectives	Not interested	Low performance	At or below average	At or above average	Exemplary performance	Earned points
Student's participation in group discussion	1 point Contributes but shows reluctance. At times, gets distracted	2 points Provides an opinion but clearly shows no prior preparation before group discussion.	3 points Makes random comments that repeat what others have said. No contribution of new ideas	4 points Engages in the discussion, occasionally uses materials from readings.	5 points Engages in the discussion, and often cites specific references to materials from readings. Shows good facilitation skills	
Student's participation during on-line forum.	1 point Participates by posting once and then disappears	2 points Gives simple response like "agree" or "disagree".	3 points Offers opinions but not supported by explanations. Does not react to other students' postings	4 points Offers opinions and supported by references. Reacts to other postings with simple replies	5 points Participates forum actively by giving opinions and ideas backed by good references. May suggest further discussions.	
					Score:	

b. Individual written assignment – 45 marks.

Instructions to student-teachers

Backdrop: It seems that a week doesn't go by without yet another article in the press about some kind of "danger" students encounter as they use the Internet. One week an article may cover *cyber-predators*; another week may see a discussion which highlights students' over-use of "copy-paste" (i.e., *violation of copyright*). It's no surprise, then, that the MOE is enlisting the help of teachers to help their students to manage some of these issues. Visit this website for more information on MOE's cyberwellness initiative: http://ict.edumall.sg/ict/slot/u151/cyberwellness/index.html.

The purpose of this assignment is to get you thinking about some of these issues, specifically to:

- plan a lesson based on the dimensions of meaningful learning
- decide for yourself which cyberwellness issue and learning outcomes are most relevant for *your* students
- generate some possible lesson activities intended to help your learners acquire better awareness and skills about the cyberwellness issue you have identified.

What you will hand up:

Thoughtful written responses to the following points:

1. Define and elaborate the cyberwellness issue you have identified (please provide citations) Why is this issue important for your students? (10 marks)
2. Draw up a lesson plan that can be implemented within 60-120 minutes using the lesson planning template provided. This lesson plan should help your learners achieve the cyberwellness objective(s). Lessons activities can be in class and/or online. (20 marks)

   You can think along two possibilities: 1) to cover the cyberwellness issue in a separate lesson *by itself*; or 2) to integrate your cyberwellness issue into a regular curriculum subject (CS) lesson. Choose one approach – separate or integrated.

In your plan, you should describe: 1) your 1 or 2 cyberwellness learning objectives *you* want your students to achieve about your identified cyberwellness issue, 2) who your learners are, the subject you are teaching, and the learning environment (see http://ict.edumall.sg/baseline/physical.html#ICTLearningEnvironments).

3. Rationalize how the activities in your lesson plan are designed, based on relevant dimensions of meaningful learning that you have identified for your students. (10 marks)
4. What practical concerns may occur during the implementation of the lesson? In other words, what may go wrong? (5 marks)

Marking guidelines for individual assignment:

1. Description of cyberwellness issue and rationalization of importance (10 marks)

- Description of cyberwellness issue is: clear and comprehensive with adequate coverage of definition supported by relevant references.
- Rationalization of importance for targeted students is well-argued; Importance of the issue based on the target learners, their personal and/or school needs is well-articulated.

2. Lesson plan (20 marks)

- Description of learners, subject and learning environment is thoughtful and relevant.
- Description of the lesson plan is very appropriate, and likely to be very effective for achieving learning objectives.

3. Rationalization based on dimensions of meaningful learning (10 marks)

- Rationalization of learning activities is strongly connected to the meaningful learning framework, in terms of depth and relevance made in the context of the activities designed.

4. Practical concerns of implementation (5 marks)

- Discussion of implementation concerns or problems is comprehensive, realistic and relevant.

c. Group assignment – 40 marks

Instructions to student teachers: Overview

In this course, we have addressed dimensions of meaningful learning as well as some tools during the Technology-Enabled Lessons (TELs). For this assignment, you are expected to apply what you have learnt from the course to develop lesson ideas using ICT.

Task

This is a group assignment and there should be three to four members in your group. Your task is to design a lesson which fosters meaningful learning through the use of ICT. You will need to rationalize your design of the lesson.

Your lesson ideas should be based on a common curriculum subject (CS) for all members in your group. Your group may wish to identify a topic or sub-topic that you feel could have been better taught using ICT, rather than a more traditional method. This lesson should be implemented within 60-120 minutes. Be sure that the topic you have identified is relevant to the present school curriculum. Please refer to MOE or SEAB (Singapore Examinations and Assessment Board) syllabi when considering your learning objectives.

There are four parts to your task:

1. Lesson Plan: A general description of what the lesson is about. Your activities should include ways of assessing student learning. Note: Use Appendix A to guide your planning process. (10 marks)
2. Lesson Plan Rationale: This should be the rationale for the lesson activities you have planned. You should discuss your rationale in terms of how you use ICT to support the dimensions of meaningful learning. (10 marks)
3. Lesson Package: Lesson materials based on one or more TELs discussed during the course. They include technological tools, worksheets, lecture PPTs, URLs, user-guides, etc. (15 marks)
4. A 10-minute in-class presentation or gallery walk to showcase your lesson package. (5 marks)

Marking guidelines for TEL

1. Lesson plan (10 marks)

Description of learning context:

- Prerequisite knowledge and skills are clearly identified and are appropriate for the nature of activities designed
- The learning objectives are written according to the ABCD model, and are appropriate for the level and characteristics of the students.
- The lesson duration is justifiable and adequate for the lesson.

Description of instructional strategies:

- The lesson plan provides the reader with a clear sense of how the envisioned lesson may unfold
- Lesson activities are logically sequenced and coherently linked. The design of the assessment of students' learning is aligned with the learning objectives.

2. Lesson plan rationale (10 marks)

- The rationalization of the following aspects are coherently argued in terms of:

- How lesson activities are designed to incorporate meaningful learning
- How the affordances of the ICT tool employed are utilized to support meaningful learning.

3. Lesson package (15 marks)

- Is appropriately designed for the target students e.g. appropriate language, sufficient scaffolds, etc.
- Effectively utilizes the affordances of the ICT tool(s) / Technology-Enabled Lesson(s) employed.
- Is technically sound e.g. clear navigational structure, working hyperlinks, the choice of fonts, colors, and layout are in line with basic design principles, etc.
- Sample student products (if any) effectively illustrate the expected learning outcomes.

4. In-class presentation (5 marks)

• Presentation is clear, well organized, and convincing. Questions are appropriately addressed.

Table 5: Descriptions of technology-enabled lessons (TEL)

Title of TEL	Brief description
Computer as a teaching – learning tool	
Expressions Alive!	This TEL allows student-teachers to explore various kinds of multimedia and multi-platform tools to create artifacts for learning. Pupils, who are considered as digital natives, will be familiar with these tools and this section allows student-teachers to have hands-on experience so that they can design relevant activities for the pupils to create artifacts that they can express their own feelings, thoughts and expressions.
Digital Game Based Learning	Most school pupils have experience playing with computer games and enjoy them. This TEL taps into pupils' interest in games. Student teachers have a chance to explore commercial and free games to understand how these games motivate pupils. They will also be able to design learning activities using off-the-shelf games to engage pupils in their learning.
Interactive White Boards (IWB)	IWB is gaining popularity among primary and secondary schools. Besides being able to annotate on the screen, there are many features which encourage collaboration among pupils. Various techniques and strategies to maximize the use of IWB for collaborative learning will enable teachers to make their lessons more participative.
WebQuest for Meaningful Learning	Good designs of WebQuest activities can lead to good learning gains among students. In this TEL, student-teachers will be given opportunities to explore the use of WebQuest strategy to engage students in collaborative problem solving. The strategy can be applied across many subjects but the crafting of good WebQuest activity is crucial to enhance learning among pupils. Assessment modes for WebQuest will also be discussed in this section.
Knowledge Building with ICT	Learning does not have to be alone. In this knowledge building using the platform, Knowledge Forum TM (http://www.knowledgeforum.com/) enables pupils to enhance their understanding through a knowledge building process. Student-teachers explore this platform and design a learning activity that lends well to this strategy.
Technology for Assessment	This TEL examines how the affordances of technology could enhance the process of conducting formative and summative assessment. Student teachers use an online assessment tool to create various forms of assessment items for subjects they will be teaching in schools. Student teachers will have a chance to explore the benefits of using e-portfolio as a performance measurement tool.
Computer-Based Presentation	Student teachers will be exposed to use the computer as presentation tool in a whole-class teaching. Good graphical designs are important to the lesson and good use of various animation techniques found in the presentation tool will enable teachers to explain concepts easier with visualization. In addition, student teachers will be exposed to interactive lessons with pupil participating actively in learning based on one-computer-one-projector classroom.
Computer as a social- media learning tool	
Podcasting for Meaningful Learning	This TEL encourages the use of the social media of podcasting. Student teachers will record regular podcasts and upload them into a portal. They will use simple tools to enhance the audio quality of their podcasts. In the portal, viewers can download and comment on the podcasts developed by student teachers. They will also explore how this can be used with their own pupils making their own podcasts.
Facebook	Facebook is used as a platform for delivery of lessons and for discussions. Since pupils in schools are very familiar with Facebook, it will be easy to use this as a platform for discussion. This TEL gives student-teachers to exploit the affordances of Facebook as a platform for discussions, collaborative work through groups, sharing of resources, and other applications found in Facebook.
Weblog	This TEL uses free web-based blogs to reflect students' learning. Student teachers will examine critically the affordances of such a platform to identify the strengths and weaknesses of this platform as a reflective tool. Student teachers will use this platform to record their views. They will also design activities for school pupils to use the blogs as an educational and reflective tool.
Designing asynchronous online discussions	As every school is equipped with a learning management system, this TEL allows student-teachers to design lessons using asynchronous online discussions to further enhance the pupils' understanding of concepts. Student teachers will also be given guidelines on how to facilitate discussions to promote higher-order thinking.

3. Outcomes: benefits and challenges

3.1 Benefits

Many student teachers have given feedback on the course content, delivery, and assignments. A significant number reported that they would have liked to have been able to take more TELs than the limit of only two permitted due to time constraints. Some TELs were less popular than others, possibly because student teachers felt the content was too demanding or not relevant to their subject areas. The curriculum committee has taken this feedback into consideration. Revised TELs are being incorporated into future ICT curricula.

The effectiveness of the course on student teachers' performance was challenging to measure as many external factors could also have impacted on performance. For example, each student teacher was issued with a notebook computer and this could have influenced responses to the post-programme survey.

Before student teachers left NIE, they were asked to answer a comprehensive on-line survey. They were asked to rate their skills in lesson preparation, lesson delivery, classroom management, ICT skills and communication. In the section on ICT skills, they were asked to rate their level of confidence in their ability to:

i. use ICT to source information and materials for teaching

ii. select appropriate ICT tools to support teaching

iii. use ICT as a tool for student learning e..g. media, IT resources, Internet.

Student teachers were asked to rate themselves on a 5-point scale with 5 being "very confident" and 1 being "not confident at all". The mean was 3.85 with a standard deviation of 0.701 (NIE, 2011). The results indicated that student teachers felt confident in using ICT for their lessons. This confidence cannot be attributed solely to the core ICT course. In the course of their one year-programme in NIE, the student teachers had exposure to ICT use in other subject areas. But it can be concluded that as an institution, NIE has produced student teachers who reported a high level of confidence in their skills in using ICT for teaching.

3.2 Challenges and solutions

As the only teacher-training institute in the state, NIE has no comparable agencies within Singapore with which to collaborate on the development and implementation of ICT courses for pre-service teachers. To solve this, faculty staff draw upon literature from other universities. As a national institute, NIE aligns its courses with the goals and initiatives of the country's educational system. NIE is linked closely with the MOE and this helps it obtain feedback from ministry officials. NIE has good synergy with the Educational Technology Department of the Ministry of Education, and good access to its resources, and this also helps in the design of the curriculum.

Student teachers face major challenges when they are posted to schools after completing their training in NIE. As beginning teachers in the school system, they must cope with a wide number of demands while they are simultaneously expected to be innovative in the use of ICT in their teaching. It has been reported that within a six-month period, beginning teachers are more at ease with the school system and begin to apply what they learned in NIE.

Overlapping of course content within NIE's general training programme is another challenge. For example, both *ICT for Meaningful Learning* and Curriculum Studies teach lesson planning. It is important that the various academic groups have an open dialog and share their course content. ICT is also used in the teaching of specific subjects. For example, mathematics courses may include teaching on specific software applicable to the teaching of geometry or algebra. Science lecturers may demonstrate the use of data loggers for science experiments, and music lecturers may use composer software to help student teachers in music composition.

4. Conclusion and further implications

ICT for Meaningful Learning is constantly reviewed and updated by LST members to make it current, relevant and pedagogically sound. Technology is moving very fast and the course must be constantly refined to be in line with new trends in learning with technology. For example, there is a growing trend towards mobile learning, including in schools. More student teachers and school pupils are adopting powerful new mobile computing devices that are cheaper than laptop computers and can be used as learning devices. NIE must capture the opportunities to enable student teachers to access their course materials and work collaboratively on the move.

The future of using technology for teaching and learning is always challenging and it is imperative for faculty staff to be constantly updated. While LST faculty are up-to date on innovative uses of technology for teaching and learning, other faculty need more exposure. NIE needs to "walk the talk". Encouraging all faculty staff to incorporate the use of technology in teaching remains a major challenge for the institute's leadership.

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Application of ICT in teaching and learning, department of innovation and information technology for education, Faculty of Education, Rajabhat Mahasarakham University (Thailand)

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Abstract

The Faculty of Education, Rajabhat Mahasarakham University, provides teacher education programmes in line with Thailand's national education policy. Faculty members also conduct research and development on educational instruction and curricula. This paper discusses an instructional model for a course that used ICT for teaching and learning. Learning activities were taught in the regular classroom and through the Internet, which was used extensively inside and outside of the classroom to facilitate teaching and learning activities, content sharing, and communication between teachers and learners. The research indicated that students who participated in using ICT in teaching and learning had higher academic achievement and a higher level of satisfaction than those traditional lecture-based classes. The results were caused by the systematically-developed curriculum including an instructional development through the assessment of the experts in educational technology, curriculum and instruction. Moreover, the data of documentary study on instructional development and educational technology including learners's needs were employed for the research on education. The instructional model was subsequently used for other subjects focusing on thinking and professional skill development for the enhancement of learning achievement and skill in information technology.

The application of ICT for education at the Faculty of Education, Rajabhat Mahasarakham University was useful and practical for graduate students. The students developed their knowledge and skill in ICT for education. In addition, teachers used ICT to encourage and facilitate their students. Teaching materials were developed by the participatory method of students. The students were provided the opportunity to share the ideas of design, decision and development of the teaching materials through ICT.

1. Institutional context/background

1.1 Introduction to Rajabhat Mahasarakham University

Rajabhat Maha Sarakham University is located in Muang District of Maha Sarakham Province, in the heart of Northeast Thailand. The University prides itself in having trained its students to become graduates in the field of education, as well as other professions who serve in a variety of sectors in many parts of the country. Since its establishment in 1925, the Institute has played an important role in the development of the community and the region. It has been part of the name "Muang Takasila" which is used to refer to Maha Sarakham as a prominent source of education where people can seek knowledge of various disciplines

The Faculty of Education, Rajabhat Mahasarakham University, plays an important role in providing teacher education programmes from the diploma to the doctoral level. The faculty also provides

academic services to teachers, university staff and students focusing on educational research and development. The main purposes of the university's research and development work are:

1) To provide a high quality of education that produces graduates who meet professional standards
2) To provide a management system of quality standards based on the principles of good governance
3) To incorporate innovative educational technology into the technical and administrative practices of teachers and administrators
4) To expand educational opportunities for all levels in society
5) To build a network of professional development for teachers
6) To develop teaching and learning processes and local educational management for teachers and administrators
7) To develop innovative practices with learning resources based on Thai wisdom
8) To support art, cultural, and religious activities for moral and environmental sustainability.

1.2 Context of the development of the ICT-related curriculum

The Faculty of Education develops new learning and teaching approaches continually, based on local needs, problems, and research results. ICT for example, is used for teaching and learning as appropriate for student needs. Various course lessons are uploaded to the Internet to facilitate student access and communication between students and teachers. University policy on technology and innovation for education requires that it provides communication facilities such as computer labs and wireless Internet facilities across the university. This paper discusses the course *Innovation and Information Technology for Education*. The course is compulsory for all first-year students in all programmes of study and is a 3-credit course focusing on product design and development; presentation and evaluation of instructional innovation, teaching materials, including application of ICT for education. The course emphasizes on both theory and practice to prepare their professional skills before practical training experience.

The course implementation showed that students had higher academic achievement in comparison with the traditional instruction, which focused on lectures by an instructor. (Teerawut, 2004) In addition, students improved their skills in effectively using information technology for education.

2. ICT-related course/curriculum

2.1 Development process

The development of curriculum and learning/teaching activities for the *Innovation and Information Technology for Education* course focused on using information technology for instruction. The development process took twenty eight weeks and involved five steps, which details presented in Table 1 Steps in Curriculum Development: (Grafinger, 1988)

1) Problems and needs analysis: A literature review and a survey of 200 students were used to collect data on needs and design of the course. The findings indicated that students needed a student-centered learning approach, and to participate in learning and teaching activities

as well as in evaluation. They needed to learn through modern media, and to learn as a group rather than as individuals. (Phusit, 2005) The results of the survey were used to design a framework for the course curriculum. The framework was discussed by 10 experts from higher education institutions in a Focus Group Discussion (FGD). (Kumar,1987) This discussion concluded that the instructional model for the course should be based on constructivist theory and cooperative learning through a computer network. Teachers would provide learning and teaching activities on the network, focusing on group assignments and evaluation, and would provide students with guidance on their activities. Students would be able to communicate with teachers and others through the Internet.

2) Design of the course content, activities and evaluation: The course content was designed by teachers and covered covering seven topics relating to theory and practice. It was then assessed by five teaching experts.

3) Development of e-instructional materials: The results of Step 2 were used to write lesson plans for 16 weeks (4 periods per week; 50 minutes per lesson) and to create the lesson in-the-computer network using the Moodle learning management system. The lessons were assessed by five experts in the development of teaching materials.

4) Implementation of learning and teaching activities: The activities and materials were tested on students who enrolled in the course in January 2009. Pre-testing was carried out with students to classify them into groups of four. Each group consisted of one student with a high score, two students with moderate scores, and one student with a low score. Each group carried out activities assigned by the teacher, presented its results in class, and discussed problems with both teachers and members of other groups.

5) Evaluation of the instruction: A post-test was carried out to assess the learning outcomes of individual students, evaluate their performance, and measure their level of satisfaction with the use of the instructional model. The post-test also served as an input to improve instruction in the next semester.

The development process for the course consisted of five steps as follows: (Prawit et al, 2008)

Table 1: Steps in Curriculum Development

	Activities	Persons in Charge	Duration	Output	Note (if any)
Step 1	Survey of problems and needs, and research relating to professional development	Instructors from the Faculty of Education	4 weeks	Framework of instructional development	
Step 2	Design of the content, instructional activities, evaluation	Instructors from the Faculty of Education	2 weeks	1) Course content 2) Course objective 3) Instructional activities 4) Instructional evaluation model	
Step 3	Development of instructional materials	Instructors from the Faculty of Education	5 weeks	Lesson Plans	
Step 4	Implementation of instructional activities management based on specified plan	Instructors from Rajabhat Mahasarakam University	16 weeks	5) Students' learning outcomes 6) Problems and limitations of instruction - inputs for improvements	
Step 5	Instructional evaluation	Instructors from Rajabhat University	1 weeks	7) Students' learning outcomes 8) Instructional efficiency 9) Students' opinions of their experience of using ICT	

2.2 Course outline

The course focused on students' ability to use ICT to search for relevant information and develop learning resources. It also looked at the benefits and challenges in applying networks of learning and at a variety of educational innovations and technologies.

2.2.1 Course provider		
Institution: Rajabhat Mahasarakham University	Faculty/School: Faculty of Education	Department:
2.2.2 Course title: Innovation and Information Technology for Education		
2.2.3 Course Type: Teaching Profession.		
Compulsory for all students in the pre-service teacher education programme		
2.2.4 Target audiences: Teaching Profession Students.		
Year 1		
2.2.5 Credit and degree: Bachelor of Education		
Number of credits: 3 Degree(s) to be obtained: Bachelor of Education		
2.2.6 Course learning objectives		
After completing the course, students should be able to: • know and understand the definition, role, value, approach, rationale, basic theories, and significance of educational innovation and technology for learning and teaching • know and understand system techniques, and processes to search for resources in relation to educational innovation and technology • know, understand, and gain competency in analyzing instructional media problems • be skilful in the management, selection, usage, evaluation, storage, and maintenance of instructional media		

2.2.7 Course learning objectives

1) know and understand the processes involved in design, production and improvement of appropriate media in the classroom
2) know, understand, and gain competency in using educational technology for work development
3) know, understand, and gain competency in using educational innovation for work development

2.2.8 Resources

1) Computer Laboratory
2) Teaching documents
3) Multimedia and equipment for presentation
4) Wireless electronic network system
5) Personal Notebook Computer

2.2.8 Course topic

	Learning activities	Instructional strategies	Delivery modes (media)
Topic 1 Meaning and Territory of Education Technology	Week 1 1) Orientation (50 minutes) 2) Class Assignment and Condition (20 minutes) 3) Lesson Planning (30 minutes) 4) Learning through Web and Sharing (100 minutes)	1) Lecture 2) Self study report 3) Demonstration 4) Learning through the web 5) Coaching 6) Learning both stand-alone and on networked system	Instructional document - Innovation and Information Technology for Education Author: Prawit Simmatun (PDF file) Resources on the web - Digital video on web - Lecture recording - PowerPoint Presentation
	Week 2 5) Conclusion of Thoughts and Sharing (100 minutes) 6) Learning Performance Evaluation (100 minutes)		Communication tools - Chat room - Webboard - Wiki - Multimedia - *Search engine* Web based Instruction for Learning; Moodle: http://www.edurmu.org/lms
Topic 2 Principles and Theory of Education Technology	Week 3 1) Orientation (50 minutes) 2) Class Assignment and Condition (20 minutes) 3) Lesson Planning (30 minutes) 4) Learning through Web and Sharing (100 minutes) Week 4 5) Conclusion of Thoughts and Sharing (100 minutes)	1) Lecture 2) Self study report 3) Demonstration 4) Learning through the web 5) Coaching 6) Learning both stand-alone and on networked system	Instructional document - Production and Presentation : Multimedia for Education Author: Prawit Simmatun (PDF file) Resources on the web - Digital video on web - Lecture recording - Classroom presentation - recording of students - PowerPoint Presentation - Communication Tools - Chat room - Webboard - Wiki - Multimedia
	6) Learning Performance Evaluation (100 minutes)		- Search engine - Web based Instruction for learning; Moodle http://www.edurmu.org/lms

	Learning activities	Instructional strategies	Delivery modes (media)
Topic 3 Instructional Media	Week 5 1) Orientation (50 minutes) 2) Class Assignment and Condition (20 minutes) 3) Lesson Planning (30 minutes) 4) Learning through Web and Sharing (100 minutes) Week 6 5) Conclusion of Thought and Sharing (50 minutes) 6) project report (100 minutes) 7) Learning Performance Evaluation (50 minutes)	1) Lecture 2) Self study report 3) Demonstration 4) Learning through the web 5) Coaching 6) Learning both stand-alone and on networked system	Instructional document - Production and Presentation : Multimedia for Education Author: Prawit Simmatun (PDF file) Resources on the web - Digital video on web - Lecture recording - Classroom presentation recording of students - PowerPoint Presentation Communication tools - Chat room - Webboard - Wiki - Multimedia - Search engine Web based Instruction for Learning: Moodle http://www.edurmu.org/lms
Topic 4 Production and Presentation : Multimedia for Education	Week 7 1) Orientation (50 minutes) 2) Class Assignment and Condition (20 minutes) 3) Lesson lanning (30 minutes) 4) Learning through Web and Sharing (100 minutes) Week 8 5) Conclusions of Thought and Sharing (50 minutes) 6) Project report (Progress Report) (100 minutes) 7) Learning Performance Evaluation (50 minutes)	1) Lecture 2) Self study report 3) Demonstration 4) Learning through the Web 5) Coaching 6) Learning both via stand-alone and on networked system	Instructional document - Production and Presentation : Multimedia for Education Author: Prawit Simmatun (PDF file) Resources on the web - Digital video on web - Lecture recording - Classroom presentation recording of students - PowerPoint Presentation Communication tools - Chat room - Webboard - Wiki - Multimedia - Search engine. Web based Instruction for Learning: Moodle http://www.edurmu.org/lms
Midterm	Week 9		
	Learning activities	Instructional strategies	Delivery modes (media)
Topic 5 Education innovation	Week 10 1) Orientation (50 minutes) 2) Class Assignment and Condition (20 minutes) 3) Lesson Planning (30 minutes) 4) Learning through Web and Sharing (100 minutes) Week 11 5) Conclusions of Thought and Sharing (50 minutes) 6) Project report (Progress *report*) (100 minutes) 7) Learning Performance Evaluation (50 minutes)	1) Lecture 2) Self study report 3) Demonstration 4) Learning through the web 5) Coaching 6) Learning both in stand-alone and on networked system	Instructional document - Production and Presentation : Multimedia for Education Author: Prawit Simmatun (PDF file) Resources on the web - Digital video on web - Lecture recording - Classroom presentation recording of students - PowerPoint presentation. Communication tools - Chat room - Web board - Wiki - Multimedia - *Search engine* Web based Instruction for Learning create by Moodle http://www.edurmu.org/lms

Topic 6 Information Technology for Education	Week 12 1) Orientation (50 minutes 2) Class Assignment and Condition (20 minutes) 3) Lesson Planning (30 minutes) 4) Learning through Web and Sharing (100 minute) Week 13 5) Conclusions of Thought and Sharing (50 minutes) 6) Project report (Progress *Report*) (100 minutes) 7) Learning Performance Evaluation (50 minutes)	1) Lecture 2) Self study report 3) Demonstration 4) Learning through the web 5) Coaching 6) Learning both in stand-alone and on networked system	Instructional document - Production and Presentation : Multimedia for Education Author: Prawit Simmatun (PDF file) Resources on the web - Digital video on web - Lecture recording - Classroom presentation recording of students - PowerPoint presentation Communication tools - Chat room - Web board - Wiki - Multimedia - Search engine Web based Instruction for Learning: Moodle http://www.edurmu.org/lms
Topic 7 Learning resources and learning network	Week 14 1) Orientation (50 minutes) 2) Class Assignment and Condition (20 minutes) 3) Lesson Planning (30 minutes) 4) Learning through Web and Sharing (100 minutes) Week 15 5) Conclusions of Thought and Sharing (15 minutes) 6) Project report (Final Report) (150 minutes) 7) Learning Performance Evaluation (35 minutes)	1) Lecture 2) Self study report 3) Demonstration 4) Learning through the web 5) Coaching 6) Learning both via stand-alone and on networked system	Instructional document - Production and Presentation : Multimedia for Education Author: Prawit Simmatun (PDF file) Resources on the web - Digital video on web - Lecture recording - PowerPoint presentation Communication tools - Chat room - Web board - Wiki - Multimedia - Search engine Web based Instruction for Learning: Moodle http://www.edurmu.org/lms
Final	Week16		

2.2.9 Course assessment

Categories	Description	Weight (%age)	Note (if any)
Attendance	Outcomes of the assigned work practice	10%	
Participation	Participation in instructional activities both inside and outside class through the Internet-based network	20%	80% of class attendance for final examination 20% of summative score from class attendance and web-based exercises
Midterm	Essay Test showing comprehension in learning contents, expression of opinion, conclusion of knowledge material obtained from self-study and working with teams on various learning activities. Evaluation: correctness of answers, completeness, creative thinking, and problem-solving techniques	20 %	
Final	Multiple Choice test covering the content; assessed by experts	30%	

Project Internet Web-based Instruction	Effect of participation in web-based activities by searching for information, recording data, creating work outputs such as multimedia presentations on searched content. Members in each group support each other to improve, correct for the most perfect performance. The instructor follows up and provides advice, encourages the students to express their opinions and participate in activities fairly, and disseminates the performance through the web by using the group score as every member's score.	20%	
Total		100%	Evaluation criterion (score and learning performance rating): Score: 85-100, A Score: 80-84, B+ Score 75-79, B Score 70-74, C+ Score 65-69, C Score 60-64, D+ Score 55-59, D Score 0-54, F

3. Outcomes: benefits and challenges

3.1 Benefits

Students from every field of study in the Faculty of Education must take the course during their first year of study. The instructional model focused on providing students with knowledge and experience of working with groups and as individuals. Students searched for information themselves but held group discussions to present and discuss their work and any challenges they faced. Group members communicated through the Internet. The instructors gave advice, answered questions, and assessed the students' learning performance. Work outputs were disseminated through a report, multimedia, and digital video via Moodle, in order to obtain recommendations and suggestions from outsiders.

The findings of the course implementation indicated that students had comprehension and competency in designing, constructing, and innovating with ICT. They were able to search for appropriate learning resources and to develop ICT-supported instructional materials. The students reported a high level of satisfaction in using the model.

The findings indicated that the average scores of course students and others were significantly different. The average score of students in innovation and information tecghnology for education who learned through the Internet was 86.68%, while the average score of the students who learned in a traditional lecture-type classroom was 58.62%. The findings indicated that the application of ICT together with lectures improved the learning achievements of students. The findings also indicated that teachers used a variety of teaching materials for more efficient instruction and spent less time lecturing in class.

3.2 Challenges and solutions

Before taking the course, students had different learning styles and competency levels in applying ICT for learning and teaching. The solution for this involved grouping students into groups of four members with different competency levels. This meant that high-scorers could help lower-scorers. Since the class schedule was flexible, students could learn, review, and consult with instructors regularly via the Internet.

The research also indicated that the website for instruction should be modern and interesting. Social media should be available to allow students to share information. The assigned tasks should enhance student creativity. Their outputs should be presented via non-traditional means, for instance via group activities on the Internet networks, and via presentations including documents, pictures, electronic slides, videos, and role-play, and through authentic assessment: preparation and planning, implementation and evaluation.

In general, course students were found to be enthusiastic about learning and participating in the assigned activities. During the course students worked together to develop the best outputs.

4. Conclusion and further implications

Data on the course was collected and a synthesis of findings was produced and assessed by ten experts in educational tehchnology, curriculum and instruction from higher education institutions. The findings were presented at an international academic conference in International e-Learning Conference 2008 (IEC2008): e-Learners in the Generation 2.0. November 20-21, 2008 (pp 45-46). Bangkok, Thailand in order to solicit additional feedback/comments and recommendations, and published in Rajabhat Maha Sarakham University Journal (Vol. 4, No. 2, 2010) for dissemination as well as to gather further feedback and advice. Follow-up research is being conducted every semester by instructors and graduate students for further course enhancement.

The findings showed that students could more easily use ICT in searching for resources and constructing, designing, and developing instructional materials. Evaluations conducted on online communication logs and interactions with instructors on the website indicated that students were confident in expressing their viewpoints as well as in using computers. They also provided continuous advice and feedback to their fellow students. As a result, the instructional model has been extended to courses focusing on practice, team work and use of ICT for education in the Faculty of Education. Students were satisfied because they saved money on teaching materials, and because the model provided them with opportunities for self study. Rajabhat Mahasarakam University has since formulated major policies on providing facilities such as computer and high speed internet for instructors and students as well as appropriate computer training courses.

In conclusion, the findings indicate that the application of ICT is very practical and useful for instructional purposes. Students are satisfied with the active learning model, and the students are also provided more opportunity to learn by themselves which affects their higher learning achievement.

However, the problem encountered is lack of computer skill and using internet of the students. The solution is following up, communicating, giving advice to students through Email , Facebook and Skype . Finally learning activities of the students should be promoted onThai Teachers TV, other television stations in Thailand and the website at http://www.thaiteachers.tv/tv/?t=10&c=372 organized by the Commission on Higher Education, Ministry of Education.

Acknowledgement

The author expresses his appreciation to the administrative committee, faculty members, students of the faculty of Education, Rajabhat Mahasarakham University, for academic cooperation and ICT support. He also appreciates Associate Professor Dr. Narongrit Sopa, a deputy director for International Relations and International Education, Rajabhat Mahasarakham University and Dr. Martin Dougiamas for their experitise in learning management system: moodle and cooperation in editing his work.

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Learning to teach with ICT: a project-based course for pre-service teachers of biology at Hanoi National University of Education (Viet Nam)

Van Hien Nguyen, Ph.D

Abstract

Hanoi National University of Education (HNUE) is one of Viet Nam's leading teacher training institutions. The university has 23 subject faculties, including the Faculty of Biology. 'Applying ICT in Biology Education' is a two-credit course for 4th-year pre-service teachers studying biology. The newest version of the course was designed using the Technological Pedagogical Content Knowledge (TPACK) model and other models. It seeks to provide pre-service teachers with appropriate ICT skills, embedded with suitable pedagogies. Using blended learning and hands-on activities, students explore trends in ICT in education and learn basic and advanced skills. For example, students learn to plan a biology unit carried out through 'e-lecturing' for face-to-face training, and to infuse ICT into a biology unit/topic. ICT-based assessments are also covered. By the end of the course, students should be able to use ICT to design new learning environments and to help pupils obtain both scientific knowledge and skills in the effective use of ICT.

1. Institutional context/background

1.1 Introduction to Hanoi National University of Education

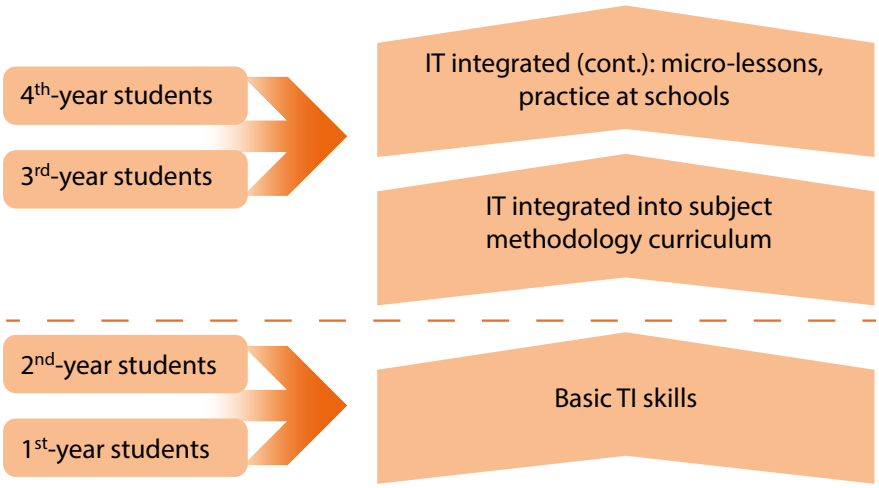
Hanoi National University of Education (HNUE) was established in 1951 and is a leader in teacher education in Viet Nam. As well as training teachers and education managers, HNUE plays a lead role in developing educational curricula, textbooks, and guidebooks, and in developing education policy. At the undergraduate level, the university has 42 training programmes. There are 49 master's programmes and 41 doctoral programmes.

1.2 Context of the development of the ICT-related curriculum

Rapid developments in technology and science are resulting in an information and communication technologies (ICT) revolution. ICT competency is essential for citizens living in the 21st century. In this context, teacher-training institutions must either become leaders or be left behind.

HNUE launched an ICT programme in the early 2000s and subsequently established a specialist ICT, the faculty of Information Technology. In addition, the university encouraged all other faculty to apply ICT in research and teaching. The university's ICT infrastructure has seen progressive upgrading. For example, about 1,000 personal computers with LAN/Internet leased line connections were acquired to support ICT-rich education curricula.

Figure 1: ICT in education curriculum at HNUE (2010 – 2011 academic year)



During their first two years of study at undergraduate programme, all pre-service teachers study General Informatics, which covers the fundamentals of computer hardware and software, including Operating Systems management. They are introduced to Microsoft Office (Word, Excel and PowerPoint) and to the Internet. In the last two years of their study, depending on the specific subject a student is learning, students study advanced ICT skills (multimedia editing, simulations), appropriate features of general software, and specific educational software.

With professional support from parties such as Intel, Microsoft and especially, UNESCO Bangkok, HNUE's approach to ICT in education has become increasingly progressive in recent years. For example, the course *Applying ICT in Biology Education* was updated under the 'Next Generation of Teachers Project' of UNESCO Asia and Pacific Regional Bureau for Education, using the Technological Pedagogical Content Knowledge (TPACK) model and the ASSURE model (Analyse Learners; State Objectives; Select Methods, Media and Materials; Utilize Media and Materials; Require Learner Participation; Evaluate and Revise).

2. ICT-related course/curriculum

2.1 Development process

Table 1 below describes the process of course development.

Table 1: The ICT related - course development process

Steps	Activities	Responsible person(s)	Duration	Output
Step 1	Analyzing learners' status and needs	Van Hien NGUYEN	1 month	Status report of students' ICT competencies
Step 2	Defining ICT competencies for teachers of biology	Van Hien NGUYEN	3 months	Report on the necessary ICT skills for teachers of biology
Step 3	Stating the objectives of the necessary learning modules	Van Hien NGUYEN and lecturers at the Department of Biology Teaching Methodology	1 month	Revised course objectives
Step 4	Building the course structure and selecting references	Van Hien NGUYEN and lecturers at the Department of Biology Teaching Methodology	1 month	Course outline with relevant references (including online and offline materials)

Step 5	Designing learning activities and assessments	Van Hien NGUYEN and lecturers at the Department of Biology Teaching Methodology	1 month	Student – centered activities and performance assessments that integrate ICT
Step 6	Writing a teaching guideline review by 3 experts	Van Hien NGUYEN and 3 experts	3 months	Inputs/comments from reviewers for the teaching guideline
Step 7	Finalizing the teaching guideline	Van Hien NGUYEN	1 month	A guidebook for applying ICT in biology education

2.2 Course outline

2.2.1 Course provider		
Institution: HNUE	Faculty/School: Biology	Department: Biology Teaching Methodology
2.2.2 Course title: Applying ICT in Biology Education		
2.2.3 Course Type		
Compulsory for students in certain teacher education programmes (Biology)		
2.2.4 Target audiences		
Year 4		
2.2.5 Credit and degree		
Number of credits: 2 Degree(s) to be obtained: Bachelor		
2.2.6 Course learning objectives		
After completing the course, students should be able to: 1) Discuss critically roles, principles and trends in using ICT in teaching and learning in general. 2) Collect, evaluate, edit or develop and manage appropriate digital content to use in biology teaching. 3) Design and facilitate ICT-based learning activities in biology teaching . 4) Develop constructivist biology lessons that incorporate ICT tools. 5) Design and implement appropriate ICT based – assessment for measuring students' biological knowledge/ skills achievements. 6) Search online resources on biology and use some common software to edit or build multimedia resources for specific biology teaching - learning activities.		
2.2.7 Resources		
Main References: 1) Barton, R. 2004. *Teaching Secondary Science with ICT*, Open University Press, USA. 2) Heichnich, R, Molenda, J.D. and Smaldino, S. E. 2002. *Instructional Media and Technologies for Learning*. New Jersey: Merill Prentice Hall 3) Sharma, Y. K. 2002, *Fundamental Aspects of Educational Technology*, Kanishka Publishers, India Other References: 1) McKenzie, W. 2005. *Multiple Intelligences and Instructional Technology*, International Society for Technology Education, Washington DC, USA 2) Shank, P. and Sitze, A. 2004. *Making Sense of Online Learning*, Pfeiffer, San Francisco, USA 3) Other Resources: A computer lab with at least 30 clients with LAN/internet connection.		
2.2.8 Course topics		

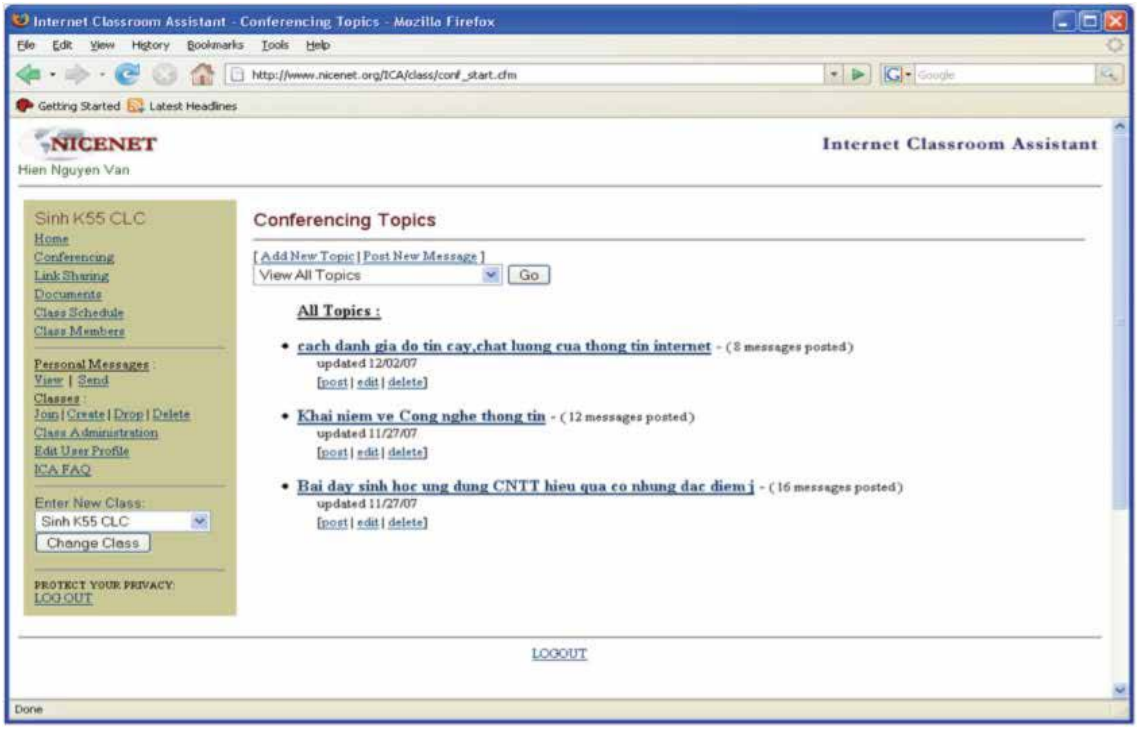
	Learning activities	Instructional strategies	Delivery modes (media)
Theory Part			
Topic 1: Overview of ICT in Education (Week 1-2)	Activity 1: Reporting on compulsory reading	Reading for meaning	Face to face (F2F) training
Topic 2: Legal, Ethics and Issues in using ICT (Week 3)	Activity 2: Critical reading of prepared materials. Activity 3: Online discussion on properly selecting and using digital resources.	Inquiry Learning Discussion	Blended Learning

Topic 3: Using ICT to support Biology Lectures (Week 4-6)	Activity 4: Explore sample lessons Activity 5: Design a biology lesson supported by ICT	Case studies Group work and Discussion	Blended Learning
Topic 4: Infusing ICT into Biology teaching (Week 7-8)	Activity 6: Analyse sample lessons Activity 7: Design a biology lesson infused with ICT	Case Studies Group work and Discussion	Blended Learning
Topic 5: Using ICT based – assessments in Biology teaching (Week 9-10)	Activity 8: Design an ICT-based assessment for specific biology knowledge/skills. Activity 9: Reflection on lessons learned.	Group work and Discussion Reflective Discussion	Blended Learning
Practice Part			
Topic 1: Mining Internet (Week 2)	Activity 1: Use Boolean Logic to search digital biological resources. Activity 2: Collect digital biology resources by themes or topics.	Hands-on	F2F training
Topic 2: Modifying and Creating Multimedia Resources (Week 3-5)	Activity 3: Edit digital biology images Activity 4: Edit and create biology animations Activity 5: Edit and create biology video clips	Hands-on	F2F training
Topic 3: Designing a Constructivist biology lesson integrated with ICT (Week 6-8)	Activity 6: Design a biology lesson supported by either the Microsoft PowerPoint or a WebQuest	Hands-on	F2F training
2.2.9 Course assessment			
Categories	Description	Weight (percentage)	Note (if any)
Attendance	Students are required to attend at least 80% of discussion time on F2F sections.	10	
Participation	Students are required to actively participate in all learning activities, include online and offline.	10	
Midterm	Formative Assessment is used in both the theory part and practice course sections. In the theory section, a performance portfolio is used as a main assessment tool. In the practice section, the technological skills of students are assessed by a quick observation rubric.	30	Theory section: 15 and Practice section: 15
Final	Students take a short multiple choice test and design a learning activity for biology lessons that is supported by ICT.	50	The summative assessment takes place in a computer lab. The multiple-choice test is installed on LAN.
Total		100	

2.2.8 Course topics and instructional strategies

The course is run under a blended learning model in which face-to-face training is combined with online learning (mainly using the e-learning environment called NiceNet (www.nicenet.org). Figure 2 below is a screenshot of a NiceNet class.

Figure 2: A screenshot of an online discussion session in a NiceNet Class



The course is divided into two sections: theory and practice:

Theory

Topic 1: Overview of ICT in Education (Week 1-2):

Learning Outcomes: Students will be able to:

- Discuss critically the roles, principles and trends in using ICT in teaching and learning in general
- Set a grid/matrix with clear criteria for choosing ICT tools in teaching a specific content to a specific audience.

Learning activity 1: Reporting on compulsory reading

- Brief description of activity:

- Task 1: Students are asked to read compulsory books and web links that discuss the roles, trends and principles of using ICT in education. Students are also encouraged to research related online and offline resources.
- Task 2: Students, individually, have to sum up what they have read and send the summary to the teacher via email.
- Task 3: In class, students form groups to share what they have learned. Groups come up with a table/matrix for selecting appropriate ICT tools in the teaching and learning process.

Topic 2: Legal, Ethics and Issues in using ICT (Week 3):

Learning Outcomes: Students will be able to:

- Apply copyright laws correctly.
- Analyse and evaluate online resources.

Learning activity 2: Critical reading of prepared materials.

- Brief description of activity:

- Task 1: Students are asked to download and study a presentation on copyright law.
- Task 2: Each student has to post at least one question about the presentation, and share and discuss the questions with other class members through an online conference initiated by the teacher in the NiceNet class.

Learning activity 3: Online discussion on properly selecting and using digital resources.

- Brief description of activity:

- Task 1: Students are asked to open and manage by themselves an online topic in the Nice Net class of how to analyse and evaluate online resources.
- Task 2: In class, students organize into groups and reflect on the following questions: What have I learned from this? How did I learn? What new skills did I acquire? How can I apply what I have learned?

Topic 3: Using ICTs to support Biology Lectures (Week 4-6):

Learning Outcomes: Students will be able to:

- Design and facilitate ICT-based learning activities in teaching biology.

Learning activity 4: Explore sample lessons

- Brief description of activity:

- Task 1: Students are asked to search and download a biology e-lesson at secondary school level.
- Task 2: In class, students organize into groups and develop a rubric to evaluate the e-lesson. Then, groups create sample lessons of their own.
- Task 3: In class, each group shows its sample lesson and its rubric for discussion.
- Task 4: In class, students watch a video clip demonstrating a biology class utilizing an ICT-based learning activities model (Students later find the clip on YouTube for future reference). Then, the class discusses the building of a rubric for assessing a biology e-lesson (a lecture lesson supported by ICT).

Learning activity 5: Design a biology lesson supported by ICT

- Brief description of activity:

- Task 1: In groups, the students discuss a procedure to build an effective lecturing environment supported by ICT.
- Task 2: Using GoogleDocs, as a whole class, students cooperate to finalize the procedure.
- Task 3: Groups design their own biology lessons supported by ICT, following the procedure finalized by the whole class.
- Task 4: In class, each group showcases its outputs and discusses them.

Topic 4: Infusing ICT into Biology Teaching (Week 7 – 8):

Learning Outcomes: Students will be able to:

- Develop constructivist biology lessons that incorporate ICT tools.

Learning activity 6: Analyse sample lessons.

- Brief description of activity:

- Task 1: Students are introduced to biology lessons delivered in WebQuest.
- Task 2: In groups, students discuss questions:
  What are the characteristics of this new way of learning? What are the main strategy/instructional approaches in this delivery mode? What are the differences between this teaching model and others (such as ICT-enhanced teaching, or traditional teaching)? What are the difficulties you encountered using WebQuest?
- Task 3: Groups create and share a WebQuest to present groups' responses to above-mentioned questions.

Learning activity 7: Design a biology lesson infused with ICT.

- Brief description of activity:

- Task 1: In groups, the students discuss a procedure to develop a biology lesson incorporating ICT.
- Task 2: Using GoogleDocs, as a whole class, students cooperate to finalize the procedure.
- Task 3: Groups design their own biology lessons infused with ICT, following the procedure.
- Task 4: In class, every group showcases and discusses their outputs.

Topic 5: Using ICT-based assessments in Biology Teaching (Week 9 - 10)

Learning Outcomes: Students will be able to:

- Design and implement appropriate ICT-based assessment for measuring students' knowledge/skills acquired from the modified biology lessons infused with ICT.

Learning activity 8: Design an ICT-based assessment for specific biology knowledge/skills.

- Brief description of activity:

- Task 1: Student groups study assessment theory and ICT-based assessment and decide on the instructional designs of any one of the suggested assessment tasks below:
  1. Designing a multiple choice and short answer test on genetics.
  2. Designing a drag and drop test on Food Chain, Food Web.
  3. Designing a hot spot test on cell structure.
  4. Designing a correction test about evolution theories as a wiki (blog).
  5. Designing a fill-in-the-blanks test on environmental knowledge.
- Task 2: Every group shares their outputs in the NiceNet class portfolio.
- Task 3: In class, students discuss the characteristics of ICT-based assessment in the field of teaching biology.

Learning activity 9: Reflection on lessons learned.

- Brief description of activity:

- Task 1: Each group member develops a reflection paper on what he/she learned. Guide questions for reflection: What have I learned? How did I learn? What new skills did I acquire? How can I develop these skills for my students? What more do I want to learn?

- Task 2: Every participant sends the reflection paper to the teacher via email.
- Task 3: In class, the teacher shares some significant findings based on the reflection papers and allows the class to discuss and make conclusions on how they have developed themselves through the course.

Practice:

The Practice section develops students' technological skills through hands-on activities. The common procedure has the following steps:

Step 1: The teacher states the objectives of the task

Step 2: The teacher demonstrates the skills at a normal pace, with explanations

Step 3: The teacher systematically demonstrates the skills and lets students follow

Step 4: The students practice the skills on their own, and conduct self-assessment and peer evaluation.

Step 5: The students practice the new tasks/skills under the teacher's guidance and suggestions.

Topic 1: Mining the Internet (Week 2)

Activity 1: Use Boolean Logic to search digital biological resources.

Students are instructed to complete the following exercise:

Use Google to find images with suggested keywords and write comments or conclusions:

- Find images of a cell using a Vietnamese keyword (Tế bào) in two ways: a) with quotation marks around the keyword and b) with no quotation marks around the keyword. Comment on the returned results and present conclusions here:

. . . . . .
. . . . . .
. . . . . .
. . . . . .
. . . . . .

- Find images of a cell using a Vietnamese keyword (Tế bào) and a keyword in English (Cell). Comment on the returned results and present conclusions here:

. . . . . .
. . . . . .
. . . . . .
. . . . . .
. . . . . .

- Find images using the keywords "succession" and "virus". Comment on the returned results and present conclusions here:

. . . . . .
. . . . . .
. . . . . .
. . . . . .
. . . . . .

• Find images with suggested syntax:

"virus" → search 1.
"virus"-"computer" → search 2.
"virus"+"biology" → search 3.
Compare the returned results and provide your conclusions here:

. . . . . .
. . . . . .
. . . . . .
. . . . . .
. . . . . .

• Find images with the following keywords: "ameba" and "amoeba".

Comment on the returned results and present conclusions here:

. . . . . .
. . . . . .
. . . . . .
. . . . . .
. . . . . .

Activity 2: Collect digital biology resources by theme or topic.

- Task 1: Students are required to find three animation videos/resources on photosynthesis; three animation videos/resources on mitosis; three animation videos/resources on the HIV virus.
- Task 2: Students are required to search and make a collection of useful links on general biology, the environment or human anatomy. They must share their findings on the Link Sharing section in the NiceNet Class.

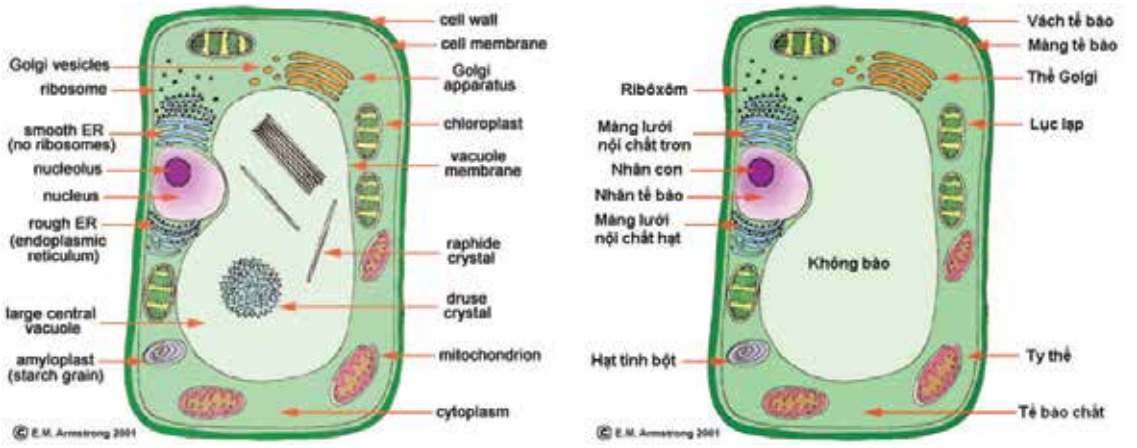
Topic 2: Modifying and Creating Multimedia Resources (Week 3-5)

Activity 3: Edit digital biology images

Have students edit a sample image using Paint software.

- Task 1: Students search the Internet for an exact or accurate image of a plant cell similar to an image provided by the teacher.
- Task 2: Students modify and localize the image using Paint software to make it suitable for secondary school students (See Figure 3).
- Task 3: Save a copy of the edited image and share it in the Class Gallery or students' Flickr account.

Figure 3: Plant cell image for practicing Paint

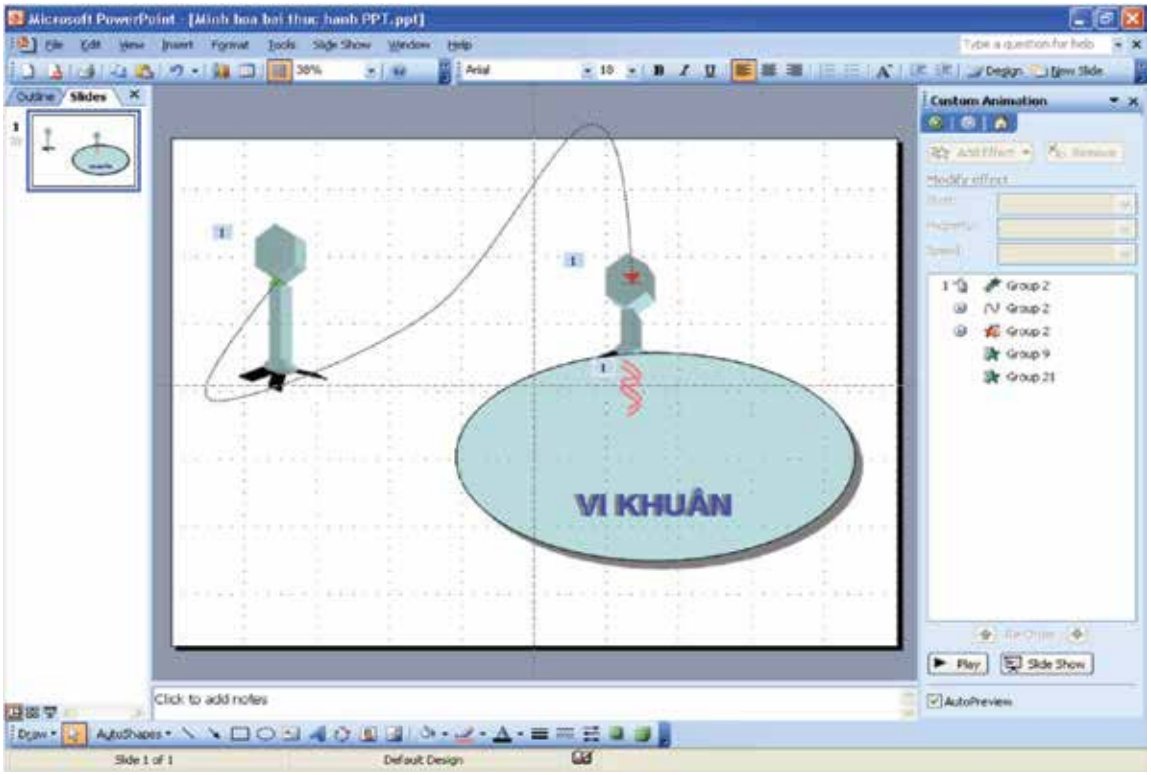


Original Modification

Activity 4: Edit and create biology animations

- Task 1: Students use Microsoft Gif Animator to edit an animation of pollination in the gif format.
- Task 2: Students use Microsoft PowerPoint to create an animation for injecting virus' DNA into host cell (See Figure 4).
- Task 3: Students combine both Microsoft PowerPoint and Microsoft Gif Animator to make an animation of Double Fertilization.

Figure 4: A screenshot of the editing mode in Microsoft PowerPoint



Activity 5: Edit and create biology video clips

- Task 1: Students search the Internet and download a video clip of a photosynthesis experiment.
- Task 2: Students use Window Movies Maker software to edit and localize the clip.
- Task 3: Students share their outputs in YouTube (or Clip.vn)

Topic 3: Designing a Constructivist Biology lesson integrated with ICT (Week 6-8):

Activity 6: Design a biology lesson supported by either Microsoft PowerPoint or a WebQuest.

- Task 1: Students try to get accustomed to using Microsoft Office PowerPoint at an advanced level (such as manage Control Toolbox to Embed Flash, Hyperlink or the Trigger technique)
- Task 2: Students explore skills to create and manage a WebQuest.
- Task 3: Students write a biology lesson plan
- Task 4: Students design a biology lesson using Microsoft Office PowerPoint or WebQuest.

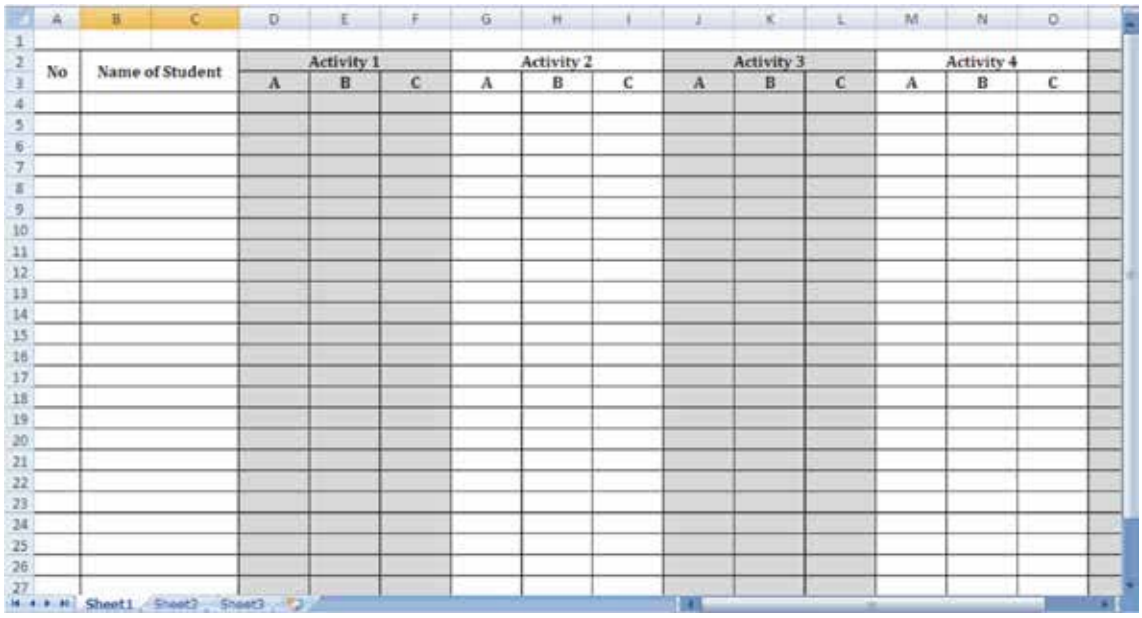
2.2.9 Course assessment

Formative assessment

Theory

Teachers design a worksheet that can be used to observe and assess students' performance. Figure 5 shows the worksheet below.

Figure 5: A screenshot of a spreadsheet used as performance portfolio



No	Name of Student	Activity 1			Activity 2			Activity 3			Activity 4		
		A	B	C	A	B	C	A	B	C	A	B	C

Notes: Level A = 1.5 mark, Level B = 1.0 mark, Level C = 0.5 mark

Practice

For a specific technological skill, the teacher uses a quick performance rubric with a Likert-type scale to evaluate students' performance. Table 2 below is a sample rubric for evaluating students' Microsoft PowerPoint skills. Teachers can use this rubric to observe and assess students' performance quickly and directly.

Table 2: A rubric for quickly assessing Microsoft Office PowerPoint skills

Skills	Level			
	Advanced	Intermediate	Basic	Undeveloped
Launching the software	+	+	+	+ (__)
Add text, pictures	+	+	+	__
Add effects for objects	+	+	__	__
Design animation/modelling (*Build interactive presentations, using hyperlinks, creating interactive objects, working with Slide Show options*).	+	__	__	__
Create effective template (*work with a Design template*).	+	__	__	__
Save file and Print a presentation	+	+	+	__

Notes: Plus symbol (+): Yes, Minus symbol (_): No

Table 3 is another example of a rubric used to assess skills in designing ICT-based learning activities in teaching biology.

Table 3: A rubric for assessing skills in designing ICT-based learning activities in biology teaching

Skills	Descriptions	Mark
Select suitable knowledge/ unit	Having selected correct information that needed supporting/ demonstrating by ICT	1
Select appropriate resources	Having selected right/appropriate digital resources, matching with textbook/with content knowledge for secondary school level	2
Design constructivist learning activities	Having designed student – centered activities and utilized strong features of ICT	3
Model abstract knowledge	Having demonstrated abstract knowledge. The modelling is exact and interesting for students' cognition.	2
Assessment	Having designed ICT based – assessment with clear layout, objective-based and matching students' level.	2
Total		10

Summative assessment

By combining a short multiple-choice test with hands-on activities, students undergo summative assessment measures.

Examples of multiple-choice type of test questions are presented below.

1. **When teaching flower structure, a teacher showed a picture of a flower structure on a screen and then questioned students. What do you think about his/her way of utilizing ICT?**

   A. Misuse and inappropriate
   B. Used ICT to activate learners
   C. Appropriate for the subject matter and used the advantages of ICT
   D. Inappropriate for students' cognition processes

2. **A biology lesson covers the following: 1. Principle of Segregation (Medel's first law); 2. DNA Replication; 3. Protein Synthesis; 4. Population (Ecology); 5. Hands-on lesson on chromosome observation. What lessons are most suitable for designing ICT-supported lessons (e-lecturing)?**

   A. 1, 2
   B. 2, 3
   C. 3, 4
   D.4, 5.

3. What kind of ICT-based assessment techniques should you choose to assess students' ability to show the stages of Complete Metamorphosis (e.g. life cycle of butterflies)?

A. A Hot spot Test

B. A True or False Test

C. A Cloze test

D. A Drag and Drop Test

4. Arrange the following steps to form the correct procedure for modelling a biology process: 1. Drawing symbols; 2. Building animation on computers; 3. Dividing the biology process into basic stages/steps; 4. Analyzing content knowledge; 5. Writing the storyboard.

A. 3 → 4 → 5 → 1 → 2

B. 5 → 3 → 4 → 1 → 2

C. 4 → 3 → 5 → 1 → 2

D. 4 → 3 → 5 → 2 → 1

3. Outcomes: benefits and challenges

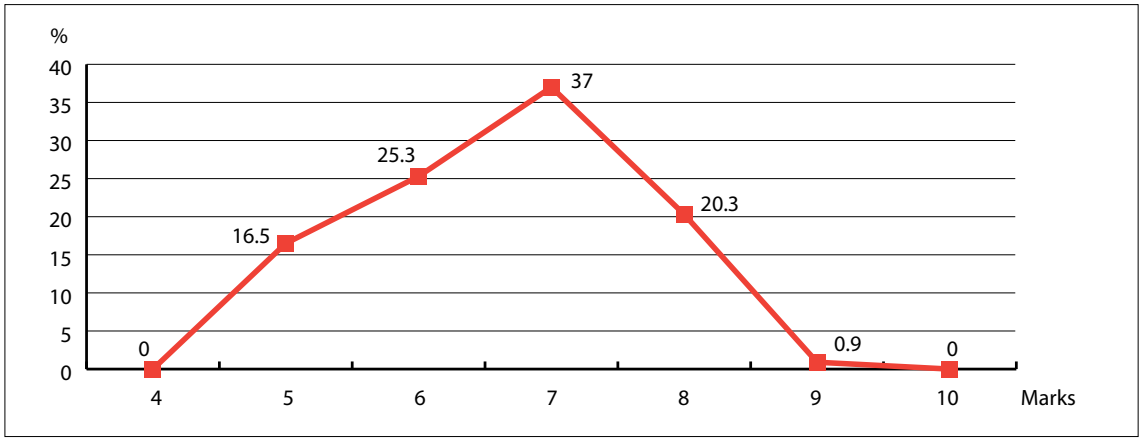
3.1 Benefits

The course has strongly contributed to students' success in applying ICT in their teaching of biology. To evaluate the capacity of students, we use quantitative methods. We mark students base on their e-porfolio and their showcase, using the rubric mentioned on Table 3. Table 4 shows students' marks that we have measured in 4 times in 4 different classes. We got a number of students (37%) getting average marks for a total of 340 pre-service teachers of biology. And diagram 1 shows the total result in percentage of table 4.

Table 4: Students' marks on designing ICT-based learning activities in biology teaching

Time	n	Students' marks (number and percentage of x_i)													
		1 - 4		5		6		7		8		9		10	
		n	%	n	%	n	%	n	%	n	%	n	%	n	%
1	74	0	0.0	11	14.9	18	24.3	32	43.2	13	17.6	0	0.0	0	0.0
2	77	0	0.0	14	18.2	23	29.9	29	37.7	10	13.0	1	1.2	0	0.0
3	83	0	0.0	14	16.9	19	22.9	30	36.1	19	22.9	1	1.2	0	0.0
4	106	0	0.0	17	16.0	26	24.5	35	33.0	27	25.5	1	0.9	0	0.0
Total	340	0	0.0	56	16.5	86	25.3	126	37.0	69	20.3	3	0.9	0	0.0

Diagram 1: A graph of 340 students' marks distribution



3.2 Challenges and solutions

The course has been undergoing continuous development and improvement. An early challenge was the fixed training curriculum. Infrastructure continues to be a challenge. Low levels of ICT competency among lecturers and students is also a barrier. The biggest challenge however is negative perceptions among lecturers regarding the role of ICT in education. It will take time to overcome these challenges. Steps already taken have included developing and enhancing lecturers' ICT competencies. This also resulted in improved budgets for infrastructure.

The course was piloted for two years (since 2004) as one part of the subject 'Theory of Biology Teaching Methodologies'. In the process of updating the curriculum in 2006, the designers were able to show the need for the course and to show its effectiveness, (based mainly on positive feedback from students). The course then became a compulsory credit course for 4th-year pre-service teachers of biology. However, the course has not yet achieved the capacity to deliver students who can design biology courseware for e-learning modality/delivery. The course faces the challenge of poor or unstable Internet connectivity in many remote areas in Viet Nam, as well as the still unchanging paradigm in Viet Nam that biology lessons are mainly written and delivered conventionally, through face-to-face teaching-learning activities.

4. Conclusion and further implications

Applying ICT in Biology Education is a work-in-progress. Though the course has got some positive impacts to students's ability of using ICT in biology teaching,it continues to evolve. We learn that e-learning, and even mobile and ubiquitous learning are becoming more and more pronounced in ICT-enhanced or ICT-related courses for pre-service and in-service teacher education programs. And in this aspect, the course obviously needs to be further improved.

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