LEADING ICT IN EDUCATION PRACTICES

A CAPACITY-BUILDING TOOLKIT FOR TEACHER EDUCATION INSTITUTIONS IN THE ASIA-PACIFIC

CHER PING LIM • CHING SING CHAI • DANIEL CHURCHILL


designed & produced
kooboo creatives

Foreword

Yong ZHAO
University Distinguished Professor
College of Education
Michigan State University

It has always been a common complaint around the world that teachers are not adequately prepared to take advantage of technology, in both developed and developing nations. Despite the many cases that have clearly demonstrated the great potential of information and communication technology (ICT) in transforming teaching and learning and significant improvement in access to ICT, majority of today's teachers around the world do not use ICT well, or frequently enough to realize its educational potential. Worse yet, many teachers even discourage their students from using ICT for their learning because these teachers are not prepared to recognize and accept ICT as a powerful education tool, or that their students will enter a society already penetrated by ICT.

It used to be the belief, at least in the developed nations, that the new generation of teachers would be ready to use technology since they grew up in the age of the Internet, and had used ICT frequently in their lives. However, this belief has been proven to be a mistake. While the new generation may be using ICT all the time, they do not necessarily use or know how to use it for education. Using ICT for personal purposes is drastically different than for education.

Teacher education institutions (TEIs) are tasked with the responsibility of preparing high quality teachers. Today's high-quality teachers must be able to use ICT competently and creatively in educational settings. It is thus the responsibility of TEIs to provide ample opportunities and engaging environments to help new and returning teachers develop such capabilities.

But TEIs face challenges as well. A large majority of teacher educators have not been prepared to teach with ICT either. Moreover, many TEIs lack the vision, plan, infrastructure, and resources to offer high-quality learning opportunities to future teachers, which are required to develop ICT skills for education.

This toolkit aims to help TEIs meet these challenges. Presented in here are comprehensive, research-based, and action-oriented actions that TEIs can adopt to build, improve, and sustain a sound education environment to help teachers become proficient in using ICT for education. This toolkit can be used in a variety of ways and contexts because it reflects both the commonality and variety of the nature of institutions and ICT situations in different countries.

What is presented here is just the tip of the iceberg, not the entire solution. To truly address the issue of teacher capacity for using ICT, we need visionary leadership and urgent actions from the leaders and faculty of TEIs. This toolkit, just like ICT, is only useful when diligently used. I hope TEIs will find it useful and be able to bring the use of ICT in education to greater heights.

A Microsoft Partners-in-Learning (Asia-Pacific) Initiative
Developed by Prof Cher Ping LIM (Edith Cowan University, Australia), Asst Prof Ching Sing CHAI (National Institute of Education, Singapore), and Asst Prof Daniel CHURCHILL (University of Hong Kong, Hong Kong SAR) and advised by Prof Yong ZHAO (Michigan State University, United States of America); in consultation with education deans and policymakers from Asia-Pacific countries.

For more information, please contact:
Cher Ping LIM
Professor of Education
Director, International Partnerships
School of Education
Edith Cowan University
2 Bradford Street, Mt. Lawley
Perth 6050, Western Australia
Tel: +61 (08) 9370-6203
Email: c.lim@ecu.edu.au
Website: http://edithcowan.academia.edu/CherPingLim

Project managed & edited by **Genii Group**
Designed by **Koodoo Creatives**
Printed in Singapore by **Fabulous Printers**

Microsoft®
Partners in Learning

Contents

Contents

Introduction

BUILDING THE CAPACITY OF TEACHER EDUCATION INSTITUTIONS/AGENCIES TO SUPPORT THE USE OF ICT FOR TEACHING, LEARNING AND ADMINISTRATION IN SCHOOLS: A TOOLKIT FOR THE ASIA-PACIFIC REGION

Why ICT in Education Competencies For Pre-Service Teachers?

The rapid advancement of information and communication technology (ICT) and its pervasive use in work and daily life have dramatically changed the way we live and the way businesses are conducted. To remain competitive in this ICT-enabled world, it is becoming inconceivable for any individual or society to be ill-equipped with ICT skills. Furthermore, ICT has also changed the way knowledge is constructed, distributed, challenged and improved upon, and greatly enhanced the efficiency for these knowledge-based activities. It has become the tool of knowledge workers, which include all kind of researchers and learners. Privileged information that was once hard to access is now becoming easily available on the Internet. The speed and the ease of computation with statistical software such as SPSS or spreadsheet like Excel have made the manipulation of data accessible to school students. Many guarded terrain that was once controlled by experts are now opened to the general public. Technologies such as Windows Live Spaces have changed the notion of authorship and the relations between readers and writers in a fundamental way. Literacy has been redefined to accommodate digital literacies (Mills, 2008; Myers, 2006). These and many other affordances of ICT could be employed to promote independent, flexible, collaborative, iterative, active and meaningful learning among learners (Jonassen, Howland, Marra, & Crismond, 2008).

> Teachers in the ICT-mediated learning environments have to take on the more demanding role of a mediator and a knowledge broker...

Consequently, these ICT-driven developments challenge many assumptions of what students should learn in schools and how education should be delivered. It has been suggested by many educators that many features of modern education, which were based primarily on the notion of knowledge transmission from the have to the have-not, have to be re-examined (for example, see Angeli & Valanides, 2009; Bereiter & Scardamalia, 2006; Fullan, Hill, & Crévola, 2006; Jacobsen & Lock, 2004; Jonassen, et al., 2008; Punie, 2007; Sawyer, 2006). These researchers strongly advocate that in the current information-age, learners have to be able to solve complex problems; think creatively and critically; communicate and collaborate with others from diverse backgrounds; with the aid of various ICT tools. Inevitably, the duty of cultivating such learners falls on the teachers, who have to first possess these skills and dispositions.

Role of teachers

While research studies have shown that ICT facilitates the development of higher order cognitive skills of evaluating arguments, analyzing problems and applying what is learnt, the teacher is not to be excluded from the ICT-based activities. Martin (2000) highlights the importance of the role of teachers in integrating ICT effectively by emphasizing that:

> Without the input and acceptance of teachers, the developments of useful educational technology projects are hindered. Not only are teachers the gatekeepers of the classroom, they are the greatest source of information about curriculum design and educational content. (p. 8)

Teachers in the ICT-mediated learning environments have to take on the more demanding role of a mediator and a knowledge broker: to provide guidance, strategic support, and assistance to help students at all levels to assume increasing responsibilities for their own learning. Inevitably, these questions have serious implication on how school teachers should be educated (Jonassen, et al., 2008; Kirschner & Selinger, 2003; Lock, 2007; UNESCO, 2008). The challenge then for teacher education institutions (TEIs), ministries of education and schools is to prepare teachers who are open to new ideas, new practices and ICT, to learn how to learn, unlearn and relearn, and to understand and accept the need for change. However, changing teachers' beliefs about teaching and learning and their use of ICT in the classroom is always a challenge. Many teachers have been taught and have been teaching in traditional learning environments, and hence, are likely to hold on to traditional beliefs of teaching and learning. They tend to perceive teaching as disseminating information and learning as a passive activity, with students doing minimal task management, or holding little responsibility for their own learning. This is contrasted with constructivist pedagogical beliefs where learning is perceived as an active construction and reconstruction of knowledge, and teaching as a process of guiding and facilitating students in the process of knowledge construction; the latter beliefs being more relevant in our knowledge societies and economies, where students are expected to be active seekers and constructors of knowledge, and their learning involves the discovery and transformation of complex information.

Pedagogical beliefs and constructivist learning

Therefore, to prepare teachers to integrate ICT into the school curriculum, there is a need for professional development programmes to create a meaningful context that allows teachers to critically examine their own pedagogical beliefs and explore the application of ICT in a more constructivist learning environment; teachers are then more likely to adopt more constructivist approaches in ICT-mediated teaching and learning. It should be noted that traditional and constructivist approaches are not to be treated as a dichotomy; the stance of this book is to promote more constructivist approaches that encompass not only meaning making of concepts and theories but also self-regulated learning and personal agency.

While teacher educators generally agree that integrating ICT into teaching and learning is important, actual use of ICT in classroom are either low or they are confined to use of ICT for productivity purposes (Becta, 2007; Valcke, Rots, Verbeke, & van Braak, 2007). There are still multiple gaps in curriculum design and delivery for the development of pre-service teachers' competencies in ICT integration (Becta,

2007; Haydn & Barton, 2007; Lawless & Pellegrino, 2007). Many teacher education colleges offer single technology course as a form of teacher preparation (Hsu & Sharma, 2006), which are usually deemed as insufficient for teachers to be adequately prepared for the complexities involved in integrating ICT (Lawless & Pellegrino, 2007). Furthermore, research indicates that instructional use of computer among faculty members in colleges of education can be below expectation (Drent & Meelissen, 2008; Sahin & Thompson, 2006; Zhou & Xu, 2007). Many issues pertaining to digital equity, cyber wellness and social justice are also emerging from the pervasive use of ICT and they need to be adequately addressed in teacher education (Futurelab, 2008; Kirschner & Selinger, 2003; Selwyn, 2008).

The conceptualization, design, development, delivery and evaluation of teacher preparation courses for ICT integration is therefore a key area for teacher educators and researchers that warrants sustained and committed research and development (Angeli & Valanides, 2009). Kirschner and Selinger (2003) further argue that a framework of action should extend beyond teachers, teacher educators and researchers to include students, industrial partners, government and society in general (see also Hsu & Sharma, 2006). Current research and reports on pre-service teacher's preparation for the use of ICT in education has several problems such as unclear documentation of contexts and courses, poor data collection, small sample size etc (Kay, 2006). In order for teacher education to move forward and beyond the current status of affairs, many more rigorous research/design and development activities are needed (Fisher, Higgens, Loveless, 2006; Haydn & Barton, 2007; Lawless & Pellegrino, 2007; Kay, 2007).

What are the ICT in Education Competencies for Pre-Service Teachers?

In most developed countries and some developing countries, the use of ICT is pervasive and it encompasses a range of activities that teachers have to perform. These ICT-facilitated activities of teachers include administration such as updating students' profile and preparing students' progress report; communication with multiple parties including parents and colleagues; resource design/development, lesson planning, out-of-school/classroom activities, students' independent learning, assessment of students' learning, and teachers' professional development. It is obvious that these activities require a range of competencies to fulfil. In this book, we focus mostly on developing teachers' competencies in the pedagogical use of technology. Other competencies, such as ICT-based administration and communication may be better addressed during the in-service induction period.

Pedagogical Competencies:

- instructional planning processes
- pedagogical knowledge
- content knowledge
- pedagogical content
- knowledge
- classroom management
- knowledge of students

Defining the pedagogical competencies that a pre-service teacher needs to possess is not a simple task as the competencies involved are complex in nature. Fortunately, many organizations have published documents that can provide good references. For example, the National Educational Technology Standards (2008) (NETS) published by Information Society for Technology in Education (ISTE) and the ICT Competency Standards for Teachers published by UNESCO (2008). These documents clearly recognize the complex skill sets that teachers have to develop for the meaningful integration of ICT into classroom teaching

Teachers Dispositions
- reflection
- willingness to innovate
- values and beliefs
- interpersonal relationships

and learning. For example, the UNESCO document portrays that teachers need to develop ICT literacy skills in stages of mastering basic tools, complex tools and then pervasive tools. The meaningful use of these tools is dependent on teachers' pedagogical competencies and dispositions.

Using a presentation tool (PowerPoint) as an example, **Table 1** illustrates the possible development trajectories of a teacher in using it.

Table 1: A Matrix of the interaction between teachers' ICT literacy, pedagogical competencies and dispositions

Levels of competencies	Basic	Intermediate	Advanced
• Model of use	• Preparation and use of PowerPoint for presentation in teaching (multimedia, text, slide transition)	• Preparation and implementation of student-centred learning package using PowerPoint as tool	• Facilitation of students' construction of multimedia presentation
• Technical	• Basic features of PowerPoint	• Advanced features of PowerPoint	• Just-in-time teaching of PowerPoint competencies and basic troubleshooting
• Pedagogical	• Explain and pose questions	• Plan and implement meaningful activities to engage students	• Empower and facilitate/ manage students' knowledge construction
• Dispositions	• Willingness to learn and use ICT	• Willingness to change pedagogical practices & beliefs	• Willingness to experiment & innovate

The above three developmental positions are roughly in agreement with UNESCO recommendation of using ICT first for technology literacy, then for knowledge deepening and finally for knowledge creation. In facilitating teachers' development for the increasing sophistication of ICT use in education, it seems clear that it would be impossible to expect the highest stage of development for most pre-service teachers in most countries. It is also clear that a single course approach is insufficient to facilitate such complex development. Depending on the current status of ICT and pedagogic readiness of a country, TEIs may need to craft different teacher education programs. Emerging countries such as Laos, Cambodia and Sri Lanka may need to aim to achieve the Basic Level of Competency. Countries like Singapore, which has embarked on ICT-based educational reforms for more than a decade may need to craft their programs to push their teachers towards advanced pedagogical use of ICT. In the next section, we suggest strategic planning processes that TEIs could embark on to facilitate the development of these ICT in education competencies among pre-service teachers.

Introduction

How can these ICT in Education Competencies be Developed among Pre-Service Teachers?

In order for TEIs to move forward in equipping pre-service teachers, Jacobsen and Lock (2004) articulated the following series of actions:

a. implement a vision and values driven technology integration plan
b. encourage education faculty members to infuse and model effective technology use across the curriculum
c. provide authentic learning opportunities for student teachers to integrate technology in campus and field experiences
d. foster greater campus and K-12 school partnerships that cultivate and nurture technology integration
e. provide ubiquitous access to a more than adequate technology infrastructure, and
f. disseminate research on effective use of technology for learning. (p. 82)

Based on their recommendations and the aforementioned literature, this toolkit proposed a framework of strategic planning processes that encompasses six strategic dimensions that TEIs need to focus on:

1. Vision and Philosophy
2. Program: Curriculum, Assessment, and Practicum
3. Professional Learning of Deans, Teacher Educators and Support Staff
4. ICT Plan, Infrastructure, Resources and Support
5. Communications and Partnerships
6. Research and Evaluation

Getting started

We argue that by attending to these strategic dimensions, TEIs should be able to generate coherent internal and external processes that would enhanced their capacity in building pre-service teachers' competencies for innovative use of technology. To facilitate the strategic planning processes, this toolkit has attempted to provide a succinct write up on each of the dimension based on the relevant literature and other relevant sources of materials. We have also derived further strategic foci for each strategic dimension. For example, in Strategic Dimension 2: Curriculum, Assessment, and Practicum, curriculum designs of the various ICT courses employ by TEIs all over the world has been summarized. This toolkit has identified 11 strategic foci for the three components of Strategic Dimension 2. The strategic foci in each dimension have been written with some depth. By employing the toolkit as an initial source of reference, leaders of TEIs should be able to at least kick start their strategic planning processes and begin their discussion of formulating strategic plans for their respective TEIs. In other words, leaders of TEIs could initiate their strategic planning process by distributing this toolkit and get their selected members of the strategic planning committee to browse through this document. A beginning point of discussion could be if the strategic dimensions and foci make sense, and what more is needed or what should be left out.

Figure 1 depicts a flowchart of our proposed strategic planning processes. It proposes that the strategic planning process to begin with the visioning exercise. Logically, this will set out the general direction and the mission/goal statements that will provide guidance for the organization. The vision and mission statements form the foundation of further strategic planning (Morphew & Hartle, 2006). This is followed by concurrent strategic planning by the various sub-groups which will develop the specific objectives and the strategies to achieve the goals of the respective strategic dimensions, leading to the realization of the vision and the achievements of the missions.

At this point, the chapters written for the various dimensions can act as anchors for discussion and further developments. To help the TEIs in assessing their current status and in positioning their action plans, each strategic focus is further broken down to four levels. The levels include Undeveloped, Fundamental, Proficient and Innovative. Members of the sub-groups can perform internal evaluation using the rubrics provided in Appendix I. For instance, the discussants in the curriculum sub-groups may evaluate that the current status of the ICT curriculum to be undeveloped using the rubrics. They could identify certain curriculum practice reported in the curriculum chapter conducive for their TEI and locate the relevant literature to understand the curriculum further. They may then adapt the curriculum and put up their plans for considerations by the strategic planning committee.

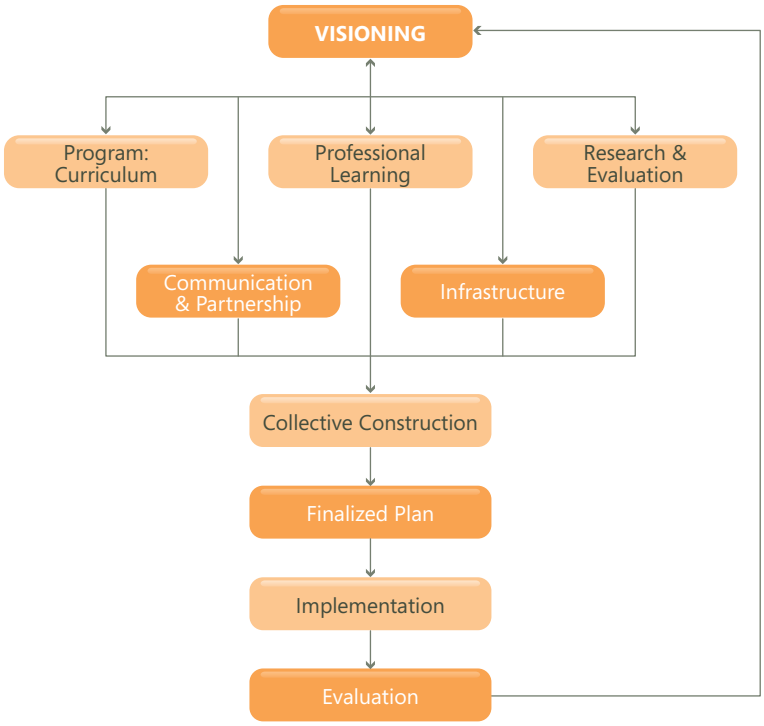


Figure 1: Collective Strategic Planning Processes for TEIs.

Introduction

After the initial plans are drawn up, numerous discussions and coordination between the various sub-groups will have to follow, to align the plans such that they are coherent and mutually supportive. We label this process as **collective strategic planning processes**. It is essential that all stake holders are cognizant of what other sub-groups are working on so as to avoid misalignment of development, which could lead to much frustration. These processes are iterative in nature and it may lead to further modification of the vision and mission statements. The plans are then finalized, implemented and evaluated to form the basis of the next cycle of strategic planning.

The above paragraphs delineate the broad procedures for TEIs to move forward in arriving at action plans to equip pre-service teachers to teach with ICT. While we propose to begin the process with the visioning exercise, we can also imagine a scenario whereby the leaders of TEI feel that they would like to embark on professional learning first to experience themselves how technology can enhance learning. This could lead to a better and perhaps a more adventurous vision. The Classroom for the Future, set up by Microsoft within the vicinity of the National Institute of Education (Singapore), could be one place for the deans to visit. Other similar setup can be found worldwide.

Strategic planning in context

In summary, strategic planning is a dynamic process that has to be contextualized rather than be prescribed. It should also be an ongoing process with appropriate feedback loops to engender continuous improvement of the TEIs to answer to the rapid advancements of the current age.

References

Angeli, C., & Valanides, N. (2009). Epistemological and methodological issues for the conceptualization, development, and assessment of ICT-TPCK: Advances in technological pedagogical content knowledge. *Computers and Education, 52*, 154-168.

Becta. (2007). *Harnessing technology: Progress and impact of technology.* Retrieved 23rd June 2008 from http://publications.becta.org.uk/display.cfm?resID=33979&page=1835.

Bereiter, C., & Scardamalia, M. (2006) Education for the Knowledge Age. In P. A. Alexander, and P. H. Winne (Eds.), *Handbook of Educational Psychology* (2nd ed.). (pp. 695-713). Mahwah, NJ : Lawrence Erlbaum.

Drent, M., & Meelissen, M. (2008). Which factors obstruct or stimulate teacher educators to use ICT innovatively? *Computers & Education, 51*, 187-199.

Fisher, T., Higgens, C., & Loveless, A. (2006). *Teachers Learning with Digital Technologies: A Review of Research and Projects, Futurelab Report Series No. 14.* Bristol, UK: Futurelab. Retrieved 30th June 08 from http://hal.archives-ouvertes.fr/docs/00/19/03/39/PDF/fischer-2006-teachers.pdf.

Fullan, M., Hill, P., & Crévola, C. (2006). *Breakthrough*. Thousand Oaks, CA: Corwin Press

Futurelab. (2008). *Designing educational technologies for social justice: A Futurelab handbook.* Bristol, UK: Futurelab. Retrieved 30th June 08 from http://www.futurelab.org.uk/resources/documents/handbooks/designing_for_social_justice2.pdf

Haydn, T. A., & Barton, R. (2007). Common needs and different agendas: How trainee make progress in their ability to use ICT in subject teaching. Some lessons from the UK. *Computers & Education, 49*, 1018–1036.

Hsu, P.-S., & Sharma, P. (2006). A Systemic Plan of Technology Integration. *Educational Technology & Society, 9* (4), 173-184.

Jacobsen, D. M., & Lock, J. (2004). Technology and teacher education for a knowledge Era: Mentoring for student futures, not the past. *Journal of Technology and Teacher Education, 12*(1), 75-100.

Jonassen, D., Howland, J., Marra, R., & Crismond, D. (2008). *Meaningful learning with technology* (3rd ed.). Upper Saddle River, NJ: Pearson.

Kay, R. (2006). Evaluating strategies used to incorporate technology into preservice education: A review of the literature. *Journal of Research on Technology in Education, 38*(4), 383-408.

Kay, R. (2007). The impact of preservice teachers' emotions on computer use: A formative analysis. *Journal of Educational Computing Research, 36*(4), 455-479.

Kirschner, P., & Selinger, M. (2003). The state of affairs of teacher education with respect to information and communication technology. *Technology, Pedagogy and Education, 12*(1), 5-17.

Lawless, K. A., & Pellegrino, J. W. (2007). Professional development in integrating technology into teaching and learning: Knowns, unknowns, and ways to pursue better questions and answers. *Review of Educational Research, 77*(4), 575-614.

Lock, J. (2007). Inquiry, immigration and integration: ICT in preservice teacher education. *Issues in Technology and Teacher Education, 7*(1), 575-589.

Martin, W.B. (2000). *Learning from the Colwell School: An ethnographic case study of an educational technology culture.* Unpublished doctoral dissertation, Cornell University.

Mills, K. A. (2008). Transformed practice in a pedagogy of multiliteracies. *Pedagogies: An International Journal, 3*(2), 109-128.

Morphew, C. C. & Hartley, M. (2006). Mission statements: A thematic analysis of rhetoric across institutional type. *The Journal of Higher Education, 77*(3), pp. 456-471.

Myers, J. (2006). Literacy practices and digital literacies: A commentary on Swenson, Rozema, Young, McGrail, and Whitin. *Contemporary Issues in Technology and Teacher Education, 6*(1), 61-66.

International Society for Technology in Education (ISTE), (2008). The ISTE national educational technology standards (NETS•T) and performance indicators for teachers. Retrieved 10th May from http://www.iste.org/Content/NavigationMenu/NETS/ForTeachers/2008Standards/NETS_T_Standards_Final.pdf.

References

Punie, Y. (2007). Learning Spaces: an ICT-enabled model of future learning in the knowledge-based society. *European Journal of Education, 42*(2), 186-199.

Sahin, I., & Thompson, A. (2006). Using Rogers' theory to interpret instructional computer use by COE faculty. *Journal of Research on Technology in Education,39*(1), 81-104.

Sawyer, R. K. (2006). Introduction: The new science of learning. In R. K. Sawyer (Ed.). *The Cambridge handbook of the learning sciences* (pp. 1-18). New York, NY: Cambridge University Press.

Selwyn, N. (2008). From state-of-the-art to state-of-the-actual? Introduction to a special issue. *Technology, Pedagogy and Education, 17*(2), 83-87.

UNESCO. (2008). *UNESCO's ICT Competency Standards for Teachers*. Retrieved 1st Jul 08 from http://cst.unesco-ci.org/sites/projects/cst/default.aspx.

Valcke, M., Rots, I., Verbeke, M., & van Braak, J. (2007). ICT teacher training: Evaluation of the curriculum and training approach in Flanders. *Teaching and Teacher Education, 23*, 795-808.

Zhou, G., & Xu, J. (2007). Adoption of educational technology ten years after setting strategic goals: A Canadian university case. *Australian Journal of Educational Technology, 23*(4), 508-528.

Vision and Philosophy

The first strategic dimension is vision and philosophy. The creation of a shared vision and its underlying philosophy provide institution leaders and teacher educators a vehicle for coherent communication about how ICT may be effectively used for teaching, learning and administration in the teacher education institution (TEI). Within this dimension, the strategic foci are:

- Institutional Vision for ICT in Education
- Underlying Philosophy for Teaching and Learning with ICT
- Needs of Schools and Society
- Formulation and Ownership of ICT in Education Vision
- Review of ICT in Education Vision

Institutional Vision for ICT in Education

Churchill and Lim (2007) point out that one barrier to ICT integration in education institutions is the lack of comprehensive vision by their leaders. The establishment of institutional vision is the primary means through which the organization defines its identity, articulates its aspirations, and fosters the commitment among its staff (Abelman & Dalessandro, 2008). The concept of institutional vision is further elaborated by Abelman and Molina (2006, p. 5):

> Institutional vision is a philosophical template; it is a conception of a college or university at its very best and the kinds of educated human beings cultivated there. It reflects the nature of the learning community within the college or university and defines the perceived purpose, priorities, and promises of the institution. Institutional vision is grounded in the physical, historical, fiscal, political, and cultural contexts in which that institution exists. However, vision transcends these characteristics — many of which may be shared by other institutions — to give that institution a distinctive function, coherence, direction, and meaning.

Articulating a coherent vision for the TEI in terms of its ICT environments and its ICT-pedagogical foundation is a necessary and meaningful exercise. This involves institution leaders and teacher educators negotiating, constructing and articulating a "vision of how and why changes are being planned and implemented, as well as ensure that changes are being driven by learning and teaching issues" (Gallant, 2000, p.73) rather than by technological advancements alone. The articulation of the institutional vision for ICT in education in turn has to be underpinned by education faculties' philosophy, explicating faculties' beliefs and the co-construction of new philosophy is necessary.

Strategic Dimension **One**

Underlying Philosophy for Teaching and Learning with ICT

An inevitable part of envisioning involves introspection among teacher educators and leaders in the TEI to re-examine their roles in a changing time. Most educational technologists strongly advocate the use of ICT to facilitate the processes of knowledge construction (Selwyn, 2008). Underpinning such inclination is a strong commitment towards the philosophy of constructivism and social constructivism. Both constructivism and social constructivism are premised on the relativistic epistemological outlook. Knowledge, from the constructivist point of view, are tentative ideas about the world and knowing is a process of constructing better understanding about some phenomena (Bereiter, 2002). Teaching and learning founded on such philosophy is radically different from the practices that are founded on objectivism. Teacher educators' epistemological positions and their conceptions of teaching and learning may not necessarily be compatible with the constructivist's position (Deng, 2004; Samuelowicz & Bain, 2001; Wong, Khine, & Chai, 2008; Zhou & Xu, 2007). The transformation of teaching practices towards the constructivist oriented practices often involves deep changes that cut across multiple dimensions (Windschitl, 2002).

Therefore, an understanding of the current beliefs and perspectives that teacher educators and leaders hold may serve as a good starting point for discussion about the underlying philosophy of the institutional vision. Based on their qualitative case study, Finley and Hartman (2004) have created a questionnaire that may be used to collect baseline data about the teacher educators' perspectives towards teaching and learning. The constructivist's notion of knowledge and knowing may then be clarified, examined and argued vis-à-vis its competing philosophies and a negotiated stance and understanding may be reached among the teacher educators and leaders. This is essential if the teacher educators are to move in tandem with the TEI vision for ICT in education. In this sense, the envisioning exercise may also be a starting point of professional learning for its teacher educators and leaders.

Together with other government and non-government agencies, TEIs are responsible for equipping pre-service teachers with a set of competencies for the actualization of the envisioned classrooms.

Needs of Schools and Society

Envisioning is a complex undertaking that requires the examination of various aspects of ICT and other related information. For example, in preparing a new vision for European countries, Punie (2007) considers not only the needs of economic development and the trend in ICT advancements but also the social trends and challenges. A more comprehensive understanding of current and future trends leads to a more robust and relevant institutional vision for ICT in education. Envisioning, in the context of pre-service teacher education, is a process of articulating the profile of future school teachers in terms of how they teach, learn, administer and innovate with ICT.

Together with other government and non-government agencies, TEIs are responsible for equipping pre-service teachers with a set of competencies for the actualization of the envisioned classrooms. As such, the envisioning endeavour of any TEI has to consult relevant policies of the country or the local government. In many countries, numerous policies have been laid out for schools to reference or being held accountable to. These policies usually outline the vision of teaching and learning in the classrooms of the country. For

example, the recent articulation of e-Strategy Framework by the government of South Australia allows schools to perform self-assessment in terms of their effort to promote teaching and learning with ICT for better learning outcomes (DECS, 2008). The framework consists of five categories: Vision and Leadership; Teaching and Learning; Professional Learning; Administration; and Resources. The document represents South Australian policymakers' vision of what an ideal school with comprehensive ICT strategies is about.

Other examples are National Educational Technology Standards of the United States[1] and the Framework for ICT in secondary education articulated by the department for children, schools and families of the United Kingdom[2]. These documents provide detailed descriptions in terms of the ICT and learning skills that students of various age groups should master. Studying such documents help the TEIs to better meet the needs of schools and society. However, as leaders in education, TEIs have to adopt a critical stance towards the policies and add value to the policies. For example, Deng's (2004) criticism against the paradigm of teacher training vis-à-vis teacher education is a valuable contribution towards the educational reforms in Singapore.

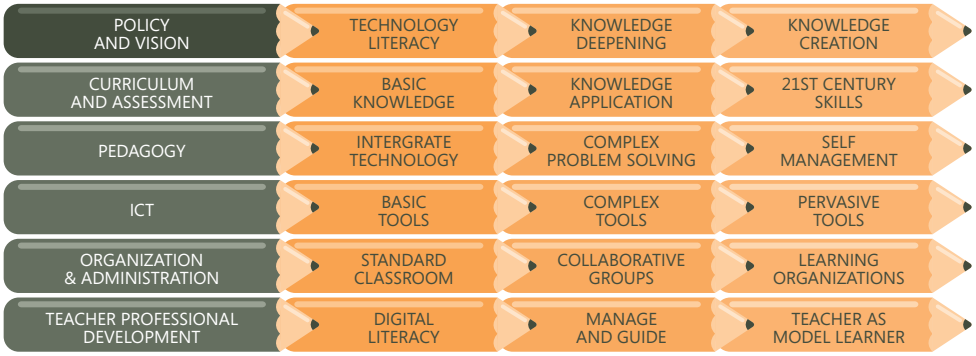


Figure 2: UNESCO ICT-CST Framework. (UNESCO, 2008, p. 11)[3]

Drawing upon the UNESCO framework

In addition to local government policies, the documents by international organisations and leading nations for the use of ICT in education are worth consulting. For example, working under the leadership of UNESCO, Microsoft, Cisco, Intel, the International Society for Technology in Education (ISTE) and the Virginia Polytechnic Institute and State University has recently crafted the UNESCO ICT Competency Standards for Teachers (ICT-CST) (UNESCO, 2008). Such documents are valuable reference especially for countries that have not formulated their own standards of ICT for teachers. The ICT-CST specifies a continuum of three approaches to education reform, namely the technology literacy, knowledge deepening and the knowledge creation approach. These approaches are mapped across six dimensions of the educational system: the policy and vision; curriculum and assessment, pedagogy; ICT tools; organization and administration and teacher professional learning. The first approach focuses on developing teachers' technological skills, while the second approach emphasizes on applying knowledge to solve complex problems with the aid of complex ICT tools. The third approach focuses on the knowledge creation. These approaches may co-exist in a TEI and serve complimentary roles for each other. **Figure 2** is extracted from the UNESCO document. The ICT-CST maps out the major components that envisioning has to consider and the possible development trajectories that a TEI may follow.

1 Reference Link: http://www.iste.org/AM/Template.cfm?Section=NETS

2 Reference Link: http://www.standards.dcsf.gov.uk/secondary/framework/ict/

3 Reference Link: UNESCO, 2008, p.11, http://cst.unesco-ci.org/sites/projects/cst/The%20Standards/ICT-CST-Policy%20Framework.pdf

Strategic Dimension **One**

Formulation and Ownership of ICT in Education Vision

The discussion of the previous three strategic foci have implied that the process of envisioning requires the ownership of the ICT in education vision by all members of the TEI rather than a top down vision imposed by the senior management of the TEI. Finely and Hartman (2004) have reported that university faculties are concerned "with the 'bells and whistles' approach to technology integration" (p. 325). By nature of their profession, university faculties, including teacher educators, are inclined to adopt a critical stance towards innovation (Brantley-Dias, Calandra, Harmon & Schoffner, 2006). The formulation of shared vision and the development of strategic plans are therefore essential in that they direct the efforts of all staff within the TEI towards that shared vision (Hew & Brush, 2007; Lim & Khine, 2006).

Review of ICT in Education Vision

The vision of a TEI may be based on fundamental values that can last the test of time. However, given the dynamic nature of ICT advancement, the same does not seem to hold true for ICT in education visions. As recent as the early 90s, before the appearance of the Internet, computers could stay as peripherals for teachers. Given the current trends of ubiquitous computing devices and the emergence of Web 2.0 technologies, ICT in education visions have to be constantly revisited to stay relevant. Ministries of education in many countries have been constantly revising and fine-tuning their ICT in education visions and strategic plans. British Educational Communications and Technology Agency, for example, has been actively studying the use of ICT in the UK to provide useful information and suggestion of how UK schools should move forward. Similarly, the evolution of the IT Masterplans in Singapore has also reflected a proactive stance of the government towards ICT. As such, the ICT in education vision developed by TEIs may need to be reviewed as the needs of schools and society change with the advancement of ICT. Zhou and Xu (2007) document the case of the University of Alberta in assessing its strategic goals after ten years of implementation. This case may provide some important information on how to collect data for the review process. Given the rate of change of ICT, ten years seems to be too long a timeframe for timely response to external needs. While five years seems to be a reasonable timeframe, responsive and exemplary review should perhaps be a proactive and ongoing process that is based on needs rather than schedule.

...ICT in education vision developed by TEIs may need to be reviewed as the needs of schools and society change with the advancement of ICT.

The outcomes of the envisioning exercise are usually in the form of a framework similar to the e-Strategy Framework or the ICT-CST documents. It should provide a clear blueprint for subsequent works on strategic planning, curriculum design and development, infrastructure and intra-institute policy setting. Shulman and Shulman's (2004) recent model of teacher learning may serve as a good reference in terms of facilitating the ideal pre-service teachers for ICT use in classrooms. Based on their research on preparing teachers to teach in the community of learners approach, they suggest five elements for their new model. They are

- Ready (possessing vision)
- Willing (having motivation)
- Able (both knowing and being able 'to do')
- Reflective (learning from experience)
- Communal (acting as a member of a professional community)" (p. 259)

Articulating these elements for pre-service teachers is a good start for the design of curriculum and assessment, which will be the focus of the next strategic dimension.

References

Abelman, R. & Dalessandro, A. (2008). The institutional vision of community colleges. *Community College Review, 35*(4), 306-335.

Abelman, R., & Molina, A. (2006). Institutional vision and academic advising. *NACADA Journal, 26*(2), 5-12.

Bereiter, C. (2002). *Education and mind in the knowledge age*. Mahwah, NJ: Lawrence Erlbaum.

Brantley-Dias, L., Calandra, B., Harmon, S. W., & Schoffner, M.B. (2006). An analysis of collaboration between Colleges of Education and Arts & Sciences in PT3. *TechTrends: Linking Research and Practice to Improve Learning, 50*(3), 32-37.

Churchill, D., & Lim, C. P. (2007). Reflection on educational technology: Moving forward and beyond. *Educational Media International, 44*(3), 181-183.

Deng, Z. (2004). Beyond teacher training: Singaporean teacher preparation in the era of new educational initiatives. *Teaching Education, 15*(2), 159-173.

Department of Education and Children's Service (DECS), Government of South Australia. (2008). *e-Strategy Framework*. Retrieved 30th Jun 08 from http://www.decs.sa.gov.au/learningtechnologies/files/links/link_89167.pdf.

Finley, L., & Hartman, D. (2004). Institutional change and resistance: Teacher preparatory faculty and technology integration. *Journal of Technology and Teacher Education 12*(3), 319-337.

Hew, K. F., & Brush, T. (2007). Integrating technology into K-12 teaching and learning: current knowledge gaps and recommendations for future research. *Educational Technology, Research and Development, 55*,223-252.

Lim, C. P., & Khine, M. S. (2006). Managing teachers' barriers to ICT integration in Singapore schools. *Journal of Technology and Teacher Education, 14*(1), 97-125.

Punie, Y. (2007). Learning Spaces: an ICT-enabled model of future learning in the knowledge-based society. *European Journal of Education, 42*(2), 186-199.

Samuelowicz, K. & Bain, J. D. (2001). Revisiting academics' beliefs about teaching and learning. *Higher Education, 41*, 299-325.

Sewlyn, N. (2008). From state-of-the-art to state-of-the-actual? Introduction to a special issue. *Technology, Pedagogy and Education, 17*(2), 83-87.

Shulman, L. S., & Shulman, J. H. (2004). How and what teachers learn: a shifting perspective. *Journal of Curriculum Studies, 36*(2), 257 – 271.

UNESCO. (2008). *UNESCO's ICT Competency Standards for Teachers*. Retrieved 1st Jul 08 from http://cst.unesco-ci.org/sites/projects/cst/default.aspx.

Windschitl, M. (2002). Framing constructivism in practice as the negotiation of dilemmas: An analysis of the conceptual, pedagogical, cultural, and political challenges facing teachers. *Review of Educational Research, 72*(2), 131-175.

Wong, B., Khine, M. S., Chai, C. S. (2008). Challenges and future directions for personal epistemology research in diverse cultures. In M.S. Khine (Ed.), *Knowing, knowledge and beliefs: Epistemological studies across diverse cultures*. (pp. 445-456). Netherlands: Springer.

Zhou, G., & Xu, J. (2007). Adoption of educational technology ten years after setting strategic goals: A Canadian university case. *Australian Journal of Educational Technology, 23*(4), 508-528.

Strategic Dimension **One**

comments

comments

Strategic Dimension **Two**

Program: Curriculum, Assessment, and Practicum

An effective and robust pre-service teacher education program will prepare teachers with the necessary ICT and pedagogical competencies to integrate ICT for teaching, learning and administration in schools (Mims, Polly, Shepherd, & Inan, 2006). The pre-service teacher education program is the second strategic dimension of this toolkit and it includes 11 strategic foci under three components of the program: curriculum, assessment and practicum.

Curriculum
- Instructional analysis (tasks, learners, context)
- Linkages of courses/units
- Pedagogical approaches
- Modelling
- Meaningful use of ICT

Assessment
- Linkages to curriculum
- Mode of assessment - Balance between process and product (validity, reliability, comprehensiveness, administration)
- Authenticity of assessment tasks

Practicum
- Linkages to curriculum and assessment
- Support in schools (mentor teachers, coordinating teachers, access to ICT & resources, student readiness, supervisors, principals)
- Expectation of ICT use in teaching and learning in schools

Curriculum

Instructional analysis (tasks, learners, context)

To design an effective curriculum for pre-service teachers, adequate instructional analysis is an important step. Education researchers have identified a range of variables that promote or inhibit pre-service teachers' use of ICT during their practicum or field experience. These variables may be broadly classified as contextual or learner-related. Contextual variables that influence pre-service teachers use of ICT include access to technology, time and workload, support from mentoring teachers etc (Dexter & Riedel, 2003; Hadyn & Barton, 2007; Brinkerhoff, 2006). Learner-related variables include attitude towards computer, experience in using computers, epistemological and pedagogical beliefs, self-efficacy and level of computer skills (Angeli & Valanides, 2005; Teo, Lee & Chai, 2008; Drent & Meelissen, 2008; Ertmer, 2005; Jimoyiannis & Komis, 2007; Paraskeva et al., 2008; Swain, 2006). These studies inform teacher educators about the learner characteristics and contextual conditions that need to be considered in the design of the pre-service teacher curriculum.

Understanding how these variables relate to the target population of pre-service teachers constitutes part of the instructional analysis. While it is clear that it will not be possible to investigate all the above variables, some information about the context and learners' characteristics are essential. Ministries of education may have spelled out the basic ICT competencies that teachers should have and such contextual information is obviously important for the design of the course.

The level of ICT competencies that pre-service teachers possess is one of the learners' characteristics that teacher educators have to take into account in the curriculum design since the pedagogical use of ICT is dependent on teachers' ICT competencies. According to their review of 33 "Preparing Tomorrow's Teachers to Use Technology (PT3)" projects in the United States, Mims and his colleagues (2006) report that most TEIs organise optional ICT competencies workshops for the pre-service teachers, mentor teachers and teacher educators. These workshop sessions typically include presentation software, movie editing tools, mind-mapping software, electronic portfolio, and digital imaging tools. Although pre-service teachers do enter TEIs with better ICT competencies nowadays, Steketee (2005) argues that such workshops are necessary.

Markauskaite's (2007) survey of pre-service teachers in the University of Sydney reveals that they may have acquired basic ICT competencies such as word processing and e-mailing but may lack more advanced ICT competencies such as the production of multimedia and web-based resources. Lee, Chai, Teo and Chen (2008) survey of Singaporean pre-service teachers reveals similar trend in terms of the pre-service teachers ICT competencies. Given that pre-service teachers may have different level of competencies in using ICT, it is necessary for TEIs to conduct further analysis of the pre-service teachers' ICT competencies and differentiate its courses to cater to different learning needs. There are questionnaires that may be adapted to serve this purpose (for example, see Anderson & Maninger, 2007; Collier, Weinburgh, & Rivera, 2004; Markauskaite, 2007; Lee et al, 2008).

...the role that TEI may assume is to provide an effective program that builds the foundation for the development of pre-service teachers' competencies towards the use of ICT in schools

Task analysis refers to the analysis of how an expert performs his/her job (Seels & Glasgow, 1998). In the context of designing the pre-service teacher curriculum, teacher educators have to observe how exemplary teachers use ICT effectively in schools. The observations are usually followed by interviews to understand how these teachers plan and use ICT. Through task analysis, the teacher educators derive a set of competencies (e.g. classroom management skills) and processes (e.g. planning processes) that informs the design of the curriculum. However, this assumes that teacher educators have the opportunity to observe and interview teachers with expertise in integrating ICT. For TEIs that are just starting its ICT in education's journey, consulting existing body of knowledge through literature review may be a more viable option.

Given the myriad of variables, pre-service teacher education programs are unlikely to be the sole determinant of whether and how beginning teachers use ICT in schools. However, as Anderson and Maninger (2007) point out, the role that TEI may assume is to provide an effective program that builds the foundation for the development of pre-service teachers' competencies towards the use of ICT in schools. Instructional analysis ensures that the curriculum provides this foundation.

Strategic Dimension **Two**

Linkages of courses/units

One common criticism of pre-service teacher education programs is that the courses/units in the program are not linked and hence, lacks coherency (Hammerness, Darling-Hammond, Grossman, Rust, & Shulman, 2005). It is therefore important that the curriculum is designed with adequate awareness of the general scheme of progression for the pre-service teachers. Without such awareness, course content may be repetitive or appear disconnected to the pre-service teachers. Given the general realization among teacher educators that a single course is unlikely to equip the teachers with the necessary competencies for the integration of ICT, it is important that courses are linked so that they build on one another and support the pre-service teachers to progress beyond the mastery of basic ICT competencies. Drenoyianni (2004) describes how ICT competencies among pre-service teachers have been developed in their four year program in Greece.

- In year 1, there is a course that focuses on ICT literacy competencies.
- In year 2, another course focuses on the pedagogical dimension of ICT use in schools.
- In years 2 and 3, ICT is also integrated into subject methods courses. ICT courses that are integrated with content teaching and/or method courses is a common approach to further enhance pre-service teachers' competencies in connecting the ICT competencies with subject matter learning (Angeli & Valanides, 2005; Lisowski, Lisowski, & Nicolia, 2006).

Pedagogical approaches

Pre-service teachers in most countries have to go through at least one introductory educational technology course. The pedagogical approaches for such introductory courses have shifted away from a transmission-based skill training approach towards a more problem-based learning constructivist approach. However, most introductory educational technology courses adopt a combination of both approaches based on the objectives of the activities. Anderson and Maninger (2007, p. 155) examine one such course in Texas, United States:

> Participants were enrolled in a one-semester course designed to meet the Texas Technology Application Standards for Beginning Teachers (Texas State Board for Educator Certification, 2003). The course provided an introduction to using educational technology for professional productivity and instructional purposes. It covered classroom application of a wide variety of software programs, including word processing, spreadsheet, database, presentation, paint, draw, desktop publishing, graphic organizer, Internet, and instructional software.
>
> Students also learned about instructional approaches such as cooperative learning, constructivism, and direct instruction, as well as issues such as copyright and censorship. Instructional methods included discussions, demonstrations, group work, and hands-on practice. An online course management system provided access to assignments, quizzes, threaded discussions, and links to Internet resources. Students participated in field work that allowed them to observe, interact with, and/or tutor individuals who were learning with computers. The final course project was an electronic portfolio.

Based on their report, the course is designed according to external standards set by the state education authority. Whether or not this constitutes adequate instructional analysis for course design is questionable. Other forms of instructional analysis such as learner analysis and task analysis are not reported. To assess the outcomes of the course, the authors adapt a 54 item self-report questionnaire that measures pre-service teacher's abilities, self-efficacy, value beliefs and intention to use ICT. The pre-post tests results reveal significant positive outcomes in all measured dimensions. Other studies that have adopted such pedagogical approaches also reported very similar outcomes (Goktas, Yildirim, & Yildirim, 2008; Wong et al., 2003).

Drenoyianni (2004) and Markauskaite (2007) suggest that one way to cater for both ICT competencies and pedagogy development is to structure the educational technology course within a broad problem-solving approach. Within this approach, pre-service teachers analyze students' needs, plan for ICT supported activities, identify and develop resources, adapt and configure the ICT environments, implement and manage the learning activities, and evaluate and reflect on the ICT-mediated lessons. An example of such a course is conducted in the National Institute of Education in Singapore. The course is focus on pedagogical reasoning and the design of constructivist-based learning units (Lim & Chan, 2007). The teaching of ICT competencies in the course is opportunistic and just-in-time. For example, if the teacher educator discovers that a group of pre-service teachers who are trained to be language teachers do not know how to use the Review functions of Microsoft Word, the teacher educator may perform a short demonstration, and perhaps use the function to provide formative feedback on students' draft.

Similarly, in the preparation of the constructivist-based learning unit, basic ICT competencies such as embedding object in PowerPoint presentation are introduced as needed. The final product of the course is usually a PowerPoint package created by two to three pre-service teachers. The PowerPoint package aims to initiate student-centred learning activities using various ICT tools.[1] The course is constructivist in orientation and the pre-service teachers are also tasked to examine case studies of exemplary use of ICT and discuss issues and implications face-to-face and online. Lee and her colleagues (2008) reported that the pre-service teachers perceived statistically significant gains in their ICT and pedagogical competencies as a result of the course.

To accommodate the developmental needs for ICT competencies and pedagogy of integrating ICT, within the limited teaching time of pre-service teacher education program, is a key challenge for the design of curriculum. A few TEIs in the United States have administered basic ICT competencies performance tests to address the enormous range of ICT competencies among pre-service teachers. In Bowling Green State University, the college of education implements an ICT competencies assessment that requires pre-service teachers to produce an artefact that "use word-processing, spreadsheet, presentation, and graphics software applications, and integrate Internet and file management expertise" (Banister & Vannatta, 2006, p. 213). To help the pre-service teachers to undertake the assessment tasks, the university set up online tutorials, video tutorials, student ICT support centre and offers individual tutoring on demand.

1 Reference Link: http://eduweb.nie.edu.sg/microlessons/samples.htm

Modelling

The effectiveness of modelling as a teaching strategy has long been established by the work of Albert Bandura (1986). The essence of modelling lies in practicing what one preaches. When teacher educators regularly model the use of ICT in their pre-service teacher education classes, they expose pre-service teachers to various innovative ways of using ICT for teaching and learning (Steketee, 2006). It may then foster deep changes in their beliefs about the educational value of integrating ICT. Modelling addresses the problems of pre-service teachers' inability to envision how ICT may be used in the classrooms (Dexter, Doering, & Riedel, 2006). Examples of explicit modelling by teacher educators in the use of ICT are reported by Dexter and colleagues (2006) and Lock (2007). Dexter and his colleagues (2006) describe a TEI-wide approach of content-area specific ICT preparation. The approach engages teams of education technologists, in-service teachers as teaching fellows, method and content teacher educators to construct and adapt resources so that the pre-service teachers may experience teaching and learning in which the use of ICT are integrated. Analysis of pre-service teachers' performance reveals that they are able to generate many potentially fruitful ideas for future ICT integration that enhance students' learning.

Lock (2007) describes her effort to integrate the use of ICT in the University of Calgary for a semester long course. The course adopts an inquiry-based approach and the pre-service teachers are assigned to investigate factors influencing the learning of English as a Second Language for students. Through the consolidation, exploration and elaboration phases of the inquiry, pre-service teachers have to use a variety of ICT tools to support their learning and reflection. They have to write reading synopsis, select digital images from the Internet, construct multimedia presentation (Web pages or PowerPoint files), and collaborate through ICT. Some of these competencies are taught to the pre-service teachers by the author. Throughout the inquiry, the pre-service teachers work in teams. Lock claims that the course constitutes meaningful learning for her students.

A common theme that emerges from the above examples is that engaging pre-service teachers to learn in a way they should support their students' learning is desirable. To achieve that, teacher educators have to model the use of ICT across various contexts and contents. At the same time, it may develop the dispositions required to facilitate group-based, constructivist-oriented student-centred learning supported by ICT that many educational reforms are aiming to achieve.

Meaningful use of ICT

Meaningful use of ICT in classrooms is dependent on the notion of integration. For pre-service teachers to integrate ICT, Angeli and Valanides (2005) advocate that there is a need for them to develop a body of knowledge that is termed ICT-related pedagogical content knowledge (PCK). The following quote explains their notion of ICT-related PCK:

> ICT-related PCK constitutes a special amalgam of several sources of teachers' knowledge base including pedagogical knowledge, subject area knowledge, knowledge of students, knowledge of environmental context, and ICT knowledge. ICT knowledge is defined as knowing how to operate a computer, knowing how to use a multitude of tools/software, and about their affordances. ICT-related PCK is the form of knowledge that makes a teacher competent to teach with ICT and can be described as the ways in which knowledge about tools and their

> affordances, pedagogy, content, learners, and context are synthesized into an understanding of how particular topics can be taught with ICT, for specific learners, in specific contexts, and in ways that signify the added value of ICT.
>
> (Angeli & Valanides, 2005, p. 294)

Meaningful use of ICT is therefore about using appropriate functions offered by a particular ICT application to enhance students' learning. The idea that pre-service teachers have to match appropriate affordances of ICT to facilitate and enhance students' learning of subject matter knowledge is rather commonly reported in literature (Jonassen et al., 2008; Lim & Chai, 2008). Loveless (2008) expresses similar beliefs and explains that teachers need to integrate the subject knowledge with the affordances of ICT through didactic analysis. Her research indicates that when there are weak didactic relations between the content and the use of ICT, ICT can become a tool for fun activity with no clear learning objectives. Chai and Lee (2006; p. 81) have provided a list of common affordances of ICT and how it may promote meaningful use of ICT as follow:

24 hours /7 days a week access to vast information sources	Anywhere/anytime learning
Connection to peers/ experts	diverse perspectives, idea improvement (reconstruction)
Multiple forms of knowledge representation	many ways to represent understanding by learners, engaging learners from different learning styles
Speedy computation/ search	learners focusing on higher order learning such as pattern recognition, hypotheses testing while the computers record, compute and etc
Revise-ability	encouraging revisions and multiple pass on information
Constructive, manipulative	learners can construct different models of understanding
Programmability	Learners can build functional models and simulation for further tests
Monitor actions through log files	learners can review their learning paths
Multiple versions of artefacts	learners can compare them for reflective learning
Recorded online interactions	Learner can visualize experts or more advanced peers' thinking
Asynchronous communication	Learners have time to reflect, many-to-many communication

Depending on the content and the learner characteristics, meaningful use of ICT may manifest in many different ways. For example, to help students to build their structural knowledge about a discipline, a teacher can task students to build concept maps using concept mapping ICT tools. Such tools are

easily revisable and students may create and link as many maps as they think are necessary. Another example is teachers who feel that their students are not articulating their thoughts or engaging in serious discussion may consider employing asynchronous discussion forum. Numerous studies have documented the benefits of discussion forum in giving students more time to think about issues and ensuring equal chance of participation (Chai & Khine, 2006; Scardamalia & Bereiter, 2006).

Assessment

Designing assessment is an integral part of the ICT curriculum development task. Well-designed assessment tasks are pivotal in engaging students in the learning process. Assessment practices ranging from standardized performance tests to e-portfolio have been employed for the evaluation of pre-service teachers' competencies in integrating ICT into classrooms. There are four areas of assessment: teachers' ICT competencies, attitude and beliefs towards use of ICT, pedagogical reasoning and actual use of ICT in classrooms (Haydn & Barton, 2007). These may be evaluated with project/artifacts analysis, surveys, short argumentative or reflective papers and classroom observations. All these may be documented in an electronic portfolio (Graham et al., 2004). We describe a few cases below to illustrate three strategic foci that teacher educators may focus upon in the design of assessment.

Linkages to curriculum

Assessments that are not linked to the curriculum are not valid forms of assessment. In some traditional instructional design systems, assessments are developed before the development of the curriculum (see Seels & Glasgow, 1998). Angeli (2005) describes a science education method course that incorporates an Instructional System Design (ISD) model to guide pre-service teachers in designing ICT integrated lessons. She documents a case of how pedagogical contents are developed alongside a set of authentic assessment criteria that is linked to the curriculum. **Figure 3** shows the ISD model.

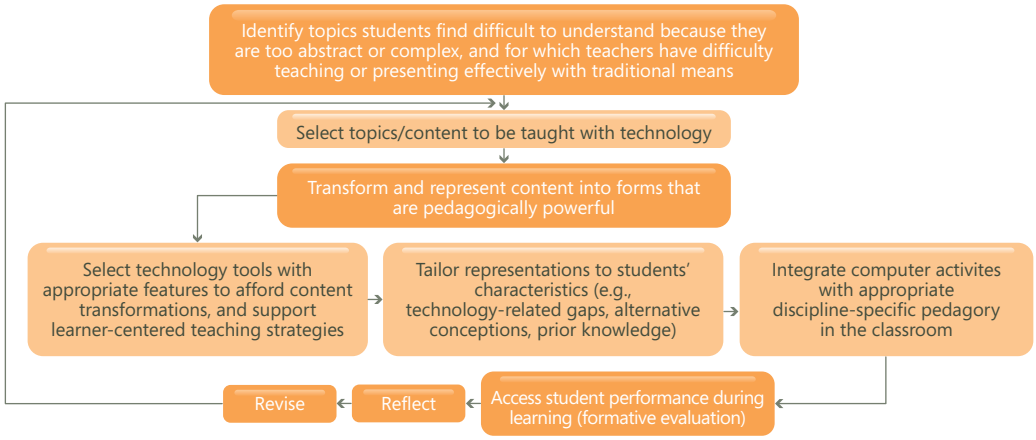


Figure 3: An ISD model for integrating ICT in method courses. (Angeli, 2005, p. 386)

Two groups of pre-service teachers were involved in this experimental course design. The first group used multimedia authoring tools entitled Hyperstudio and Multimedia Builder while the second group used a modelling tool entitled ModellingSpace. For both groups, the teacher educators modelled a series of ICT integrated lessons employing the specific tools that the pre-service teachers have to learn to use. After the lesson, the teacher educators explained the pedagogical reasoning behind the design of the modelled lesson. ICT competencies training were provided for the respective software. The pre-service teachers were then tasked to design constructivist learning unit following the process illustrated in Figure 1, with the teacher educators facilitating the design processes. They were evaluated based on four dimensions of ICT-related PCK which included:

a) selection of appropriate topic
b) use appropriate technology-supported representation to transform the content
c) use technology to support teaching strategies
d) integrate computer-based activities with appropriate pedagogy.

In this case, the evaluation is tightly coupled with the processes that are employed in the curriculum.

Mode of assessment: balance between process and product

Park and Ertmer (2007) report on their use of problem-based learning approach for an introductory educational technology course. It provides a good example of the multiple modes of assessment that are arguably balance in terms of process and product. At the start of the course, the pre-service teachers were challenged by a trigger problem of applying for a new teaching position that require the candidate to demonstrate their ability to integrate ICT for learning through a portfolio. The teachers then plan draft lessons for specific groups of learners, detailing the resources and assessment methods to be employed. These drafts allow the teacher learning to be tracked over time. The following quote documents how the pre-service teachers advance through the course and the various mode of assessment employed.

> During the semester, students watched digital video cases of exemplary technology integration in K-12 classrooms, including interviews with teachers. After watching the digital video cases, students discussed classroom problems and the strengths and weaknesses of the solutions. Also, each group created artifacts related to the skills, knowledge, and attitudes required to succeed as technology using teachers in their content areas. In addition, students submitted reflections with each artifact as well as a final course reflection describing their PBL group experience.
>
> Each small group created a digital portfolio to apply for the new positions in the school district. There were three main artifacts in each digital portfolio:
>
> a) an artifact to demonstrate skills (e.g., digital curriculum vitae)
> b) an artifact to demonstrate knowledge (e.g., lesson plans integrating technology)
> c) an artifact to highlight attitudes toward technology (e.g., an essay of teaching philosophy)

> At the end of the semester, each group made presentations to an interview panel composed of school administrators (including those who appeared in the initial video case) and content experts (e.g., professors and instructors in the College of Education). After each presentation, the interview panel asked questions about the candidates' portfolios.
>
> (Park & Ertmer, 2007, p. 251)

Park and Ertmer's (2007) work illustrate how multiple forms of assessment are integrated and balanced in the curriculum for the evaluation of both the process and product of integrating ICT for classroom learning.

Authenticity of assessment tasks

Setting authentic assessment tasks help pre-service teachers to focus on acquiring the necessary competencies and dispositions for the integration of ICT in the real world. Both Angeli (2005) and Park and Ertmer's (2007) design of assessment are considered as authentic as the competencies required to complete the tasks are the same competencies that teachers need in school settings. However, one may argue that the authenticity of the assessment may be further enhanced by the conduct of the actual lessons. The actual conduct of lesson requires a different set of competencies than those involved in preparing the lessons. This issue will be discussed further in the strategic dimension of practicum (see next section).

There are some forms of assessment that may not be authentic from the teacher educators and teachers' perspective. For example, to achieve the Qualified Teacher Status in United Kingdom, pre-service teachers are required to take tests to demonstrate that they possess adequate ICT competencies[2]. However, while this approach ensures that teachers have acquired basic ICT literacy, Haydn and Barton's (2007) research study indicates that this approach is neither welcomed by pre-service teachers nor their mentors. It is being perceived as irrelevant and unhelpful for purposeful integration of ICT. This approach to training the pre-service teachers is more akin to the traditional skill acquisition approach. It is unlikely that this approach may cultivate teachers who have the dispositions and competencies to facilitate active, collaborative and constructive learning among students with technology.

Practicum

Practicum or field experience has been viewed as an important component of teacher education as it provides an authentic learning environment for pre-service teachers to make sense of theoretical knowledge and practice the skills they acquire (Dexter & Riedel, 2003; Sime & Priestley, 2005). It is therefore common for TEIs to encourage pre-service teachers to use ICT and reflect on its use in classroom. For the field placement to enhance pre-service teachers' competencies to use ICT in classrooms, the following three strategic foci have to be taken into account.

2 Reference Link: http://www.tda.gov.uk/skillstests/ict.aspx

Linkages to curriculum and assessment

Benson and her colleagues (2004) report that the pre-service teachers from their TEI are required to use the multimedia materials they have developed during the twelve weeks educational technology course in their three weeks teaching practice. The practicum is thus directly linked to the curriculum. This seems to help the pre-service teachers to feel more prepared for the actual use of ICT. However, not many studies have reported such a clear link between TEI-based educational technology course and practicum. One necessary condition to foster such link is that the pre-service teachers need to know who and what they are going to teach before the commencement of practicum.

Dawson (2006) points out that it is not the field experience but the reflection upon the experiences that are essential for the teachers' development. Reflection may become another activity for pre-service teachers to complete if they are not scaffolded appropriately. This is especially true when the pre-service teachers feel that they are overwhelmed with the need to acquire a host of new skills during teaching practice (Hadyn & Barton, 2007). Dawson (2006) attempts to address the short coming of field-based experiences through "teacher inquiry". It requires the pre-service teachers to identify question of wonderment, plan data collection, analyze data and take action. It is akin to action research. Dawson claims that the outcomes of this intervention include pre-service teachers being more acquainted with the complexities of the use of ICT in classroom and being more focused on students' learning. However, the research also indicates that pre-service teachers are more likely to use ICT to support and enhance traditional teaching. Few pre-service teachers are able to use ICT to provide a rich context for student-centred activities that facilitate higher order learning.

The effectiveness of promoting the use of ICT during practicum is dependent on the university supervisor and the mentor teacher's support and adequate access to ICT...

In summary, literature that report linkages between educational technology courses and practicum generally testifies that such efforts enhance the pre-service teachers' competencies in using ICT. However, important conditions are needed to support such linkages. This will be discussed next.

Support in schools

The effectiveness of promoting the use of ICT during practicum is dependent on the university supervisor and the mentor teacher's support and adequate access to ICT (Dexter & Riedel, 2003; Brown & Warschauer, 2006). Without these, the practicum may inhibit ICT integration. For example, a pre-service teacher may be required to show evidence of integrating ICT into their portfolio. However, he/she may encounter problems such as limited access to ICT laboratory or the mentor teacher does not believe in ICT. These conditions may add burden to the pre-service teachers in fulfilling the requirement and cause frustration for them. It is therefore important to consider whether there are adequate supporting conditions before deciding on ICT integration as part of the practicum assessment. On the other hand, when contextual conditions are favourable, pre-service teachers are likely to gain confidence in using ICT. Pope, Hare and Howard (2005) reported that when the mentor teachers demonstrate the use of ICT, the pre-service teachers' use of ICT in classroom is also higher during practicum. Lisowski and colleagues (2006) and Brown and Warschauer (2006) made similar observation about how the attitude of the mentor teachers can influence the pre-service teachers

positively. However, there are not many mentor teachers in schools who are able to provide such modelling. Recognising the importance of the mentor teachers and supervisors as role models, TEIs are starting to provide additional training for the mentor teachers and the university supervisors.

Other forms of support include setting up online communities to enhance mutual support and reduce the sense of isolation among pre-service teachers. Sime and Priestley (2005) analyse the online discussion of pre-service teachers about the ICT practices they have observed in schools during their observational placement. This may be a meaningful activity that supports pre-service teachers to think deeper about the theory they have learnt in university and the actual practices in schools. Sime and Priestley (2005) report that the pre-service teachers are able to discern the role of ICT in changing teaching and learning and they are also able to adopt a critical stance towards ICT. Providing laptops for the pre-service teachers or mentor teachers is another form of support (Basham, Palla, & Pianfetti, 2005). These measures are beneficial for the pre-service teachers' professional development.

Expectation of ICT use in teaching and learning in schools

Many educators have reported the positive effects of engaging pre-service teachers to use ICT during practicum (Benson et al., 2004; Lisowki et al., 2006). Amongst the literature, Brush and his colleagues' (2003) report of their field-based model seems to be most radical. In their model, the pre-service teachers are required to design, implement and review ICT integrated lessons during their practicum. They are supported by graduate students who design and deliver ICT integrated lessons using specific software for specific subject. After experiencing learning through the modelled ICT integrated lessons, the pre-service teachers critique the lessons and design their own lessons with just-in-time support from the graduate students. (These graduate students are in-service or experienced teachers.) The pre-service teachers then implement the lesson and complete a written reflection discussing the strengths and weaknesses of the experience. The effects of this model are generally positive in terms of enhancing the pre-service teachers' attitude and skills towards using ICT in classrooms. It should be noted that this model is successful because of the strong emphasis on authentic learning through placement by the TEI.

Despite the above-mentioned benefits, there are still many pre-service teachers who are not given much opportunity to use ICT in classrooms (Pope et al., 2005). This may be due to the fact that teacher educators and teacher colleges recognise that sufficient supporting conditions do not exist. Brown and Warschauer (2006) observe that there is still limited expertise in schools for the proficient use of ICT for teaching and learning. However, it seems clear that TEIs may establish some expectations of ICT use during practicum. This may be a strategic thrust for TEIs to help raise the standards of ICT among its graduates.

References

Anderson, S. E. & Maninger R. M. (2007). Preservice teachers' abilities, beliefs, and intentions regarding technology integration. *Journal of Educational Computing Research, 37*(2), 151-172.

Angeli, C. (2005). Transforming a teacher education course through technology: effects on pre-service teachers' technology competency. *Computers & Education*, 383-398.

Angeli, C. & Valanides, N. (2005). Preservice elementary teachers as information and communication technology designers: an instructional systems design model based on an expanded view of pedagogical content knowledge. *Journal of Computer Assisted Learning, 21*(4), 292–302.

Bandura, A. (1986). *Social foundations of thought and action.* Englewood Cliffs, NJ: Prentice-Hall.

Basham, J., Palla, A., & Pianfetti, E. S. (2005). An integrated framework used to increase preservice teacher NETST ability. *Journal of Technology and Teacher Education 13*, 357-376.

Benson, L. F., Farnsworth, B. J., Bahr, D. L., Lewis, V. K., & Shaha, S. H. (2004). The impact of training in technology assisted instruction on skills and attitudes of pre-service teachers. *Education, 124*(4), 649-663.

Brinkerhoff, J. (2006). Effects of a long-duration professional development academy on technology skills, computer self-efficacy, and technology integration beliefs and practices. *Journal of Research on Technology in Education, 39*(1), 22-43.

Brantley-Dias, L., Calandra, B., Harmon, S. W., & Schoffner, M.B. (2006). An analysis of collaboration between Colleges of Education and Arts & Sciences in PT3. *TechTrends: Linking Research and Practice to Improve Learning, 50*(3), 32-37.

Brown, D., & Warschauer, M. (2006). "From the university to the elementary classroom: Students' experiences in learning to integrate technology in instruction." *Journal of Technology and Teacher Education, 14*(3), 599-621.

Brush, T., Glazewiski, K., Rutowiski, K., Berg, K., Stromfors, C., Van-Nest, M. H., Stock, L., & Stutton, J. (2003). Integrating technology in a field-based teacher training program: The PT3@ASU project. *Educational Technology Research and Development, 51*(1), 57-72.

Chai, C. S. & Lee, C. B (2006). Modelling with computers as Mindtools. In Khine, M. S. (Ed.), *Teaching with technology: Strategies for engaging learners.* (pp. 77-94). Singapore: Pearson Prentice Hall.

Chai, C. S. & Khine, M. S. (2006). An analysis of interaction and participation patterns in an online learning community. *Journal of Education Technology and Society, 9*(1), 250-261.

Collier, S., Weinburgh, M. H., & Rivera, M. (2004). Infusing Technology Skills into a Teacher Education Program: Change in Students' Knowledge About and Use of Technology. *Journal of Technology and Teacher Education, 12*(3), 447-468.

Dawson, K. (2006). Teacher inquiry: A vehicle to merge prospective teachers' experience and reflection during curriculum-based, technology-enhanced field experiences. *Journal of Research on Technology in Education, 38*(3), 265-292.

Dexter, S., & Riedel, E. (2003). Why improving preservice teacher educational technology preparation must go beyond the college's walls. *Journal of Teacher Education, 54*(4), 334-346.

Dexter, S., Doering, A. H., & Riedel, E. S. (2006). Content area specific technology integration: A model for educating teachers. *Journal of Technology and Teacher Education, 14*(2), 325-345.

Drent, M., & Meelissen, M. (2008). Which factors obstruct or stimulate teacher educators to use ICT innovatively? *Computers & Education, 51*, 187-199.

Drenoyianni, H. (2004). Designing and implementing a project-based ICT course in a teacher education setting: Rewards and pitfalls. *Education and Information Technologies, 9*(1), 387-404.

Ertmer, P. A. (2005). Teacher pedagogical beliefs: The final frontier in our quest for technology integration. *Educational Technology Research and Development, 53*(4), 25–39.

Goktas, Y., Yildirim, Z., & Yildirim, S. (2008). A review of ICT related courses in pre-service teacher education programs. *Asia Pacific Educational Review, 9*(2), 168-179.

Graham, C., Culatta, R., Pratt, M., & West, R. (2004). Redesigning the teacher education technology course to emphasize integration. *Computers in the Schools, 21*(1/2), 127-148.

Hammerness, K., Darling-Hammond, L., Grossman, P., Rust, F., & Shulman, L. (2005). The design of teacher education programs. In L. Darling-Hammond & J. Bransford (Eds.), *Preparing teachers for a changing world: What teachers should learn and be able to do* (pp. 390-441). San Francisco: Jossey-Bass.

References

Haydn, T. A., & Barton, R. (2007). Common needs and different agendas: How trainee make progress in their ability to use ICT in subject teaching. Some lessons from the UK. *Computers & Education 49*, 1018–1036.

Jimoyiannis, A. & Komis, V. (2007). Examining teachers' beliefs about ICT in education: Implications of a teacher preparation programme. (*Teacher Development, 112*), 149-173.

Jonassen, D., Howland, J., Marra, R., & Crismond, D. (2008). *Meaningful learning with technology* (3rd ed.). Upper Saddle River, NJ: Pearson.

Lee, C.B., Chai, C.S., Teo, T. & Chen, D. (2008). Preparing pre-service teachers' for the integration of ICT based student-centred learning (SCL) curriculum. *Journal of Education, 13*, 15-28.

Lim, C. P. & Chan, B. C. (2007) microLESSONS in teacher education: examining pre-service teachers' pedagogical beliefs. *Computers & Education, 48*(4), 474-494.

Lim, C. P., & Chai, C. S. (2008). Rethinking classroom-oriented instructional development models to mediate instructional planning in technology enhanced learning environments. *Teaching and Teacher Education, 24*(8), 2002-2013.

Lisowski, L., Lisowski, J. A., & Nicolia, S. (2006). Infusing technology into teacher education: Doing more with less. *Computers in the schools, 23*(3), 71-92.

Lock, J. (2007). Inquiry, immigration and integration: ICT in preservice teacher education. *Issues in Technology and Teacher Education, 7*(1), 575-589.

Loveless, A. (2007). Preparing to teach with ICT: subject knowledge, Didaktik and improvisation. *The Curriculum Journal, 18*(4), 509-522.

Markauskaite, L. (2007). Exploring the structure of trainee teachers' ICT literacy: the main components of, and relationships between, general cognitive and technical capabilities. Educational Technology, *Research and Development, 55*(6),547-572.

Mims, C., Polly, D., Shepherd, C., & Inan, F. (2006). Examining PT3 projects designed to improve preservice education. *Techtrends, 50*(3), 16-24.

Paraskeva, F., Bouta, H., & Papagianni, A. (2008). Individual characteristics and computer self-efficacy in secondary education teachers to integrate technology in educational practice. *Computers & Education, 50*, 1084-1091.

Park, S. H., & Ertmer, P. A. (2007). Impact of problem-based learning (PBL) on teachers' beliefs regarding technology use. *Journal of Research on Technology in Education, 40*(2), 247-267.

Pope, M., Hare, D., Howard, E. (2005). Enhancing Technology Use in Student Teaching: A Case Study. *Journal of Technology and Teacher Education. 13*(4), 573-618.

Seels, B. & Glasgow, Z. (1998). *Making instructional design decision*. Upper Saddle River, NJ: Prentice Hall.

Sime, D., & Priestley, M. (2005). Student teachers' first reflections on information and communications technology and classroom learning: Implications for initial teacher education. *Journal of Computer Assisted Learning, 21*, 130-142.

Steketee, C. (2005). Integrating ICT as an integral teaching and learning tool into pre-service teacher training courses. *Issues in Educational Research, 15*. Retrieved on 26th March 2008 from http://www.iier.org.au/iier15/steketee.html.

Steketee, C. (2006). Modelling ICT integration in teacher education courses using distributed cognition as framework. *Australasian Journal of Educational Technology, 22*(1), 126-144.

Swain, C. (2006). Preservice teachers' self-assessment using technology: Determining what is worthwhile and looking for changes in daily teaching and learning practices. *Journal of Technology and Teacher Education, 14*(1), 29-59.

Teo, T., Lee, C. B., & Chai, C. S. (2008). Understanding pre-service teachers' computer attitudes: applying and extending the Technology Acceptance Model (TAM). *Journal of Computer Assisted Learning, 24*, 128-143.

Wong, S. L., Jalil, H. A., Mohd Ayub, A. F., Abu Bakar, K., Tang, S. H. (2003). Teaching a discrete information technology course in a constructivist learning environment: is it effective for Malaysian pre-service teachers? *Internet and Higher Education, 6*, 193–204.

comments

Strategic Dimension **Two**

comments

comments

Strategic Dimension **Three**

Professional Learning of Deans, Teacher Educators and Support Staff

Pre-service teachers are often perceived as change agents in their schools with respect to the sustained use of ICT for teaching, learning and administration. In order to play such a significant role, the previous strategic dimension has emphasised the importance for the pre-service teachers to experience the effective use of ICT in all aspects of their program; namely curriculum, assessment and practicum. The deans, teacher educators and support staff have pivotal roles to play in creating these experiences. Although the deans and teacher educators are experts in their respective disciplines (such as school leadership, teacher education and mathematics/science education), many of them lack the experience (and some, the competencies) of using ICT for teaching, learning and administration. Therefore, the continual professional learning of deans, teacher educators and support staff on ICT in education is pertinent.

Professional learning is "the sum total of formal and informal learning experiences throughout one's career from pre-service teacher education to retirement" (Fullan & Steigelbauer, 1991, p. 326) and includes the support for teacher educators to examine and transform their own practice based on their evolving understanding of teaching and learning (Davies, Edwards, Gannon & Laws, 2007). Although professional learning exists in TEIs, most of these professional learning programs have been packaged and delivered to teacher educators as a result of policy mandate; they are also often delivered by "experts" in one-off workshops and seminars. Such programs are unlikely to address the professional learning needs of the teacher educators, and as a result, unlikely to transform their teaching and learning practices.

Therefore, this strategic dimension focuses on six strategic foci:

- Professional Learning Culture
- ICT Professional Learning Program
- ICT Professional Learning Plans of Staff
- Mentoring and Peer Coaching of ICT for Teaching and Learning
- Conducive Conditions for ICT Professional Learning
- Reward and Incentive Structure for ICT Professional Learning

Professional Learning Culture

Continuing professional learning of deans, teacher educators, and support staff is necessary to build the capacity of TEIs to develop pre-service teachers' competencies for effective use of ICT. Professional learning is more than simply delivering information about a new strategy or conducting periodic workshops that are not linked to practice (Ball & Cohen, 1999). It has the potential to address the gap between research and practice in TEIs; a 'perceived" gap that is inherent in the mindset of many teacher educators. In order for teacher educators to transform practices with regards to the use of ICT for teaching and learning, they have to be provided with the opportunities to engage in reflective

conversations about their existing practices and generate usable knowledge to inform their future practices (Schon, 1992). Teacher educators are then more likely to explicate his/her personal theories that are underlying the decisions made. Without such externalization, it is difficult to change the teacher educators' perspective towards the use of ICT for teaching and learning (Lim & Chai, 2008). The professional learning culture in the TEI then has to facilitate the examination of teaching and learning activities and an understanding of the complexities of ICT-mediated learning environments by the deans, teacher educators and ICT support staff so that the ICT in education competencies of the pre- and in-service teachers may be developed. This culture has to permeate all levels within the TEI and the major partners of the TEI (including schools and other education agencies).

Such a culture highlights the importance of the development of professional learning communities that engage and support the learning of both staff and pre-service teachers in the TEI (Bryk, Camburn, & Louis, 1999). It de-privatises teaching and learning by breaking the isolation that often characterises traditional teaching arrangements and learning practices. Wood (2007, p. 12) explains how a professional learning community may be developed:

> … it must push the work of improving classroom practice and student learning forward. And in order for the work to progress, the community must bond around common commitments, values, and achievements- all work related.

In the context of TEIs, a professional learning community for ICT in education emphasises the collegial nature of learning among the deans, teacher educators and ICT support staff that is focused on improving teaching and learning with ICT and about ICT in education. Staff members in the TEI are then more likely to support one another by visiting and observing each other's ICT-mediated lesson, modelling effective ICT-mediated practices to colleagues, and engaging in collaborative projects to enhance ICT-mediated practices. Through these activities, staff members in the TEI share a common language about teaching and learning, curriculum and assessment, develop a "collective instructional repertoire" (Steele & Boudett, 2008, p. 56), and assume shared responsibility for students' learning in ICT-mediated learning environments and about ICT in education.

ICT Professional Learning Program

Research studies that examine the effectiveness of professional learning programs for developing ICT in education competencies have highlighted some key characteristics of such programs that involve: longer duration (often with follow-up activities), meaningful and relevant activities for teachers' own contexts, access to ICT in teaching and learning, and collaboration and community building (Lawless & Pellegrino, 2007). One-off workshops and seminars or one-size-fits-all professional learning workshops tend to fragment the professional learning of deans, teacher educators and ICT support staff and provide them with little or no ongoing support (Jacobsen & Lock, 2004). Many of them have complained about the disconnection between these workshop activities and practices in the TEI. Moreover, these workshops and seminars do not provide the time and opportunities for them to design and implement teaching and learning activities to develop ICT in education competencies of pre- and in-service teachers. When ICT enters the learning environment, everything in the

environment changes; the staff members not only have to learn how to use the new ICT tool but also have to learn how to design ICT-mediated activities to enhance students' learning. The financial cost of delivering professional learning programs increases proportionally with the number of days involved; there is also the opportunity cost of getting teacher educators out of their classes that may be disruptive to the learning of pre-and in-service teachers. As a result, ongoing, systematic professional learning with support for staff members in their own TEIs are rare (Rust, 2009).

Designing ongoing professional learning programs for them to experiment with new ICT tools and pedagogies requires an understanding of their beliefs about teaching, learning and ICT in education, their existing practices and roles in the TEI, and their ICT in education competencies. Teacher educators, especially, make decisions about their practices based on a complex set of pre-existing professional knowledge about the community, pre-service teachers, and context that they have accumulated through years of experiences. This knowledge base significantly influences the way they plan for effective ICT integration in their courses both positively and negatively. Moreover, teacher educators may not buy into the use of ICT for teaching and learning if it has been imposed upon them; they may perceive these mandated changes to be irrelevant to or inconsistent with their everyday teaching and learning activities in the classroom (Shonkoff, 2000).

For the professional learning program to be effective, it has to change the pedagogical beliefs of the teacher educators towards the use of ICT for teaching and learning. It is only then that they will examine and transform their own practice (Ertmer, 2005; Lim & Chan, 2007). Therefore, professional learning programs have to be developed based on a needs and situation analysis of the deans, teacher educators and ICT support staff in the context of the institution in which they are situated (Wayne, Yoon, Zhu, Cronen, & Garet, 2008). The ICT program also has to be linked to other professional learning programs, and creates opportunities for practice with the appropriate level of support to transform the professional learning into teaching and learning practices, and translate it into an overall TEI improvement (Zhao, Pugh, & Sheldon, 2002).

ICT Professional Learning Plans of Staff

Empowering TEI staff to manage their own professional learning trajectory as a dean, teacher educator or ICT support staff may enhance the effectiveness of professional learning programs (Lieberman, 2009). The importance of TEI staff managing their own professional learning is emphasised in Ball's (1996, p.507) explanation of professional learning:

> Our understanding of professional development that can support teacher learning is a mix of fairly solid ideas, beliefs, myths, and conjecture… we ourselves will need to make new conjectures based on what we think we know and what we think we still have to learn.

TEI staff members need to have ownership of the changes associated with the use of ICT in teaching and learning, from self-reflection and re-evaluation, so that they understand clearly their practice, learning and goals (Fullan, 1999; Garet, Porter, Desimone, Birman, Yoon, 2000). This is consistent with research studies that emphasise the need for professional learning activities to be tailored to individual teacher educator's needs and the contexts of the teacher educators undergoing the professional learning (Lawless & Pellegrino, 2007).

Therefore, it is important that TEI staff members are provided with opportunities to develop their individual ICT professional learning plans collaboratively and are committed to these plans. Support has to be given to the staff in developing and monitoring these plans in their learning communities. Monitoring the ICT professional learning plans will have to go beyond the examination of whether ICT competencies and confidence have or have not developed, or whether there have been any changes to teacher educators' own practice. There may be a need to examine the pre-service teachers' work and their ICT in education competencies. These then will make up the intended outcomes of the professional learning and inform the evaluation strategies employed to monitor them.

Mentoring and Peer Coaching of ICT for Teaching and Learning

Mentoring and peer coaching have been in recent years an important component of the professional learning of educators (Orrill, 2001; Walkington, 2005). The collaborative nature of mentoring and peer coaching provide teacher educators with help, peer support, trust, acknowledgment, and control of their learning activity; providing a more whole institution approach towards professional learning. This component of professional learning emphasises on meeting the individual needs of teacher educators in the context of personal relationship. It provides a safe environment for reflecting on one's own practice, and reduces the solitary nature of classroom practices and replaces it with a much needed, healthy and beneficial relationship between teacher educators (Feiman-Nemser, 2001). Unlike one-off professional learning workshops, mentoring and peer coaching are long-term and ongoing, and thus more likely to have an impact on teacher educators' teaching and learning practices (Boyle, While, & Boyle, 2004). Robbins (1995, p. 206) defines peer coaching as:

> A confidential process through which two or more professional colleagues work together to reflect on current practices; expand, refine, and build new skills; share ideas; teach one another; conduct classroom research; or solve problems in the workplace.

This definition highlights peer coaching as an important component of professional learning for providing a supportive learning environment for teacher educators to inform and shape one another's practices and learning.

Joyce and Showers (2002) highlight two key characteristics of mentoring and peer coaching: collective agreement in commitment, support and evaluation and teachers learning from one another in all aspects of their professional activities (rather than from observations). For example, in a mentoring and peer coaching model of professional learning, teacher educators may first attend a specific focus workshop, followed by time spent observing and working with other teacher educators who are comfortable with using ICT. This is more likely to encourage teacher educators to risk uncertainty, plan for changed roles and develop their own ICT and pedagogical competencies. Such a model provides individualized attention and creates a safe environment for teacher educators to try out new teaching methodologies with ICT. It also supports them in decision-making, instructional planning and classroom implementation where they are encouraged to think, reflect and put their thoughts into practice.

Peer coaching may also draw upon the train-the-trainers model of professional learning where a group of teacher educators are first trained in the use of ICT in teaching and learning and are then expected to train other teacher educators. Such a model has been proven by some research studies to be effective (Cole, Simkins, & Penuel, 2002; Gershner & Snider, 2001). Teacher educators as trainers have an intimate understanding of the demands on teacher educators and the institutional culture and hence, their guidance as trainers is more relevant to the teacher educators who they train. Therefore, mentoring and peer coaching of ICT for teaching and learning have to be a component of the professional learning program of teacher educators and this program may involve teacher educators working together in the institution or with other teacher education institutions, public and private organisations and schools.

Conducive Conditions for ICT Professional Learning

The strategic foci discussed in this dimension have highlighted the importance of ICT professional learning for teacher educators, deans and ICT support staff, and how these professional learning activities may be organised to build their capacity to use ICT effectively for teaching and learning. This strategic focus discusses the conditions that are necessary and sufficient for these ICT professional learning activities. The necessary conditions include:

- access to ICT (Ertmer, Addison, Lane, Ross, & Woods, 1999)
- release time for professional learning (Cuban, Kirkpatrick, & Peck, 2001)
- relevance to teacher educators' own practice (Hunter, 2001; Lim, 2007)

In his book on the 'Diffusion of Innovations', Rogers (1983, p. 24) warns: "It matters little whether or not an innovation has a great degree of advantage over the idea it is replacing. What does matter is whether the individual perceives the relative advantage of the innovation." Teacher educators, deans and ICT support staff's perceptions of ICT in education are crucial in determining their engagement in the professional learning activities. Such perceptions may be shaped by their belief systems about the pre-service teachers in their TEI, "good teaching" in their TEI context, and the role of ICT in everyday lives (Zhao, Pugh, & Sheldon, 2002).

Leadership support is an integral and important part of the professional learning activities where TEI academic, support and senior management staff negotiate and co-develop the condiitons conducive for ICT professional learning.

One of the most significant sufficient conditions for ICT professional learning in TEIs is leadership support. Leadership support is an integral and important part of the professional learning activities where TEI academic, support and senior management staff negotiate and co-develop the conditions conducive for ICT professional learning (Hargreaves & Fink, 2003). TEI leaders have to take up more responsibilities in terms of curriculum and instructional leadership; they also need to provide a conducive TEI environment for collaboration and inquiry, accommodate teacher educators' needs for professional learning and manage existing resources to support pre-service teachers' and teacher educators' learning (Robinson, Lloyd, & Rowe, 2008). The leaders have to be consistent in their support; for example, TEI leaders who

indicate their support for the development of professional learning communities and then replacing them with top down decisions are most likely to create an environment with underlying tensions and sense of mistrust (Wood, 2007). However, TEI leaders often feel inadequate to support teacher educators' professional learning because of their lack of information and knowledge about how to give the support. When TEI leaders are involved in teacher educators' professional learning activities, they are more likely to understand what support is needed and how to provide it.

Besides leadership support, another sufficient condition is the development of professional learning communities (also discussed in the first strategic focus). Wood (2007, p. 7) explains that "learning community participation throws classroom doors open…the learning community approach seeks to imbue in teachers a sense of efficacy and to seat professional expertise, responsibility, and judgement in communities of reflection, critique and inquiry". This coupled with a shared vision and supported by responsive leadership are likely to provide conducive conditions for ICT professional learning among TEI staff and hence, greater learning opportunities for pre-service teachers. Therefore, for ICT professional learning to be effective, both necessary and sufficient conditions have to be present and these have to be constantly reviewed and revised by the TEI.

Reward and Incentive Structure for ICT Professional Learning

Linked to the previous strategic focus of conducive environments, a reward and incentive structure for ICT professional learning is another significant sufficient condition. The structure may be constructed based on an institute-wide consultation that is an integral part of the staff appraisal and management system. Professional learning grants may be made available for TEI staff to build their capacity in the use of ICT for teaching, learning and administration. These grants may be awarded on a competitive basis where individual or team of staff are expected to submit proposals of their planned professional learning activities that may include building professional learning communities, developing mentors and peer coaches, or attracting visiting ICT in education scholars. Besides grants, subsidies may also be made available for TEI staff to undertake professional learning programs organised by other training agencies. To ensure accountability, these grants and subsidies may then be tied to a recognition or staff appraisal system for innovative and effective use of ICT in teaching, learning, and administration.

Formal certification of ICT professional learning that leads to advanced diplomas may also provide incentives for deans, teacher educators and ICT support staff to upgrade and update their ICT in education competencies. These advanced diplomas may then provide alternative route for admission into the TEI's master or doctoral programs. The advanced diplomas and their accreditation framework ensure better articulated linkages between professional learning and career paths of TEI staff by providing them with more opportunities to upgrade to postgraduate qualifications (Gopinathan, Ho, & Tan, 2001).

References

Boyle, B., While, D., and Boyle, T. (2004). A longitudinal study of teacher change: what makes professional development effective? *The Curriculum Journal, 15*(1), 45-68.

Ball, D.L. (1996). Teacher learning and the mathematics reforms: What do we think we know and what do we need to learn? *Phi Delta Kappan, 77*, 500-508.

Ball, D., & Cohen, D. (1999) Developing practice, developing practitioners: Toward a practice-based theory of professional education. In L. Darling-Hammond & G. Sykes (Eds.), *Teaching as the Learning Profession* (pp.3–31) San Francisco: Jossey-Bass.

Bryk, A., Camburn, E., & Louis, K. (1999). Professional community in Chicago elementary schools: Facilitating factors and organizational consequences. *Educational Administration Quarterly, 35*(5), 751-781.

Cole, K., Simkins, M. & Penuel, W. (2002). Learning to teach with technology: Strategies for in-service professional development. *Journal of Technology and Teacher Education,10*(3), 431-455.

Cuban, L., Kirkpatrick, H., & Peck, C. (2001). High access and low use of technology in high school classrooms: Explaining an apparent paradox. *American Educational Research Journal, 38*(4), 813-834.

Davies, B., Edwards, J., Gannon, S. & Laws, C. (2007). Neo-liberal subjectivities and the limits of social change in university-community partnerships. *Asia-Pacific Journal of Teacher Education, 35*(1), 27-40.

Ertmer, P.A. (2005). Teacher pedagogical beliefs: The final frontier in our quest for technology integration. *Educational Technology Research & Development, 53*(4), 25-39.

Ertmer, P. A., Addison, P., Lane, M., Ross, E., & Woods, D. (1999). Examining teachers' beliefs about the role of technology in the elementary classroom. *Journal of Research on Computing in Education, 32*(1/2), 54-72.

Feiman-Nemser, S. (2001). Helping novice learn to teach: Lessons from an exemplary support teacher. *Journal of Teacher Education, 52*(1), 17-30.

Fullan, M. & Steigelbauer, S. (l991). *The New Meaning of Educational Change* (2nd Ed.). New York: Teachers College Press.

Fullan, M. (1999). *Change Forces: The Sequel.* Philadelphia: Falmer Press.

Fullan, M. (2001). *The New Meaning of Educational Change (Third Edition).* New York: Teachers College Press.

Garet, M.S., Porter, A.C., Desimone, L., Birman, B.F., & Yoon, K.S. (2001). What makes professional development effective? Results from a national sample of teachers. *American Educational Research Journal, 38*(4), 915-944.

Gershner, V.T. & Snider, S.L. (2001). Integrating the use of Internet as an instructional tool: Examining the process of change. *Journal of Educational Computing Research, 25*(3), 283-300.

Gopinathan, S., Ho, W., & Tan, J. (2001). Teacher education and teaching in Singapore. In Y. Cheng, M. Mok, & K. Tsui (Eds.), *Teaching effectiveness and teacher development: Towards a new knowledge base* (pp. 407-430). Dordrecht: Kluwer Academic Publishers.

Hargreaves, A., & Fink, D. (2003). Sustaining leadership. *Phi Delta Kappan, 84*(9), 693-700.

Hunter, B. (2001). Against the odds: Professional development and innovation under less-than-ideal conditions. *Journal of Technology and Teacher Education, 9*(4), 473-496.

Jacobsen, M.D. & Lock, J.V. (2004). Technology and teacher education for a knowledge era: Mentoring for student futures, not our past. *Journal of Technology and Teacher Education, 12*(1), 75-101.

Joyce, B. & Showers, B. (2002). *Student Achievement through Staff Development: Fundamentals of School Renewal* (Third Edition). White Plains (NY): Longman Publishing, Inc.

Lawless, K.A. & Pellingrino, J.W. (2007). Professional development in integrating technology into teaching and learning: Knowns, unknowns, and ways to pursue better questions and answers. *Review of Educational Research, 77*(4), 575-614.

Lieberman, A. (2009). Inquiring teachers: Making experience and knowledge public. *Teachers College Record, 111*(8), 2-3.

References

Lim, C.P. (2007). Effective integration of ICT in Singapore schools: Pedagogical and policy implications. *Educational Technology Research and Development, 55*(1), 83-116.

Lim, C.P. & Chai, C.S. (2008). Rethinking Classroom-Oriented Instructional Development Models to Mediate Instructional Planning in Technology Enhanced Learning Environments. *Teaching and Teacher Education, 24*(8), 2002-2013.

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

Robbins, P. (1995). Peer Coaching: quality through collaborative work. In J. Block, S.F. Everson & T.R. Guskey (Eds.) *School Improvement Programs: A Handbook for Educational Leaders*. New York: Scholastic.

Robinson, V.M.J., Lloyd, C.A., & Rowe, K.J. (2008). The Impact of Leadership on Student Outcomes: An Analysis of the Differential Effects of Leadership Types. *Educational Administration Quarterly, 44*(5), 635-674.

Rogers, E.M. (1983). *Diffusion of Innovations (Third Edition)*. New York: Free Press.

Rust, F.O'C. (2009). Teacher research and the problem of practice. *Teachers College Record, 111*(8), 3-4.

Schon, D.A. (1992). The theory of inquiry: Dewey's legacy to education. *Curriculum Inquiry, 22*(2), 119-139.

Shonkoff, J.P. (2000). Science, policy, and practice: Three cultures in search of a shared mission. *Child Development, 71*, 181–187.

Steele, J., & Boudett, K. (2008). The collaborative advantage. *Educational Leadership, 66*(4), 54-59.

Walkington, J. (2005). Becoming a teacher: encouraging development of teacher identity through reflective practice. *Asia-Pacific Journal of Teacher Education, 33*(1), 53 – 64.

Wayne, A.J., Yoon, K.S., Zhu, P., Cronen, S., & Garet, M.S. (2008). Experimenting with teacher professional development: Motives and methods. *Educational Researcher, 37*(8), 469-479.

Wood, D. (2007). Teachers' Learning Communities: Catalyst for Change or a New Infrastructure for the Status Quo? *Teachers College Record, 109*(3) 699-739.

Zhao, Y., Pugh, K. & Sheldon, S. (2002). Conditions for classroom technology innovations. *Teachers College Record, 104*(3), 482-515.

Strategic Dimension **Three**

comments

comments

Strategic Dimension **Four**

Strategic Dimension Four: ICT Plan, Infrastructure, Resources and Support

This strategic dimension discusses fundamental issues relevant to building ICT Plan, Infrastructure, Resources and Support at teacher education institutions. Establishing appropriate ICT plan, infrastructure, resources and support is a critical component of your overall strategy for technology integration in teaching and learning. Within this dimension, the strategic foci are:

- ICT Plan
- ICT Infrastructure and Hardware
- ICT Resources
- ICT Support

ICT Plan

Implementation of ICT infrastructure, resources and support strategy must be guided by a carefully and strategically developed ICT Plan. Implementation of the plan needs to be monitored and regularly reviewed. Developing a plan and implementing appropriate ICT resources and infrastructure is a critical component of your overall strategy for technology integration in teaching and learning. This is a complex task, requiring careful planning, consultations and financial resources. This also requires understanding and alignment amongst many socio-cultural aspects and integral components such as your institutional policies, perspectives of key people affected, knowledge of current and emerging technologies, as well as external forces such as Government policies and global developments (see Lim, & Hung, 2003; Churchill, 2008). What you need as a start is a clear aim for implementation of ICT resources in your institution. As a guide, we propose that such aim might appear similar to the following statement:

> Build environment, services, tools, human capacity and commitments for effective application of technology in educational processes

As a beginning, you might decide to set up a committee representing various stake holders (teacher educators, administrators, pre-service teachers, education authority representative, local business representative, etc) to develop your plan, guide overall ICT implementation and review and ensure that this implementation is in line with your plans and philosophy (TCET, n.d.). Your plan must remain open and flexible to allow experimentation with and adoption of emerging technologies and associated practices. Having to live in the current world full of frequent changes, we find that possessing a flexible mind is critical for progress. Kelly, McCain, and Jukes (2009) write that today we find "fundamentally different environment that is demanding completely new ideas for how things get done" and that these changes "are occurring so rapidly and are of such magnitude that education must quickly adapt or face the very real prospect of becoming irrelevant" (p. 1). For Kelly, McCain, and Jukes, schools need "New Design" and an integral part of this design is ICT resources to support 21st

century learning and digital reality and in order to these new schools to be suitable, we must answer and synthesize into a coherent aim, the following questions:

- What should teaching and learning look like in a 21st-centrury school?
- How can technology foster this kind of learning?
- What non-instructional components should be incorporated into the school?
- How can time be used differently to support what we want the schools to be?
- How can physical facilities be organized to bring this vision to reality?

We direct your attention to the importance of the overall institutional ICT plan, monitoring of its implementation and review of its success. The plan provides useful guide, however, it must be noted, as Microsoft (2008) suggests, that each school has unique issues, priorities, and resources, no general blueprint can be expected to address the specific needs of all schools. Overall ICT plan should be designed in a way that considers "all requirements, is primarily invincible, and is aesthetically pleasing when it is visible" (TCET, n.d.). Overall, your plan must consider technology beyond teaching and learning and include possibilities for supporting your operations at many different levels (e.g., administration).

ICT Infrastructure and Hardware

Setting up your technology infrastructure requires consideration of available physical infrastructure (e.g., rooms for servers, computer rooms/labs, placing of cables and network points, positioning of wireless hubs, electricity supply points), human resources to set up and maintain this infrastructure, and availability of financial resources to support such a project. The infrastructure must be designed to allow expansion and change in response to technology developments (TCET, n.d., p. 16). Here, as a guide, we describe key components of such infrastructure and hardware.

Network

Setting up networks requires appropriate server technology composed of computers for specific purpose (servers) and other associated hardware such as routers, network switches, backup electricity supplies and backup devices (see **Figure 4** for illustrated diagram of the basic network infrastructure). It also requires software to support networking services, web services, file/data management, asset management, and security. Fibre optic cables, routers, network switches, and access points need to be installed across the physical infrastructure with possible amplifiers of network signal in place. Connection is required not only for computer but also for other possible network enabled hardware such as network printers. In addition, your institution is likely to contain a number of separated networks and connecting with these networks might also be required. Finally, you must consider developing wireless network capability to support access to services from anywhere within the campus

(for more detailed discussion about how networks operate and how they can be effectively managed see Education Development Center, 2002).

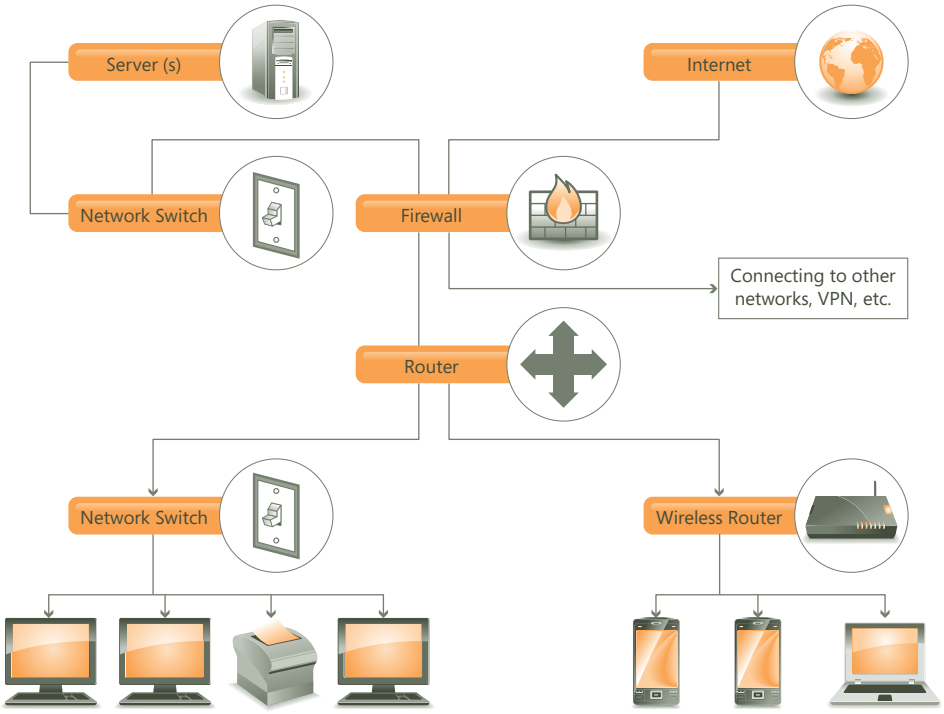


Figure 4: Basic network infrastructure.

Internet access

Providing reliable and fast connection to the Internet is critical for today's teaching, learning and administration (see Grey, 2001). As we know, the Internet contains valuable resources and nowadays provides variety of tools and services that can be leveraged for operational benefits. Today's communication is dependent upon Internet. Without fast and reliable connection even emailing will be a difficult task to do. Setting up the Internet requires you to register with certain authorities in your country and to subscribe to reliable and fast dedicated connection service. Setting up the Internet also requires you to think of potential security problems and as a base-line for dealing with this problem you require the addition of a firewall in your network infrastructure and certain software to protect client stations from attacks from viruses, spyware, malware, etc.

Once the access to the Internet has been organized, you must define how your pre-service teachers and teacher educators will access it. One basic way to access the Internet would be through fixed network points by connecting your computers, or allowing teacher educators and pre-service teachers to plug-in their laptops using wire. However, as learning extends beyond the classroom walls in the library, students hostels, homes and field, it is critical that access to the Internet is expanded beyond the fixed-point infrastructure. The first environment that mist be created is wireless access across the campus. This requires further investment and adjustments into your network infrastructure to include

additional hardware and software such as wireless routers. Having wireless network infrastructure will also allow your teacher educators and pre-service teachers to access the network and the Internet using range or additional hardware beyond the computers that you provide (Chan, 2003; Shotsberger &Vetter, 2001; Warschauer, 2006). These will include their own notebooks, ultraportable PCs and variety of mobile devices such as smart phones and portable digital assistants. Accessing the Internet via mobile devices is gaining increasing popularity as more content and services emerge on the Internet and an exponentially growing number of people possess such devices. Finally, you must consider enabling your teacher educators and pre-service teachers to access the Internet off campus. This can be achieved in a number of ways, including three of the common methods presented here.

1. Installing line-of-sight wireless access (not common in the developed countries).
2. Allowing users to dial-up through the telephone network and connect to the Internet through servers (by joining virtual private network or VPN)
3. Making special arrangements with a telecommunication companies to provide wireless access to users through:
   a) wireless hot spots (such as the ones found in shopping centres, coffee shops, etc.)
   b) through mobile telephony networks.

Computer rooms

Setting up computer rooms or labs is not simply a task of buying suitably priced machines from a vendor and placing them in available rooms. This requires consideration of a number of issues. For example, having computer rooms needs to be considered in context of, for example, pedagogical practices that your institution promotes. A common dilemma is whether to have all computers placed in a few rooms (computer rooms), or have computers distributed across all available classrooms. Certainly, having some computers in all classrooms is a good decision, and it will work in support of students-cantered pedagogical practices that require pre-service teachers to use variety of tools in completing their learning tasks. This would allow pre-service teacher to choose to use technology at any time when needed. Dedicated computers are not required as pre-service teachers would usually work in groups and a computer per group is usually adequate. However, having dedicated computer rooms might still be necessary for those specialist subjects such as programming and multimedia design, and for activities where pre-service teachers are required to access computer-based learning packages and e-learning customized for single users.

Accessing the Internet via mobile devices is gaining increasing popularity as more content and services emerge on the Internet and an exponentially growing number of people possess such devices.

Setting up a computer room also needs principally designed space that would support learning in such an environment. Computers need to be arranged in suitable ways and in such a way that is supported by available network points and power supplies (or structural reworking of a room might be necessary). Other issues needing careful consideration are other properties of the room such as lighting (as sometimes darkening of room might be necessary in particular if there is a problem with reflections of screen that could interfere with visibility). Special curtains and light switches that allow dimming should be in place.

Static electricity might also cause problems, thus consideration of appropriate flooring in the room is required. The room environment might contain various useful posters, and a cabinet with necessary manuals. Physical space should also be planned for associated hardware such as a printer, scanners, a teacher educator's computer and relevant presentation equipment (e.g., visualiser and overhead projectors). One important issue that also needs consideration is the health and safety of this environment. Precautions should be in place to protect pre-service teachers and teacher educator from any possible accidents such as flipping over cables or getting electrocuted. Having a computer room also needs to be accompanied with relevant policy and rules for its use as well as a strategy for booking of the rooms.

Open access rooms

In order to support self-directed learning, lifelong learning, independent projects, etc, pre-service teachers might be provided with access to computers and specialist software at anytime. Computers can be placed in a library and other strategic areas. However, one preferable option is to have open access room that can be used by pre-service teacher at any time. Some institutions around the world have such rooms available to pre-service teachers on a 24-hours basis. Although this might not be possible for your intuition, at least such facility should be made available to pre-service teachers during certain hours of a day. Such rooms should contain sufficient number of computers (usually much greater than the computer rooms for teaching) and other relevant hardware (e.g., printers).

Staff computers

Equipping members of the teaching staff with appropriate computers is an important part of overall strategy for ICT resources. Typically, each teaching staff is provided with a PC to be used in at school. However, today we must think about increased use of computers in teaching and learning as well as that learning and working expands beyond the classroom and office walls. Laptops are a much preferred alternative as their mobility allow teacher educators to take their machines to meetings, home, classrooms, study trips, etc. However, the challenge is that laptops are more expensive. Some institutions are dealing with this problem by allowing teacher educators the option of being provided with a PC or to be given certain amount of funding for a laptop.

Laptop schemas

Laptop schemas for pre-service teachers and teacher educators might be an effective strategy. Such scheme would enable pre-service teachers and teacher educators to purchase laptops at a special price that is considerably below the market price. Some laptop manufacturers/retailers might be keen to consider providing laptops to your institution at reduced prices. The price of laptops might be further reduced if your institution contributes certain amount of funding towards the purchase price. Overall, such strategies would empower your members to purchase their own laptops.

Digital media production facility

Today's teachers must take more active roles in producing teaching and learning material in digital media forms such as multimedia presentations, digital stories, learning objects, and visual representations. Your institution should think about providing facilities that would support digital media production, such as, audio and video recording and editing tools, authoring environment, and production of three-dimensional media. Making media designers and multimedia designers available for teacher educators to assist them in this activity could also prove to be effective.

ICT Resources and Software

Administration system

ICT has indisputable power to support administrative activities, whether in education, business or any other industry. Although the central purpose of this document is to explore ICT integration in teaching and learning, we will briefly address areas for administrative use of technology in an educational institution. Your institution should configure appropriate set of services and tools to support administration. In addition, administration can be supported not only through use of the computer but mobile devices might also have some applicable functions to extend effectiveness of this administration. Here are some suggested possibilities for administrative application of technology in your institution:

- Student records – a system to keep pre-service teachers' data such as their personal data, enrolment details and courses completed.
- Staff records – a system that keeps staff personal data, educational background, work experience, publications.
- Staff holiday systems – a system that enables staff to apply for leave and obtain approval from a supervisor.
- Timetabling – a system that supports planning of timetables and allocation of teaching duties.
- Resource booking – as system that enables booking of resources such as rooms, specific hardware (e.g., a digital camera) and assistance (e.g., of a multimedia designer).
- Meeting management system – a system that supports scheduling of meetings, booking of rooms, checking availability of staff involved, distribution of meeting materials in digital format and management of minutes/summaries of meetings and follow up actions.
- Committee management – a system that tracks committee membership, and provides information about activities of various committees.
- Curriculum development – a system that supports collaborative curriculum development and distribution of curriculum documents and relevant resources.
- Staff portfolio (and performance system) – a system that enables staff to develop and maintain their portfolio which documents their activities, achievements, publications and reflections. Also, this system can be used for assessment of staff performance.
- Financial system – a system that supports financial issues.
- Library system – a system that supports library activities.

- Research management system – a system that supports application for research grants and management of project (this system might also contain component that deals with ethical clearance, application for conference attendances and professional development, and management of research students' projects).

It is important to note that these systems are not independent from each other. They might need to pass information and function together in a holistic system that supports your institution's administration.

Communication system

How we communicate has been changing with new technologies. Predominate telephone communication has been taken over to a large extent by text communications in the form of email. Now we are witnessing that our communication is becoming increasingly multimodal. This means that the messages are composed not just of text but also audio, images and videos. New paradigms are also emerging and lately, we have witnessed that some email communications have been replaced with an emerging forms of communication supported by so-called social networking environments. As mobile phones are becoming more powerful and similar to personal computers in their functions, we are also witnessing that the nature of communication for these devices also changes. In any case, for your institution, it is critical to have reliable and effective communication systems to support your teaching, learning, administration and other activities.

Email communication represents a critical component of your overall operations. A reliable and effective emailing system would ensure that you are always connected. Establishing such a system requires selection of appropriate server components (email server) and corresponding client software to access email. It is becoming increasingly important that you enable web-based access to email accounts for all of your members. People nowadays are on the move, accessing email from different computers, mobile devices, Internet cafés, airports, etc. They should be empowered to access the Internet at anytime, anywhere and from any device that is the Internet enabled. You also need to provide sufficient amount of storage space for each of your accounts. How much space is enough? You can decide on this but remember that even free email services on the Internet provide spaces in excess of 1GB. Another issue that you need to take care of is to ensure that your email system is equipped with a mechanism to identify spams and viruses and defend your architecture and end-users from possible attacks. Email should also integrate with other services. Your system should contain components that enable individuals to manage contacts, appointments, meetings, and project time-lines. Email might be also integrated with a learning management system to allow teacher educators and pre-service teachers to easily send messages and attachments.

It is becoming increasingly important that you enable web-based access to email accounts for all of your members.

A number of Internet technologies today provide easy and often free conferencing tools and services. These should be utilised by your institution. However, you might opt to have dedicated audio/video conferencing facility at your institution. This facility can be used for purposes such as: seminars by overseas scholars,

PhD confirmation meetings where panel members are at different locations, and interviews of job applicants who apply for academic posts from overseas.

Web sites

Organizing web sites is an effective strategy for your institution in a number of ways. Firstly, web sites are effective as a marketing strategy. They allow you to provide potential pre-service teachers with useful information, for example, about your courses. Secondly, web sites enable external community to know more about your activities, strength, vision, and objectives. Thirdly, web sites are effective as a strategy that create constructive self-criticism and promote your own reflections thus influencing you to think about improvements in various aspects of your institution. In this section we will examine some key components of your overall web site. This collection can further grow, depending on your local circumstances and needs.

Home page of TEI

Your institution's home page is the face of your institution to the public. This web page will provide visitors with initial impression about your institution. Thus, this web page must be very attractive, user-friendly and developed using latest Web technology to provide the impression that you are a modern institution, open to developments and that follows trends. The home page should contain most important information and achievements of your institution. It can also contain latest news, important developments and potential employment opportunities. It should provide appropriate navigation that is easy for visitors to follow links to areas of their interest through the network of your web pages. The home page should use a limited set of colours (your corporate colours) and a limited number or preferably just a single larger size image. This image could be dynamically displayed, that is, every visit to your home page would display one of the images from a collection. It is always more effective that these images show friendly faces from your institution with nice background of your facilities (rather than facilities alone). Images from various events, important visitors, and social gathering, sporting events are also effective. You also need to ensure visibility of your home page on the Internet. Search engines must be able to locate you. Potentially, you can advertise your-self on other web sites and ensure that a web address to your institutional home page is printed in publicity documents, your letterheads and staff visit cards. Some institutions these days tend to present themselves in Wikipedia. Having a Wikipedia article about your institution is also an important strategy to inform public about yourself and to draw potential visitors to your web site. Another possibility is to have your corporate video or presentation featured in one of the major video sharing repositories.

Having a Wikipedia article about your institution is also an important strategy to inform public about yourself and to draw potential visitors to your web site.

Each of your departments should have their own web site. Each department's site should present information about the department's activities, teaching, research, community services, and provide information about available programs, and staff members. The site might also provide information about any centre attached to the department.

Strategic Dimension **Four**

Staff pages should provide information about teacher educators such as their background, teaching areas, research interest areas, publications and graduate students. Teacher educators might also wish to present some of their publications and presentations. They might also provide links to their courses pages. Your institution should provide some form of mechanism to support your teacher educators to develop and manage their web pages. As a minimum, you should provide teacher educators with some web space and a strategy for publishing of pages. You might also want to create a set of templates and a web portal to help teacher educators to develop and manage their pages.

You must promote your institution as a modern organisation that follows global developments and participates in creation of new knowledge.

Your web site needs to contain information about your programs and courses. Although this information should also be available from web sites of departments, you should not expect your visitors to go through the departments before accessing information about programs. It is logical to assume that many of your home page visitors will be visiting because of their interest to continue their education. Critical for them is to know if your institution offers a program that is suitable to their needs. In this context, your home page should provide direct access to programs by allowing prospective pre-service teachers to search for programs, read about a program's structure, curriculum, assessment requirements, key teaching staff involved (with links to staff pages), testimonies of alumni, and carrier prospect and further educational opportunities upon graduation.

You web site should provide information about students' life. This might include information about life on campus, study experiences, various activity groups and student organisations. The site might include extract of interviews with pre-service teachers either as text or digital video. The site might also include a blog where pre-service teachers on regular basis write about their experiences at your institution.

You must promote your institution as a modern organisation that follows global developments and participates in creation of new knowledge. You must also show that you are constantly making links between your research and teaching for benefits of your programs and pre-service teachers. This area of your web site should feature your research projects and recognition that your research received locally and international. The web site might also include information about postgraduate students, research programs, scholarship options, research funding, international collaboration and significant publications.

Teaching and learning support system

A number of software tools are required for effective support of teaching and learning. Appropriate selection, installation, configuration and management of these tools will ensure development of your institutional capacity to support teaching and learning not just in classroom environment but also anytime and anywhere (see Peñalvo, 2008). This system of tools will enable you to support classroom integration of technology, blended learning and distance learning courses. The system will support management of your digital assets, course development, activities and administration of learning. In

this part of the document we provide some essential recommendations for selection of suitable set of software tools that can be built into your overall teaching and learning system.

Learning management system or LMS is software that automates administration of teaching and learning. LMS allows registered pre-service teachers to enter assigned course environments. In these environments, pre-service teachers can access course outlines, resources and activities, participate in discussion forums, and submit their assignments. The system allows teacher educators to upload course material, create tests, set-up discussion forums, place pre-service teachers in groups for specific activities and send emails. Some systems also allow synchronous activities such as chatting and interacting. LMS can usually facilitate the creation and delivery of tests, and keeps pre-service teachers results. The system can also keep statistics about usage of resources and access to various areas of learning environment. The courses can be archived for later reuse. Some LMS systems also include blogs, wikies and other so called plug-ins that extend basic functionality (see Richardson, 2006 for more details about Web 2.0 tolls in education). There is a number of popular LMS products that you might select for your institutional uses. Some are costly (e.g., Blackboards) while some others are free for use (e.g., Moodle). Considering technology development, it is quickly becoming evident that today's LMS systems and their functionalities are not sufficient for contemporary teaching and learning (Churchill, 2007). These need to be expanded by inclusion of other components, some of which are discussed in this section of the document.

A collaborative work-space is an environment that supports individuals to share resources, and plan, interact and work on joint projects.

Online learning

An LMS is typically not designed to handle resources developments, sharing and management. Individual teacher educators develop content using publishing or authoring tools and upload these into their course spaces for their own pre-service teachers to access. Usually, such resources are not shared amongst teacher educators and courses. There is no mechanism for these resources to be located and used apart from the course in which they were made available. However, resources (e.g., courseware, notes, presentations, videos, images) are your important assets. These can be reused in different courses, and redeveloped and improved by different people. Optimizing their reuse would result, for example, in saving of time (if a particular resource is located then there is no a need for duplication), and sharing of ideas amongst teacher educators. A suitable repository of digital assets is required to support resource sharing and management. This repository should allow teacher educators to upload resources that they develop or bookmark resources that they find useful in their teaching (e.g., web links or resources developed by others). This system should integrate with LMS and allow a teacher educator to present resources from the repository in their course environments.

Although today's LMS systems usually contain tools that support synchronous (e.g., chat) and asynchronous (e.g., discussion forum) communications, contemporary technology is capable of providing much advanced functionalities. For example, conferencing tools allow the integration of variety of functions into interactive environments that allow real-time data exchange, and text, video and audio communication. Participants can interact through

different modes, exchange files, and display information in real time. Today's systems also tend to integrate tele-communication functionalities, for example, the system is also able to connect to telephones and send SMS messages. Some of these possibilities mean that lectures can be delivered to pre-service teachers in real time via the Internet with the option to engage pre-service teachers in interaction with lecturers, experts in the field and other pre-service teachers. Expanding communicative functionalities of an LMS is something that may be explored.

Collaborative tools

A collaborative work-space is an environment that supports individuals to share resources, and plan, interact and work on joint projects. Such systems usually allow individuals to form groups and track activities of selected people. Such systems also might contain blog, wikies, file-sharing facility, and some communication tools. This system is an important tool for supporting contemporary student-cantered pedagogies as it enables pre-service teachers to collaboratively work on projects.

This system should allow teacher educators to create a questionnaire to early explore pre-service teachers' experiences and identify some formative improvements for their courses. The purpose of the system is to empower teacher educators with a tool to early identify area of potential improvements. The system should support creation of questions and collection and presentation of data.

Your institution might also have a need for "the end of the course" evaluation. This evaluation can also effectively be supported by a system that allows on-line completion and collection of data for presentation to individuals such as course coordinators, heads of departments, etc. End of the course evaluation should allow pre-service teachers to evaluate effectiveness of the course, and teacher educator effectiveness based on their experiences.

Software & additional hardware to support teaching and learning

Selecting and acquiring appropriate set of software tools to support your teaching and learning is in ways equally important as a good selection of appropriate hardware. As we know, hardware can be useless without appropriate software and strategies for effective use. Selection of software must be mapped against your available/projected hardware, intended uses, predominant pedagogical practices, and people skills and preferences. In this section of the document we describe some essential software tools required. We also suggest certain additional hardware that might find effective and productive uses in your institution.

We broadly categorise software tool requirements into three categories:

- Productivity tools
- Creative suites
- Subject-specific tools

Productivity tools include software tools that support processes such as preparation of classroom material (e.g., presentations, notes, worksheets), and administration of teaching (e.g., mark-sheets,

data-bases). Pre-service teachers also need these tools, for example, to write their assignments, and prepare project presentations. Microsoft provides an appropriate selection of tools to support day to day teachers' and students activities (Microsoft Office tools such as Word, Excel, Publisher and PowerPoint).

Creative suites software tools are required to support work with digital media production and managements. New technologies enable individuals to express themselves through a variety of media. Teachers can create digital media for teaching and learning. Many institutions nowadays expect their students to produce digital essays and portfolios composed of digital media instead of traditional written text. Creative suite software might include tools for digital image manipulation (e.g., for preparation of instructional diagrams), digital video editing (for construction of digital video essays), digital audio editing (e.g., for preparation of podcasts of lectures) and multimedia production and authoring (e.g., for development of courseware and learning objects). All these tools must support production of digital media for delivery via the Internet (Web-based media). However, with increased presence of small-screen devices (e.g., smart phone and iPods), producing digital media for delivery via such technology should be considered.

Subject specific software tools might also be required. These might include, for example, software such as graphic calculators, statistical data analysis software, discourse analysis software, accounting software, or software that supports collection of scientific data with aid of some hardware extension.

All these tools must support production of digital media for delivery via the Internet...

Although you can find resources on almost any topic on the Internet today, you might also decide to acquire a collection of educational CD-Rom/DVD titles. These can be made available to teacher educators and pre-service teachers through your library. There are some excellent encyclopedias, interactive multimedia tutorials and instructional games available as CD-Rom/DVD titles. In addition, there are also some instructional videos which might be worth acquiring and making available for teaching and learning purposes.

Besides providing computers for teaching and learning, you will need to consider acquiring a range of other associated hardware and tools. These might include following:

- Projectors – necessary for projection of a computer screen. Most, if not all, of your classrooms should be equipped with projectors.
- Interactive white boards – this technology emerged over the last few years and has become every popular in schools in the developed world. Initially, these were very expensive; however, their price has considerably reduced lately. Interactive white boards allow computer screen to be displayed on a large interactive surface. Teacher educators and pre-service teachers can interact with these displays, highlight information, write on it, move objects, etc. There is an increasing number of educational software available that is designed specifically for application via interactive white boards.

- Printers – you might decide to acquire and provide a printer in each of your computer rooms/labs. However, some institutions believe in a so called paperless environment. Documents can be easily distributed and accessed in portable digital format that preserve original look and feel. These can be read, annotated and manipulated on a computer screen without a need for printing. Pre-service teachers can submit their assignments in digital forms. However, access to printers needs to be arranged at least for your teaching staff, but even for them this should also be managed appropriately. This can be achieved by introducing limited printing quota available to each teacher educator.
- Scanners – A few units of scanners will prove to be useful. For example, scanners will allow pictures and text to be converted from analogue to digital format.
- Digital cameras (still pictures and video) – digital cameras are important tools for teacher educators and pre-service teachers to capture images and videos. Some of these devices should be acquired and made available for loan to teacher educators and pre-service teachers. However, these days, mobile telephones also can capture images and videos and possible educational application of this affordance should be explored.
- Digital audio recorders – these devices can be used to record lectures and interviews. These devices support hours of recoding and usually are accompanied with a software that supports audio editing and conversion of files in formats suitable for audio CD and podcasting. They might be in particular useful to support research where researchers collect data by interviewing study participants or to support teacher educators who wish to audio record their lectures and make them available as podcasts.
- Portable digital assistants (PDA) and other mobile devices – PDA devices today are powerful technology with capabilities similar to computers (see Roschelle, 2003). They are Internet-enabled and equipped with a powerful operating system (Microsoft Mobile) and a set of tools such as MS Office Mobile (Word, Excel, etc.). They integrate well with other computer applications and support emailing, calendars, notes etc. They allow digital media display and portable documents (e.g., e-books). More recently there has been integration of this technology with mobile phones and digital cameras. This marriage produced new generation of powerful personal devices whose potential for educational applications should not be ignored.
- Ultraportable PCs – lately there has been an increased number of ultraportable PC available at low cost (e.g., Classmate PC or EEE). Potential for their educational applications should be explored.

Besides these listed additional hardware, it is important to remain sensitive to developments and be open to experimenting and acquiring emerging technologies which have potential to advance teaching and learning activities.

Security

It is important to consider challenges that emerge with the integration of technology in teaching and learning. Here, we use the term security to broadly address some of the important issues.

Firewalls and virus protection software need to be installed on your servers and client machines to protect them from attacks by viruses, spyware, malware, phishing attacks and to otherwise defend system and data. Your computers need to be properly configured to allow automatic Windows updates and updates to virus definition. New forms of attack emerge continuously and unless your computers and servers are protected with latest updates this will pose serious risk. Virus protection should also guard against viruses that might be accidently or purposefully introduced by pre-service teacher files (e.g., submitted assignments and mail attachments). You also need to carefully guard your wireless network from intruders.

The Internet is becoming more challenging due to increased activities of criminal groups and individuals with dishonest intentions. For example, these include various soliciting to engage in online interactions, extortions of money, sexual predating, pornography, pressure to invest and buy products. Although this might not be particularly challenging in higher education environment, schools with underage students must take on the responsibility to educate and protect students from this problem. Some software solutions such as Net Nanny from Finer Technologies offer a degree of protection. However, it is becoming increasingly difficult to monitor and control what people do on the Internet. The least we can do is to educate our pre-service teachers about these threats and their individual and social responsibilities when using the Internet.

In addition to the problems from outside, some inappropriate behaviour of our own pre-service teachers might also pose challenges (e.g., visiting inappropriate sites and installing unlicensed software). One solution to some of these problems is blocking access to certain sites. However, continuous emergence of new web sites means that it is hard to stay updated. Some software solutions enable computer classroom management that allows facilitators to view screens of students' computers and intervene if necessary (e.g., Junglebyte). In addition, the computers should be configured in a way that prevents unauthorised installation of software.

Your institution will house expensive computer equipment, associated hardware and software tools. These assets are exposed to potential theft. One way to protect your assets is to obtain an appropriate insurance policy. However, in order to protect your assets with insurance policy you are also responsible for installing certain security measures. Some of these measures might include: installation of security cameras, ensuring that doors and windows are installed with elements that secure appropriate closure (e.g., entrance door requires smartcard for entry), installation of alarm system, steel cables used to attach hardware to fixed structures, and regular visits by security guards. Some advanced possibilities include use of biometric devices and RFID technology (Radio Frequency Identification).

The least we can do is to educate our pre-service teachers about these [criminal] threats...

Teacher educators, pre-service teachers and other people using your computer equipment must be protected from potential accidents. Cabling must be arranged to prevent any accidental contact with electricity, fire or flipping over. Environmental factors such as lighting, noise level, selected furniture and arrangement of computer peripheral must be ergonomically organized. Providing safe environment also means that you have to establish a set of rules for use of computer equipment and labs. For example, eating and drinking in a computer lab should not be allowed. Finally, it is important to have an appropriate insurance policy to protect your ICT resources.

Strategic Dimension **Four**

ICT support

Your ICT strategy will require a set of professionals to support implementation and operations. This support should include support for educators (e.g., instructional design support, technical support, media production support), ICT support for pre-service teachers, and ICT support for administration. TCET (n.d.) suggest that "essential piece of the technology infrastructure that is too often overlooked is an adequate technical support staff– adequate in terms of the number of full-time technical support personnel and in terms of their skills and experience" (p.20). The following is a list of essential individuals although scope of your operation will more precisely define your needs:

- Network specialist – responsible for designing your network topology, and installing and maintaining network functionalities.
- Computer technical officers – responsible for servers management, computer labs management, checking that legal versions of software are used throughout the computer labs, and management of client workstations (e.g., teacher educators' computers)
- Programmer (system engineer) – responsible for installation, management of system components and development of server-side applications, management of your data-bases (you might also consider data-base administrator as a separated individual) and other programming tasks as required by your environment
- Instructional designer – to design educational resources and manage e-learning strategy
- Media/audio-visual specialist – to develop media and support teacher educators in media design activities
- Multimedia production specialist – to author instructional multimedia, courseware and learning objects, and to assist teacher educators who engage in this process themselves
- Web master – to develop and maintain your institutions' web sites

References

Chan, S. C. (2003). Wireless technology use in schools to support student learning. Retrieved December 10, 2008, from http://hub.hku.hk/handle/123456789/31009.

Churchill, D. (2007). Web 2.0 and Possibilities for Educational Applications. *Educational Technology, 47*(2), 24-29.

Churchill, D. (2008). *E-learning: concepts and issues for higher education. ASAIHL Conference:* Borderless education: challenges an opportunities for Southeast Asian universities. April 7-10, 2008, Bangkok, Thailand.

Education Development Center. (2002). *The School Network Handbook*. International Society for Technology in Education.

Grey, D. (2001). *The Internet in school.* London: Continuum.

Kelly, S. F., McCain, T., & Jukes, I. (2009). *Teaching the digital generation: no more cookie-cutter high schools.* Thousand Oaks, CA: Corwin Press.

Lim, C.P., & Hung, D. (2003). An activity theory approach to research of ICT integration in Singapore schools. *Computers & Education, 41*(2003), 49-63.

Microsoft (2008). *Microsoft Technology Blueprint for Primary and Secondary Schools Research.* Retrieved, December 18, 2008 from http://www.microsoft.com/education/blueprint/default.mspx.

Peñalvo, F. J. G. (2008). *Advances in e-learning : experiences and methodologies* (Ed.). Hershey, PA: Information Science Reference.

Richardson, W. (2006). *Blogs, Wikis, Podcasts and Other Powerful Web Tools for Classrooms.* Thousand Oaks, CA: Corwin Press.

Roschelle, J. (2003). Unlocking the learning value of wireless mobile devices. *JCAL, 19*(3), 260-272.

Shotsberger, P. G., & Vetter, R. (2001). *Teaching and Learning in the Wireless Classroom. Computer, 34*(3), 110-111.

Texas Centre for Educational Technology, TCET. (n.d.). *Designing the technology infrastructure for school.* Retrieved December 10, 2008, from http://www.tcet.unt.edu/pubs/di/.

Warschauer, M. (2006). *Laptops and Literacy: Learning in the Wireless Classroom.* New York: Teachers College Press.

Strategic Dimension **Four**

comments

comments

Strategic Dimension **Five**

Communications and Partnerships

Communications and partnerships are two key inter-dependent pillars that support the capacity of TEIs for ICT in education. Effective communications between the TEIs and other organisations provide the foundation for building partnerships between the TEIs and organisations. In these partnerships, effective communication is pivotal in building trust and respect among the various stakeholders. ICT provides the opportunities to facilitate such communications. Recent evidence indicates that TEIs that have been developing tightly integrated programs that involve schools, school sectors (ministries of education, departments of education, etc.), and private sector are more likely to produce teachers who are more effective and stay in teaching for a longer period of time (Darling-Hammond, 2006; Edwards & Mutton, 2007). This highlights the importance of TEIs engaging partners in their community of practice to improve the recruitment, quality and retention of teachers.

Given the pertinence of engaging partners in teacher education, this section focuses on communications and partnerships. It explains the following six strategic foci and provides examples of best practices and lessons learnt:

- Communications Facilitated by ICT
- Institutional Approach Towards Partnerships on the Use of ICT for Teaching, Learning and Administration
- Partnerships with Schools on the Use of ICT for Teaching, Learning and Administration
- Partnerships with Education Ministry or Department on the Use of ICT for Teaching, Learning and Administration
- Partnerships with Other Private, Public, National and International Organisations on the Use of ICT for Teaching, Learning and Administration
- Engagements with Local and Global Communities Facilitated by ICT

Communications Facilitated by ICT

Learning to teach well is an ongoing process for teachers. For the professional learning of teachers to be effective, it has to be linked to their own practice and more importantly, an intimate understanding of the context they work in and its broader socio-cultural contexts (Cochran-Smith & Lytle, 2001). To bridge the gap between theory and practice, partnership between the TEI and its stakeholders is pivotal. Partnerships may be established by activities such as mentor teachers, site directors, teacher educators and program directors taking joint responsibility in planning, implementing and reviewing professional learning activities that support current pedagogy and are aligned with current education issues. Communication among these stakeholders of teacher education then becomes a necessary condition to support such partnerships. ICT affords partnerships with anywhere and anytime communication, both synchronous and asynchronous. For ICT-mediated communication to be effective, it has to go beyond the dissemination of updated and well-organised information on

the TEI's website or e-newsletters that are sent out to its stakeholders. It has to engage them with a multi-directional communication through online chats, forums and conferences; and empower them to contribute to conversations about enhancing professional learning programs for teachers.

At the National Institute of Education in Singapore, Sharpe, Hu, Crawford, Gopinathan, Khine, Moo, & Wong (2003) show how multipoint desktop video conferencing is being used to engage pre-service teachers, mentor teachers and teacher educators in a dialogue about the pre-service teachers' practices during the practicum. Connections between theory and practice are made to help the pre-service teachers reflect upon and make sense of their practices. More importantly, such communications promote sharing of common purposes, values and language between the TEI and its stakeholders, addressing the criticism of a lack of dialogues among the stakeholders of teacher education (Triggs & John, 2004).

Institutional Approach Towards Partnerships

Although partnerships with other stakeholders of teacher education offer significant benefits for the TEIs in building their capacity for ICT in education, establishing and sustaining successful partnerships is challenging. Research studies have identified two key challenges faced by TEIs – logistical issues and organisational differences (Bartholomew & Sandholtz, 2009). The former includes time, rewards and incentives, and funding, and the latter includes missions, organisational structure and culture. Therefore, besides encouraging teacher educators and deans to establish partnerships, the TEI has to provide them the support to address these challenges.

Since the establishment of partnerships is time intensive, the rewards and incentives system developed by the TEI is crucial to ensure sustained participation by teacher educators and deans, and also their partners. At the same time, financial resources have to be set aside by the TEI to launch and institutionalise the partnerships. Although external funding may be secured for some of these partnerships, funding from within the TEI is necessary to demonstrate its commitment to its partners. The TEI also has to build a long-term relationship with schools and education agencies where trust and openness are pivotal to the relationship. The culture of a TEI differs significantly from that of the culture of a school or education agency. Teacher educators and deans tend to take a more theoretical approach to new situations and problems, whereas teachers and school leaders tend to take a more pragmatic approach (Davies, Edwards, Gannon, & Laws, 2007). These differences may lead to potential conflicts and hence, trust and openness among the partners are pivotal to successful partnerships; and the TEI has to adopt an institutional wide approach in establishing such relationships.

Partnerships with Schools

One of the key challenges facing pre-service teacher education programs is the lack of connection between the programs that are carried out predominantly in TEIs and the teaching and learning practices that are taking place in schools (Furlong, 2005; Levine, 2007). This may lead to a gap between theory and practice for pre-service teachers, difficulty in finding practicum placements of quality for

pre-service teachers to gain professional experience and lack of transferability of core competencies between TEIs and schools (Villegas & Davis, 2007). The development of core competencies requires both theoretical knowledge and practical experiences. Deng (2004, p. 143) explains the role of theory in pre-service teacher education: "The role of theory is not only to assist in the training of pre-service teachers in skills and procedures, but more importantly, to educate them more widely about the complexities, intellectual and moral nature of classroom practice". He adds that making the link between theory and practice is a complex process where the practicum has an important role in establishing this link.

Hence, a strong TEI-school partnership model is critical to support such field experiences by pre-service teachers (Wong & Goh, 2002). Besides working together towards the shared goal of improving the quality of teachers and co-developing strategies to accomplish this goal, schools are more involved in the assessment of pre-service teachers. By shifting teachers and their 'wisdom of practice' from the margins to the centre of investigations about teaching provides a different perspective of teacher education (Lieberman & Mace, 2008). This perspective will position pre-service teacher education programs to be more relevant and responsive to the needs of schools. Active involvement of pre-service teachers in schools strengthen the links between theory and practice as they receive a more holistic practicum experience by being involved in school activities such as staff meetings etc. Pre-service teachers may also be involved in research or collaboration with school staff.

A strong TEI-school partnership is also critical for the on-going professional learning for both mentor teachers and teacher educators. Mentor teachers and teacher educators have to model and guide learning and teaching practices in schools and TEIs, they also need to know when to fade the guidance of these practices. Moreover, mentor teachers have to be equipped with the science of teaching and learning to help pre-service teachers make sense of their practices, and teacher educators have to be equipped with a sense of reality into the everyday activities and practices of the school. At the Teachers College of Emporia State University in the United States, teacher educators spend a substantial amount of time in schools to teach demonstration classes, team teach with teachers, and mentor pre-service teachers (Levine, 2007). Teacher educators may also need to position themselves as co-researchers with teachers and pre-service teachers to inquire and examine teachers' practices in ICT-enhanced learning environments. Davies, Edwards, Gannon, and Laws (2007, p. 37) warn that:

> "When teachers begin teaching they find the answers they have been given in their training often do not work for them. Since they have not been given the analytic processes to discover why it doesn't work and to generate new answers, they often blame those who taught them."

Co-inquiry then, ensures that the credibility of teacher educators remains intact.

However, there is considerable diversity of TEI-school partnership models that fall into three main categories:

1. Where the TEI has more power than schools
2. Where there is a separatist or complementary partnership, that is, where schools and TEI agree to have separate but complementary fields of responsibility

3. Where there is collaboration based on equal partnership between the TEI and schools (Furlong, Whitty, Barrett, Barton, & Miles, 1995).

It is the last category that TEIs aim to achieve. Partnerships with schools involve not only activities where teacher educators serve as resource persons, but also activities where teachers and school leaders serve as resource persons such as being involved in the design and development of the curriculum and assessment tasks and teaching in the pre-service teacher education program.

Partnerships with Education Ministry or Department

Although partnerships between TEIs and schools are important to provide pre-service teachers with a scaffolded professional learning experience in the school context, these partnerships may be further strengthened with the involvement of the education ministries or departments. For example, in the Oxford Internship Scheme for pre-service secondary school teachers undergoing a one-year postgraduate education program, the interns are supported by the school, TEI and the local education authority to acquire situational competencies of teaching that are evidence-based and to be enculturated as a secondary school teacher by being a member of the school community (Furlong, 2005). Such situational competencies include using ICT for effective teaching and learning. TEIs, schools and education ministries share the common goal of educating pre-service teachers who, upon graduation, will be the kind of beginning teachers that schools wish to employ. This is highlighted in 2003 by the National Council on Teaching and America's Future (NCTAF) that a consensus has been reached where "well-prepared teachers are the most valuable resource a community can provide to its young people" (NCTAF, 2003, p.4). Hence, many TEIs in the world have established long-term working relationships with education ministries and schools.

The partnership between the TEI and education ministry is not a uni-dimensional or unidirectional one; both parties share a common goal that cannot be reached by either party independently (Callahan & Martin, 2007). Besides undertaking commissioned projects by the education ministry or department, the partnership between the two parties on the use of ICT for teaching, learning or administration may involve education officers and directors engage in the design and development of the curriculum and assessment tasks and teaching in the pre-service teacher education program.

Partnerships with Other Private, Public, National and International Organisations

There is growing belief that no one sector can effectively bring together the resources and capability to address or resolve the social and development issues we are facing (Googins & Rochlin, 2000; Tennyson, 2003). Public-private partnerships (PPP) as possible mechanisms for developing and sustaining public infrastructure and services have created growing interest from governments around the world (Moore, 2005). Public is used to refer to any service or infrastructure provided by the state whereas private refers to any endeavours that are associated with the private sector or non-state sector. This includes both civil not-for-profit organizations and those more commonly associated with profit-related objectives (Latham, 2006). For the latter, they are usually corporations that have

the resources and desire to undertake social responsibility. Partnership is used to refer to activities that require shared objectives, responsibilities, decision-making and risk. PPP then focuses on the shared responsibility of both the public and private sectors towards the provision and maintenance of infrastructure and services for the general population.

Despite the growing interest in PPP, there have been few peer-reviewed articles regarding specific case studies of PPP and how they provide or fail to provide for infrastructure and services for the country. Such case studies are especially scarce in the area of education reform. Many of these case studies focus on how PPP is instrumental to bridge the digital gap between the haves and have-nots. Dangwal, Jha, Chatterjee, and Mitra (2005) provide an account of how a PPP seeks to bridge this gap and provide educational opportunity to those individuals typically associated with the disadvantaged. In this project, the government of a developing nation establishes a PPP with a private sector technology company to provide technical solutions to support the education of students who were irregular or non attendees in traditional classrooms. While the paper does not describe the structure, operational procedures or the project management of the PPP, it outlines a project that has clear educational benefit for disadvantaged youth.

Another PPP that has been documented and published is the Co-NECT model of school reform that is funded by New American Schools (NAS), working together with private and public sector partners. The Co-NECT project emphasises the development of students' higher-order skills through their work on extended, multidisciplinary projects. To provide a conducive environment for project-based learning, Co-NECT restructures the organisation of students by forming them into clusters composed of students across grade levels. Co-NECT also provides professional development for the teachers and works closely with the principals to support the teachers. Although ICT is a pivotal tool in all curriculum areas, the Co-NECT model does not position ICT to be a reform in and of itself. In this model, ICT serves as a hub that holds together several aspects of a school reform effort (Russell & Haney, 1997).

...Many [PPP] have chosen to focus on building capacity of local stakeholders and end users.

One of the few articles on PPP in teacher education evaluates the Microsoft's Partners-in-Learning Initiative (Lim, Wong & Quah, 2007). Based on the collective case study of five Asian countries in the initiative, the article discusses the best practices and associated problems, and formulates lessons learned and recommendations for the sustainability and scalability of a PPP. The partnerships (at the local and national levels) highlighted in this paper are usually based on commonly agreed objectives and many have chosen to focus on building capacity of local stakeholders and end users. At the same time, the creation of partnerships with the local TEIs is seen as a way to ensure sustainability and scalability of the initiative.

However, in an era of increasing accountability of education institutions, the challenge is to measure the impact of these partnerships; "ultimately, the time and effort spent on a partnership needs to translate into some sort of measurable outcome" (Callahan & Martin, 2007, p. 143). The outcomes may include both quantitative and qualitative measures such as student achievement data, school readiness data of pre-service teachers, teacher educators' understanding of practices and policies in schools, and school leaders' perception and assessment of pre-service teachers longitudinally.

Engagements with Local and Global Communities

Economic, ecological, social, political and cultural integration across nation states combined with the rapid advancement of technology have brought about transformations that are part of globalisation. Regardless of our location, we face a common destiny; where the unfolding of an event in one part of the world affects lives in other parts. In such a new world order, our children and young people have to be prepared to be agents of change rather than just passive observers of world events (Davies, 2006; Torres, 2002). TEIs have to start engaging pre-service teachers in activities and conversations about preparing their students in understanding the nature of global issues and taking an active role in addressing them.

Engagement is paramount for learning success; where engagement entails mindfulness, intrinsic motivation, cognitive effort and attention. Learning for engagement has to involve teachers in empowering their students and providing them with opportunities to enact the meaning that they have made of a phenomenon as a global citizen. Globalisation is a complex and multidimensional phenomenon that has become a part of everyday life that complicates local, national and global boundaries and creates tension between local and global dynamics (Yamashita, 2006). In light of such a phenomenon and its associated challenges, learning for engagement has to provide students with opportunities to critically examine local and global issues and act upon them. ICT affords such engagements by bringing the learning experiences of the students beyond the four walls of the classroom. TEIs may then start engaging local and global communities, facilitated by ICT, and make such engagements as integral parts of the pre-service teacher education curriculum and assessment.

ICT opens opportunities for TEIs to collaborate with different organizations and people in local and international communities to engage pre-service teachers in conversations about and action of local and global issues. With planning and commitment, TEIs are capable of innovative ICT-based projects to improve the bonds between themselves and their communities. One example is the partnership between Southern Cross University and the Advisory Committees of the Gondwana Rainforests of Australia World Heritage Area to engage schools in promoting environmental education goals. As part of their university assessment requirements, pre-service teachers may choose to create web-based teaching and learning resources on rainforests and world heritage areas for use at primary and secondary schools. It is important that such localised resources are developed as the students in schools are more likely to relate to environmental issues in their own context. Moreover, such resources may be a springboard for partnerships between local organisations and schools to engage in environmental teaching and learning activities.

References

Callahan, J.L. & Martin, D. (2007). The spectrum of school-university partnerships: A typology of organisational learning systems. *Teaching and Teacher Education, 23*(2), 136-145.

Bartholomew, S.S. & Sandholtz, J.H. (2009). Competing views of teaching in a school-university partnership. *Teaching and Teacher Education, 25*(1), 155-165.

Dangwal, R., Jha, Swati, Chatterjee, S. & Mitra, S. (2005). A model of how children acquire computing skills from Hole-in-the-Wall computers in public places. *Information Technologies and International Development, 2*(4), 41-60.

Darling-Hammond, L. (2006). *Powerful Teacher Education: Lessons From Exemplary Programs.* San Francisco (CA): Jossey-Bass Publishers.

Davies, B., Edwards, J., Gannon, S. & Laws, C. (2007). Neo-liberal subjectivities and the limits of social change in university-community partnerships. *Asia-Pacific Journal of Teacher Education, 35*(1), 27-40.

Davies, L. (2006). Global citizenship: Abstraction or framework for action? *Educational Review, 58*(1), 5-25.

Deng, Z. (2004). The role of theory in teacher preparation: An analysis of the concept of theory application. *Asia-Pacific Journal of Teacher Education, 32*(2), 143-157.

Edwards, A. & Mutton, T. (2007). Looking forward: Rethinking professional learning through partnership arrangements in Initial Teacher Education. *Oxford Review of Education, 33*(4), 503 – 519.

Furlong, J. (2005). New Labour and teacher education: the end of an era. *Oxford Review of Education, 31*(1), 119 – 134.

Furlong, J., Whitty, G., Barrett, E., Barton, L., & Miles, S. (1995). Integration and partnership in initial teacher education – Dilemmas and possibilities. *Research Papers In Education, 9*(3), 281-301.

Googins, B. & Rochlin, S. (2000). Creating the partnership society: Understanding the rhetoric and reality of cross-sectoral partnerships. *Business and Society Review, 105*(1), 127-144.

Latham, M. (2006). Private, Public Partnerships: Fact of fiction - what is the score? [Electronic Version]. Retrieved January 29, 2009 from: http://www.cfbt.com/pdf/Michael%20Latham%20Paper%20/PPPs%20Fact%20or%20Fiction.pdf.

Levine, A.E. (2007). The school-college divide and teacher preparation. *Education Week, 26*(17), 46-48.

Lieberman, A. & Mace, D.H.P. (2008). Teacher learning: The key to educational reform. *Journal of Teacher Education, 59*(3), 226-234.

Lim, C. P., Wong, P., & Quah, V. (2007). Supporting technology use in schools with a public-private partnership: A collective case study of five Asian countries. *Educational Media International, 44*(3), 267-285.

Moore, M. H. (2005). Creating public value through private/public partnerships [Electronic Version]. Retrieved January 29, 2009 from: http://www.unpan1.un.org/intradoc/groups/public/documents/CLAD/clad0052203.pdf.

National Commission on Teaching and America' Future (NCTAF) (2003). *No Dream Denied: A Pledge to America's Children.* New York.

Russell, M. & Haney, W. (1997). Testing writing on computers: An experiment comparing student performance on tests conducted via computer and via paper-and-pencil. *Education Policy Analysis, 5*(3).

Sharpe, L., Hu, C., Crawford, L., Gopinathan, S., Khine, M.S., Moo, S.N., & Wong, A. (2003). Enhancing multipoint desktop video conferencing (MDVC) with lesson video clips: recent developments in pre-service teaching practice in Singapore. *Teaching and Teacher Education, 19*(5), 529-541.

Tennyson, R. (2003). *The Partnering Toolbook.* London: The International Business Leaders Forum (IBLF).

Torres, C.A. (2002). Globalization, education and citizenship: Solidarity versus markets? *American Educational Research Journal, 39*(2), 363-378.

Triggs, P. & John, P. (2004). From transaction to transformation: information and communication technology, professional development and the formation of communities of practice. *Journal of Computer Assisted Learning, 20*(6), 426-439.

Villegas, A.M., & Davis, D. (2007). Approaches to diversifying the teaching force: Attending to issues of recruitment, preparation, and retention. *Teacher Education Quarterly, 34*(4), 137-147.

Wong, A., & Goh, K.C. (2002). The practicum in teacher training: A preliminary and qualitative assessment of the improved National Institute of Education-School partnership model in Singapore. *Asia-Pacific Journal of Teacher Education, 30*(2), 197-206.

Yamashita, H. (2006). Global citizenship education and war: The needs of teachers and learners. *Educational Review, 58*(1), 27-39.

comments

Strategic Dimension **Five**

comments

comments

Strategic Dimension **Six**

Research and Evaluation

This strategic dimension discusses fundamental issues relevant to building environment, services, tools, human capacity and commitments to educational research and evaluation involving ICT at teacher education institutions. Research is best described as the systematic and objective approach to scholarly inquiry that is directed toward a solution of a problem and advancement of human knowledge through development of theories. It utilizes carefully designed procedures that apply rigorous analysis and builds on what is already known about an educational problem and how others have investigated it or similar problems in the field. Roblyer and Knezek (2003) write that research involving technology in education should:

a) have a commonly-held, theory-based agenda
b) deliver findings that provide convincing evidence about how technologies enhance achievement and motivation
c) lead to shaping of practice in the field

Overall, there are three key research paradigms: empiricism, critical theory and interpretivism (for discussion about these paradigms see Willis, Thompson, & Sadera, 1999).

This chapter does not intend to provide detailed discussion about specific methodologies in the educational research involving ICT, or how such research can be conducted. There is a large body of literature that discusses fundamental issues of educational research (see Blaxter, Hughes, & Tight, 2001; Cohen, Manion, & Morrison, 2000; Gall, Gall, & Borg, 1999; Gay, Mills, & Airasian, 2006; Krathwohl, 1998). Rather, this strategic dimension provides a rationale, and directs a reader's attention to the important issues relevant to building and sustaining one's institutional capacity for research involving ICT in education. Within this dimension, the strategic foci are:

- Evidence-Based ICT-Mediated Practices and ICT-Related Policies
- Research and Development Funding and Support
- Impact of Research and Development on the Pre-Service Teacher Education Program
- Impact of Research and Development on Schools and the Education System
- Evaluation

Evidence-Based ICT-Mediated Practices and ICT-Related Policies

Constant revision is needed to be in tandem with the ICT advancements (evidence-based policies and practices)

Developing and sustaining institutional research capacity will ensure relevance and continuous advancement in teacher education programs through generation and application of new knowledge, technologies, pedagogies, effective ICT policies, effective administration services, and lead to support and advancement of the local educational system and schools. At the same time the research will

provide platform for professional advancement of academics staff (teacher educators) and increase in scholarly impact of the institution. Building and sustaining institutional research capacity is particularly important in the contemporary technology-inhibited world as ICT continuously creates new opportunities and challenges for education. Constant research is needed to be in tandem with the ICT advancements to provide evidence to developments and changes in policies and practices.

Literature discusses a spectrum of possible areas for research involving ICT in education. Overall, it is suggested that there is a growing need for more focused studies that will produce convincing evidence on technology's benefits to education (Pollard & Pollard, 2004; Roblyer & Knezek, 2003). This is in particular important, as teacher educators and policy-makers seek out educational technology research to provide sound rationale that their time, effort and funds are properly invested (Ringstaff & Kelley, 2002). Furthermore, Ringstaff and Kelley (2002, p. 24) suggest:

> [T]here is a substantial body of research that suggests that technology can have a positive effect on student achievement under certain circumstances and when used for certain purposes. However, there is no magic formula that educators and policymakers can use to determine if this "return" is actually worth the "investment." Perhaps, rather than asking, "Is technology worth the cost?" the more important question is, "Under what conditions does technology have the most benefits for students?"

Roblyer (2005) and Roblyer and Knezek (2003) suggest that relevant research should aim to:

- establish relative advantage of ICT in education
- develop and improve implementation strategies
- monitor impact on important societal goals, monitor and report on common uses
- shape desired directions

For Hanffin et al. (1996), the central focus of research involving technology in education should be to understand "the cognitive impact of people working in partnership with technology rather than studying the effect of technology on learning" (p. 392). It is suggested that this will lead us to "understand better how to optimize the capabilities of learners and technology, as well as to conceptualize how emerging technologies can be utilized to improve classrooms and school" (Hanaffin et al., 1996, p. 395). More specifically, reporting on the outcome of Delphy Study, Pollard & Pollard (2004, p.159) underline as important the following focus areas for research on ICT in education:

- Examine the relationship of technology and learning,
- Develop models for preparing in-service and pre-service teachers to be more effective users of technology,
- Develop instructional models to support student learning in the classroom and in the online environment,
- Develop appropriate methods and criteria for evaluating the effectiveness of technology-enhanced instruction,
- Investigate changes in the classroom, teacher roles, and schools due to technology integration and determine how technology might best facilitate educational reform, and

- Investigate factors influencing the digital divide and the effects of technology on social interaction and collaboration.

Hedberg and Lim (2004) suggest that some issues are more strategically important for research involving technology in education. These include the following as issues:

- Professional development of teachers in ICT integration (from pre-service to in-service)
- Research of emerging technologies grounded in theories and pedagogies
- Systemic processes in schools to facilitate ICT integration
- ICT integration in specific disciplines; that is, how the affordances of ICT are taken up to enculturate students into discipline-specific way of thinking
- ICT-mediated learning environments for low-performance students
- Student generated games and simulations

Similarly, Hanaffin et all. (1996), recommends a set of key issues for research involving ICT in education which, arguably, will dominate research in the 21st century:

- Development of alternative design strategies for designing learning environments,
- Rapid prototyping of innovative designs and strategies
- Hybridization of analog technologies into digital formats
- Tools and resources that aid in the construction of knowledge
- Innovative classrooms and reinvented schools
- Optimization of both learner and technological capabilities
- Integrated view of clarification of relationships among teaching, learning, and technologies
- Redefinition of research problems and assessment methods
- The study of expertise
- Evolution of new, integrated theories

Areas of research focus

This part of the strategic dimension presents some area that might provide productive grounds for research involving ICT in education at a teacher education institution. It is hoped that these areas will help influence teacher educators to recognize appropriate research opportunities and needs within their own context.

Teacher educators' own environments provide places for conducting research with emerging pedagogical practices and ICT in the context of teacher education. Such research might, for example, explore pre-service teachers' perspectives about ICT, teacher educators' changes through pedagogical integration of ICT, effects of certain technology on learning outcomes, new assessment models such as digital portfolio assessment, cognitive processes through learning uses of digital media, students as media designers, etc. Teacher educators should be encouraged to formalize their experimentation with ICT by strategically collecting data, and aiming to present and publish outcomes of their effort (for an example of such study see Churchill, 2009). At the more centralized level, a teacher education

institution can conduct formal studies of uses of ICT in classrooms and effects on teaching, learning and assessment in a teacher education program (for overview of issues relevant to research on technology and teacher education see Willis, Thompson and Sadera, 1999).

Schools in a country provide another important context for research. Unlike research in own classrooms, research in schools needs to be organized and conducted in more formal ways with permissions from people affected, such as, school principals, teachers, students and parents. Potential studies in schools might focus, for example, on the effect of ICT on student learning, teachers' pedagogical development, or school leadership and ICT policy. Studies conducted in schools with students and teachers provide important insights for pedagogical application of ICT, and inform possibilities and approaches for conducting research in such environments.

There is a large number of studies that investigated students' uses of ICT in schools and documented a variety of relevant issues, such as, effects on learning outcomes and achievement, collaboration, knowledge building, engagement attitudes toward learning, self-confidence, and self-esteem (see Butzin, 2000; Sandholtz, Ringstaff, & Dwyer, 1997; Scardamalia, & Bereiter, 1994; Schacter, & Fagnano, 1999; Sivin-Kachala, & Bialo, 2000; Teo, & Churchill, 2007b; Waxman, Connell, Gray, 2002). One important effect of ICT in the classroom suggested by the literature is that technology transforms pedagogy in student-centered direction, for example, inquiries and project-based activities where students are more engaged, collaborative and active in learning 'with' rather than 'from' technology (e.g., Bozeman & Baumbach, 1995; Culp, Hawkins, & Honey, 1999; Jonassen, & Reeves, 1996; Means, 1994; Reeves, 1998; Penuel et al., 2000; Ringstaff, & Kelley, 2002). ICT appear to be most effective when used as tools in student-centered activities. However, it is important for a researcher planning research in school classrooms to consider the following recommendation Ringstaff and Kelley (2002, p. 23-24):

> Classrooms are not experimental laboratories where scientists can compare the effectiveness of technology to traditional instructional methods while holding all other variables constant. Moreover, few reliable, valid, and cost-effective assessments exist that measure students' higher-order thinking skills, problem-solving ability, or capacity to locate, evaluate, and use information — skills that many researchers and teachers believe can be enhanced through technology use. Technology has also been shown to increase student motivation and engagement, prepare students for jobs, and enhance students' ability to work collaboratively, but we have few, if any, tools and methods to measure impact in these domains.

In addition, there are also a large number of studies that examined classroom teachers' uses of ICT and issues such as changes in their pedagogies, attitude, confidence, competence and lesson planning, effects of professional development, barriers to adoption of emerging ICT, teachers' understanding of technology affordance (e.g., Becker, & Ravitz, 1999; Churchill, 2006; Foo, Ho, & Hedberg, 2005; Henriquez & Riconscente, 1999; King, 2002; Mann, 1999; Moallem, 1998; Rogers, 2000; Windschitl, & Sahl, 2002). Also, some studies explored issues relevant to pre-service teachers, such as their pedagogical beliefs (e.g., Lim, & Chan, 2007).

Conducting research in such context depends largely on a teacher education institution's relationship with schools. This relationship might be between individual teacher educators and schoolteachers with whom they developed connections, or more formally through partnerships developed with educational authorities (e.g., Ministry of Education) and schools. A practicum office can play an important role in building relationship between the teacher education institution and schools. Also, connections can be developed with the help of students, in particular serving schoolteachers attending postgraduate courses, teacher professional development programs or seminars. For success of research, it is important that a teacher education institution develops effective strategy for establishing, promoting, and supporting connections with schools. In this context, the institution must ensure that the school perceive themselves as partners in advancement of education.

Research should focus on exploring emerging pedagogical practices, and how ICT can support these practices in achieving intended outcomes.

Comparing ICT in education practices from one context (e.g., one's institution or school system in the home country) with practices in other contexts (such as other institutions, educational system in other countries) can provide another focus area for research. For example, International Association for the Evaluation of Educational Achievements conducted a Second Information Technology in Education Study (SITES) from 1998 to 2003 and included schoolteachers, students, principals and schools from a number of nations (see Plomp et al., 2009). Over the recent years, stimulated by positive aspects of globalization and economical developments in Asia, international journal publications become increasingly interested in educational systems and ICT integrations in countries such as China for example. Furthermore, ICT has created the so-called digital divide between countries in developed and developing world. Conducting comparative studies focusing on ICT practices might potential facilitate transfer of successful implementations of ICT from developed to developing countries or success cases from developing countries to other developing countries, and potentially contributing to effective bridging of the digital divide in the developing world. The United Nation and its linked organizations are also keen to support cross-national and comparative research as a tool for understanding possibilities for improvements in educational practices in the developing world.

Student-centred pedagogical practices

Research should focus on exploring emerging pedagogical practices, and how ICT can support these practices in achieving intended outcomes. Nowadays, student-centered pedagogical practices are promoted as means for preparing student for the relevant world (Churchill, 2006a). These practices are radically different from traditional teacher-centered practices, and include approaches such as inquiry-based learning, project-based learning, problem solving, and design-based learning. Developing models for successful applications of these approaches and understating ways that ICT can support these is an important area for research. Some approaches that promote student-centered pedagogy and educational uses of ICT technologies, are discussed in literature as: a constructivist learning environment (Jonassen, 1999), problem solving (Jonassen, 2000), problem-based learning (Savery & Duffy, 1995), rich environments for active learning (Grabinger, 1996), technology-based learning environments (Vosniadou, De Corte & Mandl, 1995), interactive learning environments (Harper & Hedberg, 1997), collaborative knowledge building (Bereiter & Scardamalia, in press), Quest Atlantis

(Barab, et al., 2005), situated learning (Brown, Collins, & Duguid, 1989), MicroLessons (Divaharan & Wong, 2003) and WebQuest (Dodge, 1995).

Emerging technologies

Emerging technologies offer attractive possibilities for educational applications. For example, more recently emerging technologies such as social networking, podcasting, digital storytelling, blogs, and mobile technology sound as attractive proposition for applications in teaching and learning (see Churchill, 2007). However, research is required to understand the full potential of these technologies as well as optimal strategies for their educational applications. Researching with emerging ICT and subsequently developing research outputs also represents attractive publishing opportunity. Journals in the field are continuously looking for articles providing cases and evidence from actual applications of emerging ICT technologies in various educational contexts.

Research involving learning technology design will focus, for example, on development and applications of digital media, educational games, cognitive tools, learning management platforms, and learning environment and tools based on emerging ICT technological possibilities. For example, Churchill and Hedberg (2008) explored learning object design considerations for small-screen handheld devices. Somewhere else, Churchill (et al., in print) describes development of a social bookmarking-repository-networking system and possibilities for educational applications. Conducting research with such focus requires that a teacher education institution has developed capacity for learning technology design. This capacity includes relevant design expertise (e.g., multimedia design) and other human resources (e.g., software engineering) as well as availability of relevant software and hardware tools (e.g., multimedia authoring suites). Studies in this area usually aim to understand issues relevant to human learning (e.g., cognitive processing, conceptual changes, mind modeling, and collective intelligence), as well as to develop models for learning technology designs and applications in teaching and learning. The studies might also result in learning technologies products with potential for applications beyond local contexts.

Research might also focus on instructional design related issues. Instructional design is a key process in development of educational multimedia packages such as computer-based learning/training, computer-managed instructions, intelligent tutorials, and other forms of courseware and e-learning packages (see Reiser, & Dempsey, 2002). Instructional design is in particular important in contexts of designing distance learning courses as well as employee training courses in corporate environments, industrial training, and military.

Integrated and informed research (based on needs and anticipated trends) –link between research and practice

One of the key problems with research involving ICT in education is in the application of research findings in actual practice in your own institution and in schools. Often, research results are reported in publications such as conference papers, reports, books, and journal articles. These are then read by other researchers and very often by research students, however, the transfer of knowledge to practice is in some ways limited. Lim (2004) suggests that for a research to transform practices, schools should

understand and accept its outcomes. Lim (2004) further underlines certain problems for transfer of knowledge: the culture of schooling does not support innovation, and the transfer is further affected by the lack of coordination of effort between research, design, development, policy and practice. Roblyer (2005) also elevates an importance of an associated issue of 'cumulativity,' and writes that:

> Technology research, especially, suffers from what might be called the single study syndrome. Perhaps the goal was to get the doctoral degree or to achieve tenure. The study is done; case closed. The best, most well-bred research has a lineage that looks to the future as well as builds on the past. In studies of human behavior, where variables are numerous and complex, it takes many studies over time to build a case for causation and impact. Consequently, articles reporting research ideally should make it clear that the study is part of a current or proposed line of research, along with proposed next steps in the line.

This section presents some of the strategies for disseminating research outcomes and transfer of knowledge, and possibilities for maximizing impact of these on existing knowledge, further research, and practice in a teacher education institution, as well as in other contexts.

Ongoing and completed research projects might be featured on dedicated web sites. The sites can present outlines of projects and their backgrounds, methodologies used, intended or completed outcomes, completed and ongoing publications, reports and slides from any presentations based on the projects, and details about project team members (e.g., their resumes, research interest, and publications). The sites can also outline possibilities for applications of the research outcomes in further research, and actual practices. In addition, the sites can contains discussion tools to allow others to post suggestions and comments, or make inquiries. The site might also contain RSS Feeds features to allow visitors to subscribe for any upcoming information about projects and their outcomes. Besides web sites, other Internet-based possibilities for promoting projects and disseminating their outcomes are: setting up wiki spaces dedicated to projects, setting a social networking site accounts for projects or featuring the projects in some of the popular video sharing sites. In addition, a teacher education institution might also set up a site to promote own best research practices and cases from effective transfer to existing knowledge, further research, and practice in one's own and other contexts.

Formal publications... are not the most obvious way of disseminating research outcomes and attempting to transfer knowledge beyond an institution.

Formal publications (e.g., journal articles, reports, book/book chapters) are the most obvious way of disseminating research outcomes and attempting to transfer knowledge beyond an institution. However, publications mostly attract attention of peoples such as academics, researchers and research students, while their impact on actual practices where outcomes are to be applied is in some ways limited. Nevertheless, producing publication is an important activity that will not only facilitate dissemination of research results in the field, but also effectively contribute to raising profiles of researchers as well as the overall reputation and ranking of an institution. For information about global ranking of universities a reader can further examine one of these three ranking systems: Leiden, Shanghai Jiao Tong or Times Higher Education Supplement Ranking. Producing publications and other forms

of scholarly work (e.g., designs, patents and innovations) is an important activity that will result in increased ranking of an institution amongst all other institutions in the world, which in turn might result in increased interest in a particular institution by prospective pre-service teachers and increased opportunities for funding from local government.

Publication effort should be appropriately distributed to ensure that not just international audience but also members from a local community are informed about important research outcomes and ways of applying these in the actual practice. In order to do this, the publications can be produced in a spectrum of channels, such as local publications (e.g., reports for distribution to schools, institutional research newsletter and websites), local and international conference publications, book chapters or books if possible, and international journal publications.

For raising profiles of teacher educators, and reputation and ranking of an institution, publishing in well-regarded, highly ranked international journals is critical. There are a number of journal-ranking systems; however, the important one to consider is SSCI (Social Science Citation Index) by Thompson Reuters[1]. This ranking system tracks citations, and reports annually on journals that are ranked according to so called 'impact factor.' Not all journals in the field are included in the SSCI ranking system. Those journals that are included, and those that have higher impact factors, are generally the ones that teacher educators should try to target for publications of their articles. However, these journals usually apply a rigorous blind peer review process and rejection rate is often high. Some of the most reputable journals in the field of ICT in education that are listed in the SSCI ranking system are presented in the **Table 2**. There are also some journals in the field of ICT in education that are not listed in the SSCI ranking system but they enjoy good reputation amongst the scholars and are widely read. Examples of such journals are Educational Technology[2] and Educational Media International[3].

Table 2: Top-ranked ICT in education related journals from SSCI listing

Journal Name	Impact Factor for 2007	Web Site
Computers & Education (C&E)	1.602	http://www.elsevier.com/wps/find/journaldescription.cws_home/347/description#description
Journal of Learning Sciences	1.571	http://www.cc.gatech.edu/lst/jls/
Journal of Computer Assisted Learning (JCAL)	0.800	http://jcal.info/
British Journal of Educational Technology (BJET)	0.574	http://www.wiley.com/bw/journal.asp?ref=0007-1013
Educational Technology Research & Development (ETR&D)	0.270	http://www.springer.com/education/learning+&+instruction/journal/11423

1 Reference Link: http://www.isiknowledge.com/

2 Reference Link: http://asianvu.com/bookstoread/etp/

3 Reference Link: http://www.tandf.co.uk/journals/routledge/09523987.html

Conferences & seminars

Participations and presentations at national and international conferences is another important platform for dissemination of the research outcomes. Besides providing an opportunity to present research, conferences are also effective platform for networking with individuals who are interested in similar work or are willing to apply existing research outcomes in their context. Conferences often result in some forms of publication such as conference proceedings. However, some conferences select best presentations and papers for possible publication in a special issue of an affiliated journal.

Similarly with journal publications, some conferences enjoy higher reputation (e.g., AERA -- Conference of the American Educational Research Association, and Ed-Media -- World Conference on Educational Multimedia, Hypermedia & Telecommunications). Although most of the ICT in education conferences are attracting academics and researchers (e.g., ICCE -- International Conference on Computers in Education), nowadays there are conferences that aim to attract schoolteachers (e.g., SITE -- Society for Information Technology & Teacher Education). The schoolteachers' conferences are perhaps suitable places for exploring possible transfer of research outcomes to actual classrooms in school. In addition, schoolteachers' conferences are places to identify those schoolteachers who are willing to engage with emerging ICT technologies and pedagogies, and possibly accept to participate in further research activities. Attendance at schoolteachers' conferences might also provide new ideas for technology integration as well as to expose certain possibilities for research in schools.

Teacher educators should be active in organizing regular seminar presentation series in their institutions to disseminate ongoing and completed research outcomes. These seminars can be open not only to an institution's teacher educators, researches and research students, but the institution might also send regular invitations (via a web site, email, phone SMS service or RSS feeds) to teachers in schools, officers in education authority offices, and members of other educational institutions. In addition, institutions' web services should allow interested individuals to subscribe for information regarding upcoming seminar presentations. Furthermore, institutions might audio- or video-record seminar presentations and make them available via technologies such as podcasting or video sharing repositories.

Postgraduate research programs

Developing and administering research programs such as Master of Philosophy, Philosophy Doctorate or Education Doctorate will not only contribute to the development of overall research capacity but it will also serve as an important tool for dissemination of research outcomes. Research students will continue existing research efforts, build on existing and newly produced knowledge, and otherwise extend an institution's research capacity. In addition, the research students can also engage in publishing activities and participation in conference and in this way contribute to increase reputation of their institution. Upon graduation (or through the study if the students are practicing teachers who study on part-time basis), the pre-service teachers can help disseminate research outcomes, and transfer and apply these in their own contexts in schools or other institutions.

Research activities that demonstrate productive outputs and potential for growth should be extended and supported beyond published reports, articles and conference presentations. This can be done through calls for further research on specific topics and strategically imported areas. Such calls can be made, for example, within the research outputs and a project web site. An institution might also explore the possibility of forming strategic research themes by grouping relevant research projects and people with overlapping interests. Recruiting and supervising students interested to further expand successful research outcomes can also extend research projects' outcomes.

Research and Development Funding and Support

It is critical to establish and continuously provide suitable supporting services, tools and incentives in order to develop and sustain a teacher education institution's research capacity. These services, tools and incentives might support a variety of activities such as research projects' proposals preparation, research stuff recruitment, funding and budgeting, mentoring and assistance with writing of reports and publications. However, most importantly, these services, tools and incentives must be presented in ways that are perceived by researchers as enabling rather than constraining. In this section we outline a number of potential services, tools and incentives that an institution needs to establish in order to provide enabling environment for research activities of its members. A teacher education institution should have a relevant office responsible for management of some of these services. In addition, it is also important to ensure that these services, tools and incentives are appropriately communicated to the institution's members.

Grants (funding) are important tools to stimulating and supporting research activities. These can support recruitments of research personnel such as research assistants, project managers, programmers, multimedia designers, research professors and fellows, and relief teachers, as well as expenses for required equipment, consumables and communication. Major and most respected grants come from outside of an institution (e.g., from National Science Foundation in USA, Australian Research Council in Australia, or Research Grants Council in Hong Kong). Occasionally, there are calls for research by various government departments, associations and authorities from foreign countries. Also, some funding opportunity might be available from local educational authorities or from international public agencies such as UNESCO. Microsoft is also active in providing funding to support research that involves ICT in education.

A teacher education institution should plan and set a budget aside to provide reasonable funding to initiate and support research activities. These might be in forms such as seed grants, research grants for new staff, and teaching development grants. Those internal grants can be seen as a tool to help teacher educators to organize their ideas and conduct some pilot studies in preparation for applications for external grants. In addition, an institution might set regular award schemes such as 'outstanding researcher award,' or 'outstanding research output award' that recognizes quality research and publications. These awards should also include certain funding to support further research activities of the awardees. The awardees might also be required to act as mentors to others or deliver seminars reporting on their research experiences.

Strategic Dimension **Six**

Providing assistance with writing could be an important support strategy to promote research, and in particular, to facilitate transfer of research outcomes to further research and practice. This assistance will include editing of papers, applications for funding, project proposals, and reports by technical writers, and reviews by experienced researchers and successful grant holders. In particular if an institution is in a non-English speaking environment, and is aiming to increase institutional impact in the field through international publications, then publishing in English language publications is the requirement. In this case the institution's staff might have difficulties in producing papers of expected quality in the English language. To solve this problem the institution might either engage external services, or develop an in-house team tasked to help with the writing.

In addition, publications must be written in an appropriate technical style. The style most often used for publications related to technology in education is known as APA (see American Psychological Association, 2001). There are also some useful books and guides that describe how to effectively publish papers (e.g., Day, 1998).

New staff might in particular experience difficulties in their initial publishing efforts. Such difficulties might result in longer-term dissatisfaction with the profession, and low productivity in term of scholarly outputs. One strategy that can assist the new staff is to provide them with small grants that can be paid to external experts who agree to provide mentorship and commit to help in securing publications. External advisors/mentors can also be engaged to facilitate proposal preparation for major funding opportunities. More senior colleagues, and in particular those who have been successful in obtaining external funding or awarded with awards such as previously mentioned 'outstanding researcher award,' or 'outstanding research output award' could also be engaged to provide mentorship on proposal preparation, other research-related issues and publishing.

Regular research retreats can provide platforms for advancement of research-related activities.

Appropriately addressing ethical issues in the ICT-related educational research is required. In particular, such clearance is critical if a study involves subjects such as school children. It is likely that some researchers (in particular new researchers) might not be aware about how and when the ethical issues are not addressed appropriately in their research. A relevant group within an institution's research office should be set-up to ensure that research is conducted in an ethical manner. Researchers (and research students as well) should be expected to place an application for ethical clearance (usually before any funding is granted). This application should be reviewed, and if necessary changes to the proposed study should be recommended and requested. Researchers should not commence their participant recruitments and data collection until ethical application has been approved. Relevant forms and templates (e.g., a template of a consent form) should be provided to assist the researchers in preparing their applications for ethical clearance. In addition, occasional training sessions, or seminars should be organized to inform new researchers and research students about ethic-related issues and procedures for clearance.

Providing appropriate leave schemas will support individual researchers in activities such as data-collection, research-related professional development, consultation with experts, visit to places

and scholars conducting similar research or otherwise sharing similar interest, and attendance at conferences. Sabbatical leave schemas might also be a useful tool to promote and facilitate research activities. Such schema might entitle staff to take prolonged leave, accumulated based on a number of years of services to the institution, to visit overseas institutions and place uninterrupted time to focus on strengthening their research-related output. Sabbatical scheme should also include some funding support to travel and visit an overseas institution. Further funding and leave schema should be in place to support at least one annual attendance to a key international conference related to ICT in education. It is ordinary to expect a staff who received such funding to present a paper at that conference, and to report to colleagues on the conference upon return. Besides support for own staff to visit overseas institutions and attend conferences, there might also be schemas to support overseas scholars to visit a teacher education institution. Such schemas might range from a short visit and a presentation of a seminar, to a schema that supports visiting professor positions over a prolonged period of time. Further leave schemas might support activities such professional development.

Regular research retreats can provide platforms for advancement of research-related activities. Such retreats would involve a whole day meeting of staff at a relaxing venue and atmosphere outside of the regular working environment. The program of the retreat might involve discussion of strategic aims related to the research involving ICT in education, reflection and suggestions for improvements in transfer of research outcomes to further research, theory and practice, discussion related to improvements in research support services, and development of strategic plan for the following year(s). Research staff can be engaged in presenting their research agendas and plans. In this way, suggestions for improvements, ideas and possibilities for collaborations might surface.

Research centers

Establishment and operations of research centers and groups will support development of research-related activities. The research centers can be based on strategically important themes with proven capacity to result in research output and potential for transfer to further research, theory and practice. Such centers can serve as platforms for grouping of researchers with similar interests and research agendas. The centers can also provide consultations to individual researchers, organize seminars and conferences, produce publications, and manage connections with external institutions and schools. Some interesting examples of centers and groups are: Cognition and Technology Group at Vanderbilt University, The Learning and Epistemology Group at MIT University, Center for IT in Education at The University of Hong Kong, and Asia-Pacific Centre of Excellence for Teacher Education and Innovations at the Edith Cowan University.

Staff appraisal can serve as an important tool to stimulate and sustain productive research activities, publications and transfer of knowledge. Unlike other previously described support services, all staff from an institution might not warmly welcome staff appraisal exercises. However, when properly managed, staff appraisal can serve as an important tool that would foster a sense of responsibility and accountability for researchers (in particular those researchers with funded projects). The appraisals can be conducted annually, and the staff should report on their research output and publications.

Strategic Dimension **Six**

Impact of Research and Development on the Pre-Service Teacher Education Program

Teacher education institutions need a strategic synergy between research, development and teaching, and to develop sustainable environment for knowledge creation and innovation. For Sivin-Kachala and Bialo (2000) due to the rapid developments institutions must continuously advance their ICT in education plans and make revisions in policy in order to remain relevant and to benefit from arising opportunities. Also, studies and publications suggest that technology can serve as an effective tool and catalyst for changes at classrooms, school, teacher education institutions and educational authorities (e.g., Bozeman & Baumbach (1995; Chang et al., 1998; Glennan, & Melmed, 1996; Hawkins, Spielvogel, & Panush, 1996; Means, 1994; Ringstaff, & Kelley, 2002). However, the changes and revisions will be most effective when informed by relevant and significant research and evaluation outcomes. In this strategic dimension, we present some of the key reasons for research involving ICT in education with an intention to inform institutional vision. Local context will contribute to some further reasons, and this dimension helps the reader to think more about these possibilities.

Research activities provide a platform for development of existing knowledge and creation of new knowledge. Understanding of relevant research problems and areas for investigations could enable a teacher educator to recognize limitations in existing practices, ICT policies and knowledge, and create focus directions for improvements and generation of new knowledge. Analysis of data could provide new evidence challenging existing knowledge and contribute to development of new knowledge such as more effective models for teacher education. Also, applying research findings in actual practice and teacher education could help further existing knowledge. Research provides tools for development of new knowledge that can be (and should be) integrated in teacher education programs. New knowledge generated through research can be audited by expert teams (and possibly in consultation with education authorities) for potential integration in the overall teacher education curriculum. In this way research can directly contribute to advancement of the curriculum, and through the curriculum, to preparation of generations of teachers equipped with most recent knowledge, while enabling a teacher education institution to sustain relevance. At the same time, research can serve as an important tool for exploring relevance of the existing curriculum content, and lead to identification of potential areas for improvements. Through the research and integrations of the research outcomes, teacher education curriculum is more likely to be up-to-date, relevant and competitive. Research on ICT has emerged as an important area for inquiry and improvements of practices at teacher education institutions. Some groundwork studies have already been done around the world in relation to technology in teacher education. Willis, Thompson, and Sadera (1999, p.41) wrote that from studies on ICT in teacher education, we know that:

> Most teacher-education students have very positive attitudes towards the use of technology in education but are far less confident about their ability to actually use technology. We know that teacher-education faculty also have positive attitudes towards technology in education, but many do not feel they have strong background in actually integrating that into the teacher-education courses they teach. We also know that most preparation for pre- service teaches in the area of technology remains inadequate.

Willis and colleagues (1999) suggest that the major research effort of ICT in teacher education should be in relation to processes of institutional and teacher changes, and 'diffusion' of good practices and innovation across institutions.

Research can contribute to professional growth of academic staff (teacher educators) and other research team members, and provide research students with important learning and development tool. By engaging in research teacher educators will generate new knowledge while expanding their own knowledge and research skills.

Contributing to development of knowledge in the field and disseminating results of research will make a teacher education institution better known locally and internationally. Producing new knowledge that can inform theory and practices in other institutions locally and internationally will result in increase in reputation not only for a teacher education institution but also for individual teacher educators.

A developed and sustainable research environment will provide a ground for experimentation with emerging ICT and pedagogies, and development of ICT policy. This is in particular important today as we witness new and emerging ICT technologies continuously challenging traditional practices and introducing new possibilities for development of teaching and learning. Embracing ICT and exploring their pedagogical and other applications in more formal ways through research activities will create fruitful environment for both: development of new knowledge and practices, and development of an environment for experimentation with existing knowledge.

Impact of Research and Development on Schools and the Education System

Pursuing research will lead teacher educators to explore problems relevant to local issues and practices, either in schools in their country or their own institution. Understanding of local issues and practices is important in order to ensure institutional relevance and quality of service to the local community. At the same time, understanding local issues and practices will enable teacher educators to make comparison with leading examples from around the world, and identify areas where the local context and educational system can benefit from international practices, or from new knowledge in the field.

A critically important component of a teacher education institution's overall research capacity is a framework for research that would inform overall vision, policy, strategies and plan for transfer to research outcomes to actual practice in schools and local education system. Such framework can serve as an important tool to guide implementation of relevant mission, achievement of objectives, and alignment and orientation of researchers, as well as, facilitate research-related processes and administration. As a useful starting point for development of a framework for research, teacher educators might for example, expand the framework presented in the **Figure 5** (Lim & Hung, 2003).

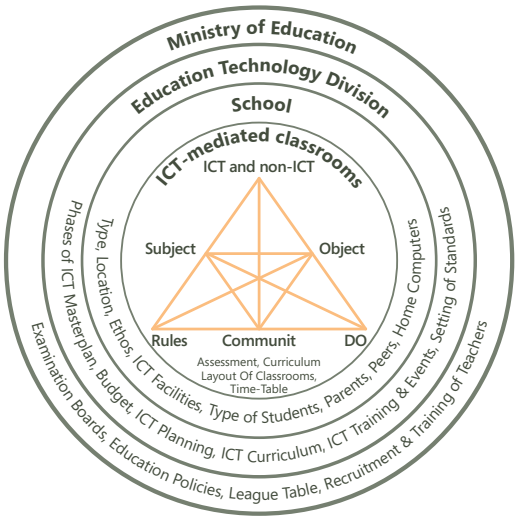


Figure 5: Activity Systems within the Broader Sociocultural Context of the Classrooms (from Lim & Hung, 2003).

Evaluation

Research activities should be closely linked to processes of auditing and evaluation of a teacher education institution's ICT-mediated practices, policies, teaching, learning, curriculum and administration. Research can provide useful data for evaluation, and suggest areas that require attention. Regular and appropriately organized evaluation, as well as subsequent follow-ups on its outcomes, is an important tool for institutional improvements and development.

An existing ICT policy and practices need to be regularly audited and evaluated in order to identify areas for improvements and revisions. It is critical that all the key stakeholders from a teacher education institution are involved in the auditing, identification of gaps and areas for improvements, and revision. In addition, visits to other institutions, and reviews of good practices elsewhere, might play an important role in the overall evaluation of ICT practices and policy. Outcomes of evaluation should always lead to required revisions of practices and policy. In this context, any current evaluation needs to include evaluation of implementation of outcomes from the previous evaluation exercises.

In addition, a teacher education institution will benefit from regular evaluation of teaching and learning for potential relevance, suitability of curriculum content, and appropriateness in term of dominant pedagogical practices and ICT uses. Regular evaluation of teaching and learning can be administered through processes such as pre-service teachers' evaluation of teaching, classroom observations, teaching staff performance appraisal, and engagements of external reviewers and examiners. Besides this summative evaluation, it is appropriate and beneficial that an institution promotes formative evaluation of teaching and learning. Formative evaluation will enable continuous improvements in teaching and learning as and when relevant areas for improvements are identifies. Teachers are to play leading role in administering and facilitating formative evaluation, and implementing required revision. In any case, data and outcomes of evaluation must be carefully considered, and discussions regarding possibilities for revision and improvements in teaching and learning should take place within relevant departments and committees (e.g., a course program committee, or teaching and learning quality committee).

References

American Psychological Association. (2001). *Publication manual of the American Psychological Association.* Washington, D.C.: APA.

Barab, S., Thomas, M., Dodge, T., Carteaux, R., & Tuzun, H. (2005). Making Learning Fun: Quest Atlantis, A Game Without Guns. *ETR&D, 53*(1), 86–107.

Becker, H., & Ravitz, J. (1999). The influence of computer and internet use on teachers' pedagogical practices and perceptions. *Journal of Research on Computing in Education, 31*(4), 356-385.

Bereiter, C., & Scardamalia, M. (in press). Learning to work creatively with knowledge. In E. De Corte, L. Verschaffel, N. Entwistle, & J. van Merriënboer (Eds.), *Unravelling basic components and dimensions of powerful learning environments.* EARLI Advances in Learning and Instruction Series. Retrieved May 8, 2009 from http://ikit.org/fulltext/inresslearning.pdf.

Blaxter, L., Hughes, D. & Tight, M. (2001). *How to research.* Buckingham: Open University Press.

Bozeman, W., & Baumbach, D. (1995). Educational technology: Best practices from America's schools. Princeton, N.J.: Eye on Education, Inc.

Brown, J. S., Collins, A., & Duguid, P. (1989). Situated cognition and the culture of learning. *Educational Research, 18*(1), 32-42.

Butzin, S. M. (2000). Project Child: A decade of success for young children. *Technology Horizons in Education Journal, 27*(11). Retrieved May 5, 2009, from http://www.thejournal.com/articles/14835.

Chang, H., Henriquez, A., Honey, M., Light, D., Moeller, B., & Ross, N. (1998). *The Union City story.* New York: Education Development Center, Center for Children and Technology.

Churchill, D. (2006a). Student-centered learning design: key components, technology role and frameworks for integration. *Synergy, 4*(1), 18-28.

Churchill, D. (2006b). Teachers' private theories and their design of technology-based learning. *British Journal of Educational Technology, 37*(4), 559-576.

Churchill, D. (2007). Web 2.0 and Possibilities for Educational Applications. *Educational Technology, 47*(2), 24-29.

Churchill, D. (2009). A Teacher Reflection on Educational Application of Blogs with a Postgraduate Class. *International Journal of Continuing Engineering Education and Life-Long Learning, 19*(2/3), 112-125.

Churchill, D., & Hedberg, G. (2008). Learning object design considerations for small-screen handheld devices. *Computers & Education, 50*(3), 881-893.

Churchill, D., Wong, W., Law, N., Salter, D., & Tai, B. (In print). Social bookmarking-repository-networking: possibilities for support of teaching and learning in higher education. *Serials Review.*

Cohen, L., Manion, L. & Morrison, K. (2000). *Research methods in education.* New York: Routledge Falmer.

Culp, K., Hawkins, J., & Honey, M. (1999). *Review paper on educational technology research and development.* New York: Education Development Center, Center for Children and Technology.

Day, R.A. (1998). *How to Write & Publish a Scientific Paper.* Phoenix, AZ.: Oryx Press.

Divaharan, S., & Wong, P. (2003). Student-centered learning: microlessons. In S.C. Tan (Ed.), *Teaching and learning with technology: an Asia-pacific perspective* (pp. 182-198). Singapore: Prentice Hall.

Dodge, B. (1995). *Some thoughts about WebQuests.* Retrieved October 18, 2005 from http://webquest.sdsu.edu/about_webquests.html.

Foo, S. Y., Ho, J., & Hedberg, J. (2005). Teachers' understanding of technology affordances and their impact on the design of engaging learning experiences. *Educational Media International, 42*(4), 297-316.

Gall, J. P., Gall, M. D., & Borg, W. R. (1999). *Applying Educational Research: a practical guide.* New York: Longman.

Gay, L. R., Mills, G. E., & Airasian, P. (2006). *Educational Research: Competencies for Analysis and Applications.* Upper Saddle River, N.J.: Pearson/Merrill Prentice Hall.

Glennan, T. K., & Melmed, A. (1996). *Fostering the use of educational technology: Elements of a national strategy.* Santa Monica, CA.: RAND. Retrieved May 5, 2009, from http://www.rand.org/publications/MR/MR682/contents.html.

References

Grabinger, R.S. (1996). Rich environments for active learning. In D.H. Jonassen (Ed.), *Handbook of Research for Educational Communications and Technology* (pp. 665-692). New York: Macmillan.

Hannafin, M. J., Hannafin, K. M., Hooper, S. R., Rieber, L. P., & Kini, A. S. (1996) Research on and research with emerging technologies. In D. H. Jonassen (Ed.), *Handbook of Research on Educational Communications and Technology* (pp. 378-402). New York Simon & Shuster Macmillan.

Harper, B., & Hedberg, J (1997). *Creating Motivating Interactive Learning Environments: a Constructivist View.* Paper presented at the ASCILITE 97, Retrieved March, 18, 2006 from http://www.ascilite.org.au/conferences/perth97/papers/Harper/Harper.html.

Hawkins, J., Spielvogel, R., & Panush, E. (1996). *National study tour of district technology integration: summary report.* New York: Education Development Center, Center for Children and Technology.

Hedberg, J.G., & Lim, C.P. (2004). Charting trends for E-Learning in Asian schools. *Distance Education, 25*(2), 199-213.

Henriquez, A., & Riconscente, M. (1999). *Rhode Island Teachers and Technology Initiative: Program evaluation final report.* New York: Education Development Center, Center for Children and Technology.

Jonassen, D. (1999). Designing constructivist learning environments. In C. M. Reigeluth (Ed.), *Instructional Design Theories and Models: A New Paradigm of Instructional Theory, volume 2* (pp. 215—239). Hillsdale, N.J.: Lawrence Erlbaum Associates.

Jonassen, D. (2000). Towards design theory of problem solving. *ETR&D, 48*(4), pp.63-85.

Jonassen, D. H., & Reeves, T. C. (1996) Learning with Technology: Using Computers as Cognitive Tools. In D. H. Jonassen (Ed.), *Handbook of Research on Educational Communications and Technology* (pp. 693-719). New York: Simon & Shuster Macmillan.

King, K. P. (2002). Educational technology professional development as transformative learning opportunities. *Computers & Education, 39*(3), 283-297.

Krathwohl, D.R. (1998). *Methods of educational and social research: an integrated approach.* New York: Longman.

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

Lim, C.P. (2004). *Integrating ICT in Education: A study of Singapore schools.* Singapore: McGraw-Hill.

Lim, C.P., & Hung, D. (2003). An activity theory approach to research of ICT integration in Singapore schools. *Computers & Education, 41*(1), 49-63.

Mann, D. (1999). *Documenting the effects of instructional technology: A fly-over of policy questions (Secretary's Conference on Educational Technology).* Retrieved May 5, 2009, from http://www.eric.ed.gov/ERICWebPortal/contentdelivery/servlet/ERICServlet?accno=ED452823.

Means, B. (1994). *Technology and education reform: The reality behind the promise.* San Francisco, CA.: Jossey Bass.

Moallem, M. (1998). En expert teachers' thinking and teaching and instructional design principles: An ethnographic study. *ETR&D, 46*(2), 37-64.

Penuel, B., Golan, S., Means, B., & Korbak, C. (2000). *Silicon Valley Challenge 2000: Year 4 report.* Menlo Park, CA: SRI International.

Plomp, T., Anderson, R. E., Law, N., & Quale, A. (2009). *Cross-national information and communication technology: policies and practices in education.* (Eds.). Charlotte, N.C.: Information Age Publishing.

Pollard, C & Pollard, R. (2004). Research priorities in educational technology: a delphy study. *Journal of Research on Technology in Education, 37*(2), 145-160.

Reeves, T. C. (1998). *The impact of media and technology in schools: A research report prepared for The Bertelsmann Foundation.* Retrieved May 5, 2009, from http://www.ic.sunysb.edu/Stu/ashidele/The_Impact_of_Media_by_Bertelsmann_Fdtn.pdf.

Reiser, R. A., & Dempsey, J. V. (2002). *Trends and issues in instructional design and technology.* (Eds). Upper Saddle River, N.J.: Merrill/Prentice Hall.

References

Ringstaff, C., & Kelley, L. (2002). *The learning return on our technology investment: A review of findings from research.* San Francisco: WestEd RTEC. Retrieved May 5, 2009, from https://www.msu.edu/~corleywi/documents/Positive_impact_tech/The%20learning%20return%20on%20our%20educational%20technology%20investment.pdf.

Ringstaff, C., & Kelley, L. (2002). *The learning return on our technology investment: A review of findings from research.* San Francisco, CA.: WestEd RTEC. Retrieved May 5, 2009, from https://www.msu.edu/~corleywi/documents/Positive_impact_tech/The%20learning%20return%20on%20our%20educational%20technology%20investment.pdf.

Roblyer, M. D. (2005). Educational technology research that makes a difference: Series introduction. *Contemporary Issues in Technology and Teacher Education [Online serial], 5*(2). Retrieved May 2, 2009, from http://www.citejournal.org/vol5/iss2/seminal/article1.cfm.

Roblyer, M.D., & Knezek, G. A. (2003). New Millennium Research for educational technology: A call for a national research agenda. *Journal of Research on Technology in Education, 36*(1). Retrieved May 1, 2009, from http://courseweb.tac.unt.edu/gjones/sum2006/cecs5610/pdf/RoblyerKnezekfinal.pdf.

Roblyer, M.D., & Knezek, G. A. (2003). New Millennium Research for educational technology: A call for a national research agenda. *Journal of Research on Technology in Education, 36*(1). Retrieved, May 1, 2009, from http://courseweb.tac.unt.edu/gjones/sum2006/cecs5610/pdf/RoblyerKnezekfinal.pdf.

Rogers, P. L. (2000). Barriers to adopting emerging technologies in education. *Journal of Educational Computing Research, 22*(4), 455-472.

Sandholtz, J. H., Ringstaff, C., & Dwyer, D. C. (1997). *Teaching with technology: creating student-centered classrooms.* New York, N.Y: Teachers College Press.

Savery, J. R., & Duffy, T. M. (1995). Problem based learning: an instructional model and its constructivist framework. *Educational Technology, 35*(5), 31-38.

Scardamalia, M., & Bereiter, C. (1994). Computer support for knowledge-building communities. *The Journal of the Learning Sciences, 3*(3), 265-283.

Schacter, J., & Fagnano, C. (1999). Does computer technology improve student learning and achievement? How, when, and under what conditions? *Journal of Educational Computing Research, 20*(4), 329-343.

Sivin-Kachala, J., & Bialo, E. (2000). *2000 research report on the effectiveness of technology in schools (7th ed.).* Washington, D.C.: Software and Information Industry Association.

Teo, Y. H., & Churchill, D. (2007). Using sentence openers to support students' argumentation in an online learning environment. *Educational Media International, 44*(3), 207-218.

Vosniadou, S., De Corte, E., & Mandl, H. (1995). *Technology-based learning environments.* Heidelberg: Springer-Verlag.

Waxman, H.C., Connell, M. & Gray, J. (2002). *A quantitative synthesis of recent research on the effects of teaching and learning with technology on student outcomes.* North Central Regional Education Laboratory. Retrieved May 1, 2009, from http://www.coe.ufl.edu/Courses/eme5054/Foundations/Articles/waxman.pdf.

Willis, J., Thompson, A., & Sadera, W. (1999). Research on technology and teacher education: current status and future directions. *ETR&D, 47*(4), 29-45.

Windschitl, M. & Sahl, K. (2002). Tracing teachers' use of technology in a laptop computer school: The interplay of teacher beliefs, social dynamics, and institutional culture. *American Educational Research Journal, 39*(1), 165-205.

comments

comments

Appendix I

Strategic Dimension **One**

Vision and Philosophy

There are 5 strategic foci under the first strategic dimension:

- Institutional Vision for ICT in Education
- Underlying Philosophy for Teaching and Learning with ICT
- Needs of Schools and Society
- Formulation and Ownership of ICT in Education Vision
- Review of ICT in Education Vision

Strategic Dimension **One**
Vision and Philosophy

	Vision and Philosophy				
	Institutional Vision for ICT in Education	**Underlying Philosophy for Teaching and Learning with ICT**	**Needs of Schools and Society**	**Formulation and Ownership of ICT in Education Vision**	**Review of ICT in education Vision**
Undeveloped	Absence of articulated institutional vision for ICT in education.	Absence of underlying philosophy for teaching and learning with ICT.	Absence of needs and situation analysis of schools and society.	Absence of staff involvement in the formulation of ICT in education vision.	Absence of review of ICT in education vision.
Fundamental	Focuses ONLY on the use of ICT to support existing culture, policies and practices.	Traditional notions of teaching and learning with ICT that are grounded in behaviourist/ cognitivist paradigm.	Needs of schools ONLY based on their existing culture, policies and practices constrain the formulation of the institutional vision for ICT in education	Staffs are involved in the formulation of the ICT in education vision but do not have ownership of the vision.	Review of ICT in education vision is based on pre-determined work schedules.
Proficient	Institutional vision focuses on driving changes in culture, policies and practices mediated by ICT.	Underlying philosophy is based on progressive notions of teaching and learning with ICT that are grounded in constructivist/ social constructivist paradigm.	Changing needs of schools and society are considered in the formulation of the institutional vision for ICT in education; that is, the vision supports changes in schools that partially meet societal needs.	Staff are involved in the formulation of the ICT in education vision and have developed a sense of ownership of the vision.	Review of ICT in education vision is reactive in essence. That is, it reacts to changing needs of schools and society.
Innovative	Institutional vision is being studied and emulated by other institutions.	Underlying philosophy is based on emerging notions of teaching and learning with ICT that are grounded in knowledge creation paradigm.	Changing needs of schools and society are full integrated in the institutional vision for ICT in education; that is, the vision leads changes in schools that meet societal needs.	Staffs are empowered in the formulation of the ICT in education vision. That is, staffs are contributing members of an evolving and dynamic vision.	Review of ICT in education vision is proactive and visionary (anticipating/ pre-emptive) in essence. That is, it triggers reviews in other institutions.

Strategic Dimension **Two**

Program: Curriculum, Assessment, and Practicum

There are 11 strategic foci under the 3 components of the second strategic dimension:

Curriculum

- Instructional analysis (tasks, learners, context)
- Linkages of courses/units
- Pedagogical approaches (implies the paradigm)
- Modelling (practising what you preach)
- Meaningful use of ICT

Assessment

- Linkages to curriculum
- Mode of assessment - Balance between process and product (validity, reliability, comprehensiveness, administration)
- Authenticity of assessment tasks

Practicum

- Linkages to curriculum and assessment
- Support in schools (mentor teachers, coordinating teachers, access to ICT & resources, student readiness, supervisors, principals)
- Expectation of ICT use in teaching and learning in schools

Strategic Dimension **Two**

Program: Curriculum, Assessment, and Practicum

	Program: Curriculum, Assessment and Practicum										
	Curriculum					Assessment			Practicum		
	Instructional Analysis	Linkages between Units	Pedagogical Approaches	Modelling	Meaningful Use of ICT	Linkages to Curriculum	Mode of Assessment	Authenticity of Assessment Tasks	Linkages to Curriculum and Assessment	Support in Schools	Expectation of ICT Use in Teaching & Learning in Schools
Undeveloped	Absence of analysis of tasks, learners and context.	Absence of linkages between units. ICT units are developed in isolation.	Integration of ICT in the curriculum does not change the pedagogical approaches adopted.	Absence of modelling by teacher educators on how ICT is used in the curriculum.	Absence of meaningful use of ICT in the curriculum; ICT use is not contextualised for pre-service teachers.	Absence of linkage between assessment and curriculum.	Mode of assessment is summative or formative but there is no use of ICT in the assessment.	Assessment tasks are not authentic; the tasks are not developed in the context of school or classroom practices.	Absence of linkage between practicum and curriculum/ assessment.	Absence of support by teacher education institution for pre-service teachers in schools.	No expectation of pre-service teachers to use ICT for teaching and learning in schools.
Fundamental	Analysis of tasks, learners and context based on personal experiences of teacher educators.	Limited linkages between units. ICT units are developed with knowledge of other units.	Integration of ICT in the curriculum changes the pedagogical approaches but the changes are not informed by a learning paradigm.	Modelling by teacher educators on how ICT is used in the curriculum is carried out only within the ICT units.	Use of ICT in the curriculum is contextualised for pre-service teachers within the ICT units only.	There is ICT use in and linkages between the assessment and curriculum of the ICT units only.	Mode of assessment is summative and ICT is used to facilitate the assessment.	Assessment tasks are somewhat authentic; the tasks are developed in the context of school or classroom practices but may not be relevant to pre-service teachers.	Linkage between practicum and curriculum but no linkage between practicum and assessment; concepts and strategies/ examples in the curriculum are drawn upon for and from the practicum.	Some support by teacher education institution for pre-service teachers in schools; support is in the form of e-mail exchanges with and school visits by teacher educators.	There are expectations of pre-service teachers to use for teaching and learning in schools but no expectation of how it is used.
Proficient	Basic analysis of tasks, learners and context based on systematic but limited collection of primary and secondary data.	Coordinated linkages between units. ICT units are developed with other unit coordinators.	Integration of ICT in the curriculum changes the pedagogical approaches and the changes are informed by a learning paradigm.	Modelling by teacher educators on how ICT is used in the curriculum is carried out institute wide.	Use of ICT in the curriculum is contextualised for pre-service teachers at the program level.	There is ICT use in and linkages between the assessment and curriculum of most units in the pre-service teacher education program.	There are both formative and summative assessments and ICT is used to facilitate the assessment. However, the formative assessment is not linked to the summative one.	Assessment tasks are authentic; the tasks are developed based on pre-service teachers' experiences in the school and classroom.	Linkages between practicum and curriculum and assessment; concepts and strategies/ examples in the curriculum and assessment are drawn upon for and from the practicum.	Support by teacher education institution for pre-service teachers in schools; online and onsite support are provided that include online resources (lesson plan templates, frequently asked questions), discussion boards, online and on-site mentoring by teacher educators.	There are expectations of how pre-service teachers use ICT for teaching and learning in schools. However, these expectations are not shared among the teacher education institution, school and pre-service teachers.
Innovative	In-depth analysis of tasks, learners and context based on systematic and comprehensive collection of primary and secondary data.	Robust linkages between units. ICT is an integral part of all units and they are co-developed by the unit coordinators involved in the program/ course.	Integration of ICT in the curriculum changes the pedagogical approaches and the changes are informed by a learning paradigm based on the affordances of ICT.	Modelling by teacher educators on how ICT is used in the curriculum and how the use may transform the curriculum is carried out institute wide.	Use of ICT in the curriculum is contextualised for pre-service teachers at the program level, and they are given the opportunities to transform the curriculum with the use of ICT.	The design of the assessment and curriculum of most units in the pre-service teacher education program are driven by the affordances of ICT.	There are both formative and summative assessments and ICT is used to facilitate the assessment. The formative assessment builds up to the summative one.	Assessment tasks are innovative and authentic; pre-service teachers are required to carry out the assessment tasks in the context of their school or classroom.	The practicum provides the context for the development of the curriculum and assessment tasks.	Holistic support by teacher education institution for pre-service teachers in schools; a professional learning community (both online and on-site) is developed that consists of major stakeholders in the school and university.	There are clear and shared expectations among the teacher education institution, school and pre-service teachers of how pre-service teachers use ICT for teaching and learning in schools.

Strategic Dimension **Three**

Professional Learning of Deans, Teacher Educators and Support Staff

Teacher educators are often viewed as experienced experts in their respective fields but may lack experience in using ICT for teaching, learning and administration. There are 6 strategic foci under the third strategic dimension:

- Professional Learning Culture
- ICT Professional Learning Program
- ICT Professional Learning Plans of Staff
- Mentoring and Peer Coaching of ICT for Teaching and Learning
- Conducive Conditions for ICT Professional Learning
- Reward and Incentive Structure for ICT Professional Learning

Strategic Dimension **Three**

Professional Learning of Deans, Teacher Educators and Support Staff

	Professional Learning of Deans, Teacher Educators and Support Staff					
	Professional Learning Culture	**ICT Professional Learning Program**	**ICT Professional Learning Plans of Staff**	**Mentoring and Peer Coaching of ICT for Teaching and Learning**	**Conducive Conditions for ICT Professional Learning**	**Reward and Incentive Structure for ICT professional learning**
Undeveloped	Absence of a professional learning culture.	Absence of an ICT professional learning program for staff.	The staffs in the teacher education institution do not have an ICT professional learning plan.	Absence of mentoring and peer coaching of ICT for teaching and learning.	Absence of conducive conditions for ICT professional learning.	Absence of a reward and incentive structure for ICT professional learning.
Fundamental	Professional learning culture exists to some extent but not at all levels nor institution-wide; the need for professional learning is being enforced from the management of the institution.	There is an ICT professional learning program; however, its development is not based on a needs and situation analysis of the staff and institution.	Staff in the teacher education institution develops their individual ICT professional learning plan; however, there is a lack of ownership and commitment for this plan as they are mandated by the management of the institution. No support is given to the staff in developing these plans.	Mentoring and peer coaching of ICT for teaching and learning are planned. The teacher education institution has a system of assigning mentors or peer coaches to individual staff or groups of staff. However, there is no support or professional learning for the mentors and peer coaches.	Some conducive conditions for ICT professional learning exist but they are mainly necessary conditions of access to professional learning and access to ICT facilities.	A reward and incentive structure for ICT professional learning is in place but it is not an integral part of the staff appraisal system.
Proficient	Professional learning culture permeates all levels within the institution.	The ICT professional learning program is developed based on a needs and situation analysis of the staff and institution. However, the ICT program is not linked with other professional learning programs.	Each staff in the teacher education institution develops his/her own ICT professional learning plan and is committed to the plan. Support is given to the staff in developing these plans.	Mentoring and peer coaching of ICT for teaching and learning are planned. The teacher education institution has a system of assigning mentors or peer coaches to individual staff or groups of staff. These mentors and peer coaches are supported and have undergone professional learning.	Conducive conditions for ICT professional learning exist and they include both necessary and sufficient conditions. Necessary conditions include access to ICT facilities and professional learning; and sufficient conditions include leadership support, opportunities for practice and a professional learning community.	A reward and incentive structure for ICT professional learning is an integral part of the staff appraisal and management system. However, the structure is constructed without an institute-wide consultation.
Innovative	Professional learning culture permeates all levels within the institution and the major partners of the institution (including schools and other education agencies).	The professional learning program is developed based on a needs and situation analysis of the staff and institution. The ICT program is linked to other professional learning programs and created opportunities for practice.	Staffs in the teacher education institution develop their individual ICT professional learning plans collaboratively and are committed to these plans. Support is given to the staff in developing and monitoring these plans in their learning communities.	Mentoring and peer coaching of ICT for teaching and learning are planned and they involve working with other teacher education institutions, public and private organisations and schools. Mentors and peer coaches are well supported and have undergone professional learning.	Conducive conditions for ICT professional learning exist and they include both necessary and sufficient conditions. These and other conditions are constantly reviewed and revised by the teacher education institution.	A reward and incentive structure for ICT professional learning is constructed based on an institute-wide consultation and is an integral part of the staff appraisal and management system.

Strategic Dimension **Four**

ICT Plan, Infrastructure, Resources and Support

There are 12 strategic foci under the fourth strategic dimension that consists of 4 key components:

ICT Plan
- Development of ICT Plan
- Implementation of ICT Plan
- Review of ICT Plan

ICT Infrastructure, Hardware and Software
- Setting Up of ICT Infrastructure and Hardware (support existing practices, leading practices)
- Maintenance of ICT Infrastructure and Hardware
- Choice and Purchase of Software
- Access to ICT Infrastructure, Hardware and Software

ICT Resources
- Use of ICT resources (adopted, customised, co- or construction)
- Management of ICT resources

ICT Support
- ICT Support for teacher educators (support from instructional designers.
- Technical support)
- ICT Support for pre-service teachers (training)
- ICT support for Administration

Strategic Dimension **Four**
ICT Plan, Infrastructure, Resources and Support

	ICT Plan, Infrastructure, Resources and Support						
	ICT Plan			ICT Infrastructure, Hardware, and Software			
	Development of ICT Plan	**Implementation of ICT Plan**	**Review of ICT Plan**	**Setting Up of ICT Infrastructure and Hardware**	**Maintenance of ICT Infrastructure and Hardware**	**Choice and Purchase of Software**	**Access to ICT Infrastructure, Hardware and Software**
Undeveloped	Absence of an ICT plan for the teacher education institution.	Absence of an implementation of the ICT plan in the teacher education institution.	Absence of a review of ICT plan for the teacher education institution.	The setting up of ICT infrastructure and hardware is ad-hoc or unplanned.	Absence of maintenance of ICT infrastructure and hardware.	Choice and purchase of software are not based on a needs and situation analysis of the teacher education institution.	Absence of access to ICT infrastructure, hardware and software.
Fundamental	The ICT plan is developed without consultation with staff and students.	The ICT plan is implemented as a directive without consultation with staff and students.	The ICT plan is reviewed periodically by only the senior management of the teacher education institution.	The setting up of ICT infrastructure and hardware is planned so as to support existing policies and practices in the teacher education institution.	The maintenance of ICT infrastructure and hardware is carried out periodically by a designated team or department in the teacher education institution. Each maintenance activity is not documented.	Choice and purchase of software are administered centrally based on the needs and situation analysis carried out by the ICT department of the teacher education institution.	Access to ICT infrastructure, hardware and software is limited to prescribed curriculum time and pre-booked slots for the pre-service teachers and staff.
Proficient	The ICT plan is developed in consultation with staff and students but does not allow for changes in conditions and emergence of new ICT tools.	The ICT plan is implemented in consultation with staff and students but does not allow for customization by staff to better fit the plan to the context.	The ICT plan is reviewed and revised regularly by a committee made up of different stakeholders of the teacher education institution.	The setting up of ICT infrastructure and hardware is planned so as to support the changing needs of the main stakeholders of the teacher education institution.	The maintenance of ICT infrastructure and hardware is carried out regularly by a designated team or department in the teacher education institution. Each maintenance activity is well-documented and monitored.	Choice and purchase of software are administered at the department, cluster or program level based on the needs and situation analysis it carried out locally. The ICT department coordinates, monitors and supports purchases centrally, no other support is given to the department, cluster or program.	Access to ICT infrastructure, hardware and software is open to pre-service teachers and staff as long as the ICT facilities are supervised and manned.
Innovative	The ICT plan is developed in consultation with staff and students, and the plan allows for changes in conditions and emergence of new ICT tools.	The ICT plan is implemented in consultation with staff and students and allows for customization by staff to better fit the plan to the context.	The ICT plan is reviewed and revised regularly by a committee made up of different stakeholders of the teacher education institution. The review is based on an analysis of data collected from multiple sources.	The setting up of ICT infrastructure and hardware is based on the anticipated future needs of the main stakeholders of the teacher education institution.	The maintenance of ICT infrastructure and hardware is the shared responsibility of all stake holders in the teacher education institution. The maintenance is facilitated, documented and monitored by a designated team or department.	Choice and purchase of software are administered at the department, cluster or program level based on the needs and situation analysis it carried out locally. The ICT department co-ordinates, monitors and supports the department, cluster or program in its choices and purchase of software.	Access to ICT infrastructure, hardware and software is open to pre-service teachers and staff 24/7 with appropriate security measures taken by the teacher education institution.

	ICT Plan, Infrastructure, Resources and Support				
	ICT Resources		ICT Support		
	Use of ICT Resources	**Management of ICT Resources**	**ICT Support for Teacher Educators**	**ICT Support for Pre-Service Teachers**	**ICT Support for Administration**
Undeveloped	Absence of use of ICT resources for teacher educators.	Absence of management of ICT resources in the teacher education institution.	Absence of ICT support for teacher educators.	Absence of ICT support for pre-service teachers.	Absence of \ICT support for administration.
Fundamental	ICT resources are used by teacher educators without customization of resources or change of activities.	Limited management of ICT resources where resources are consolidated and tagged whenever new resources are available. All uploads are done only by the ICT department in the teacher education institution.	Limited ICT support is provided for teacher educators mainly in the form of an ICT Helpdesk that deals only with technical issues.	Limited ICT support is provided for pre-service teachers mainly in the form of an ICT Helpdesk that deals only with technical issues.	Limited ICT support is provided for the administration of the teacher education programs that includes registration, access to student database, timetabling and room allocation, and communication with pre-service teachers. No or little professional development is available to use the different administrative systems.
Proficient	ICT resources are customized by teacher educators and/or activities are planned to support the use of ICT resources to enhance teaching and learning.	Management of ICT resources where resources are consolidated, tagged, and reviewed regularly. Teacher educators may upload and share ICT resources using a standard upload template. The ICT department monitors the repository of ICT resources.	ICT support is provided for teacher educators beyond an ICT Helpdesk; instructional designers and multimedia developers are available to support teacher educators in their teaching with ICT.	ICT support is provided for pre-service teachers beyond an ICT Helpdesk; a Learning Support unit is available to support pre-service teachers in their learning and teaching (especially during practicum) with ICT and development of ICT competencies.	ICT support is provided for the administration of the teacher education programs that includes registration, access to student database , timetabling, room allocation, communication with pre-service teachers, curriculum and course outlines, and examination and grades. Although professional development to use the different system is available, most of the systems are independent of one another.
Innovative	ICT resources are customized or developed by teacher educators and pre-service teachers, and activities are planned by them to support the use of ICT resources to enhance teaching and learning.	Management of ICT resources where resources are consolidated, tagged, and reviewed regularly. Teacher educators and pre-service teachers may upload and share ICT resources using a standard upload template. The ICT department monitors the repository of ICT resources.	Besides an ICT support team or department that addresses the teacher educators' technical and instructional needs, a peer coaching or buddy system is in place for the teacher educators to support one another in the use of ICT for teaching and learning.	Besides the ICT Helpdesk and Learning Support unit, a peer coaching or buddy system is in place for the pre-service teachers to support one another in the use of ICT for teaching and learning	ICT support is provided for the administration of the teacher education programs that includes registration, access to student database , timetabling, room allocation, communication with pre-service teachers, curriculum and course outlines, and examination and grades. Professional development to use the different system is available, and most of the systems are inter-connected.

Strategic Dimension **Five**

Communications and Partnerships

The fifth strategic dimension consists of 6 strategic foci:

- Communications Facilitated by ICT
- Institutional Approach Towards Partnerships on the Use of ICT for Teaching, Learning and Administration
- Partnerships with Schools on the Use of ICT for Teaching, Learning and Administration
- Partnership with Education Ministry or Department on the Use of ICT for Teaching, Learning and Administration
- Partnerships with Other Private, Public, National and International Organisations on the Use of ICT for Teaching, Learning and Administration
- Engagements with Local and Global Communities Facilitated by ICT

Strategic Dimension **Five**
Communications and Partnerships

	Communications & Partnerships					
	Communications Facilitated by ICT	**Institutional Approach Towards Partnerships on the Use of ICT for Teaching, Learning and Administration**	**Partnerships with Schools on the Use of ICT for Teaching, Learning and Administration**	**Partnership with Education Ministry or Department on the Use of ICT for Teaching, Learning and Administration**	**Partnerships with Other Private, Public, National & International Organisations on the Use of ICT for Teaching, Learning and Administration**	**Engagements with Local and Global Communities Facilitated by ICT**
Undeveloped	Communications of the teacher education institute are not facilitated by ICT.	Partnerships on the use of ICT for teaching, learning or administration are not encouraged in the teacher education institution.	Absence of partnership with schools on the use of ICT for teaching, learning or administration.	Absence of partnership with education ministry or department on the use of ICT for teaching, learning or administration.	Absence of partnership with other private, public, national and international organisations on the use of ICT for teaching, learning or administration.	Absence of engagement with local and global communities facilitated by ICT.
Fundamental	Communications of the teacher education institute are facilitated by ICT but most of such communications are information dissemination that are not updated regularly or not well-organised.	Partnerships on the use of ICT for teaching, learning or administration are encouraged by the teacher education institution but there is a lack of formal support structure to develop and sustain these partnerships.	Partnerships with schools are limited to pre-service teachers' placement and their supervision by mentor teachers from the school and teacher educators from the institute or university.	Partnership with the education ministry or department on the use of ICT for teaching, learning or administration is limited to discussion about meeting the demand for ICT competencies among teachers and school leaders in the education system.	Partnerships with other organisations on the use of ICT for teaching, learning or administration are often limited to one-off projects such as co-organising a professional learning workshop or seminar, collaborating on a research and development project, or co-financing the building of ICT infrastructure.	ICT-facilitated engagements with local and global communities are limited to extra-curricular activities and/or after-school programs.
Proficient	Communications of the teacher education institute are facilitated by ICT where updated information from all levels is disseminated and organised for different target audience (e.g. Staff, Students, Future Students, Alumni and Visitors).	Partnerships on the use of ICT for teaching, learning or administration are encouraged by the teacher education institution and there is a formal support structure and resources (financial, human, infrastructure, hardware and software) allocated to develop and sustain these partnerships.	Besides pre-service teachers' placement and supervision, partnerships with schools include professional learning opportunities for teachers and school leaders, and research and development projects in the classroom and school. However, most of these activities involve the teacher educator as the resource person or source of expertise.	Partnership with the education ministry or department on the use of ICT for teaching, learning or administration involves the ministry or department commissioning the teacher education institution to undertake professional learning or research and development projects to address the demand for ICT competences among teachers and school leaders in the education system.	Most of the partnerships with other organisations on the use of ICT for teaching, learning or administration are sustainable where there is long term commitment from both the teacher education institute and organisation towards an ICT project or suite of ICT and non-ICT projects.	ICT-facilitated engagements with local and global communities are integral parts of the pre-service teacher education curriculum and assessment. However, these engagements are initiated by either the teacher education institution or the deans/teacher educators.
Innovative	Besides the dissemination of updated and well-organised information, there are opportunities for future students and visitors to engage in the institute's activities such as online forums and conferences, and online chats with existing students and staff.	Besides encouragement and support by the teacher education institution for partnerships on the use of ICT for teaching, learning or administration, teacher educators and deans are pro-active in identifying and building partnerships.	Partnerships with schools involve not only activities where teacher educators serve as resource persons but also activities where teachers and school leaders serve as resource persons such as being involved in the design and development of the curriculum and assessment tasks and teaching in the pre-service teacher education program.	Besides undertaking commissioned projects by the education ministry or department, the partnership with the ministry or department on the use of ICT for teaching, learning or administration involves education officers and directors engage in the design and development of the curriculum and assessment tasks and teaching in the pre-service teacher education program.	Besides long term commitments on a project or suite of projects, the partnerships with other organisations on the use of ICT for teaching, learning or administration involve secondment of teacher educators and deans to the organisations and/or secondment of the staff from the organisations to the teacher education institution.	ICT-facilitated engagements with local and global communities are initiated by all stakeholders of the teacher education institution and are integral parts of the pre-service teacher education curriculum and assessment.

Strategic Dimension **Six**

Research and Evaluation

In the sixth strategic dimension, there are 2 key components with 7 strategic foci:

Research and Development:

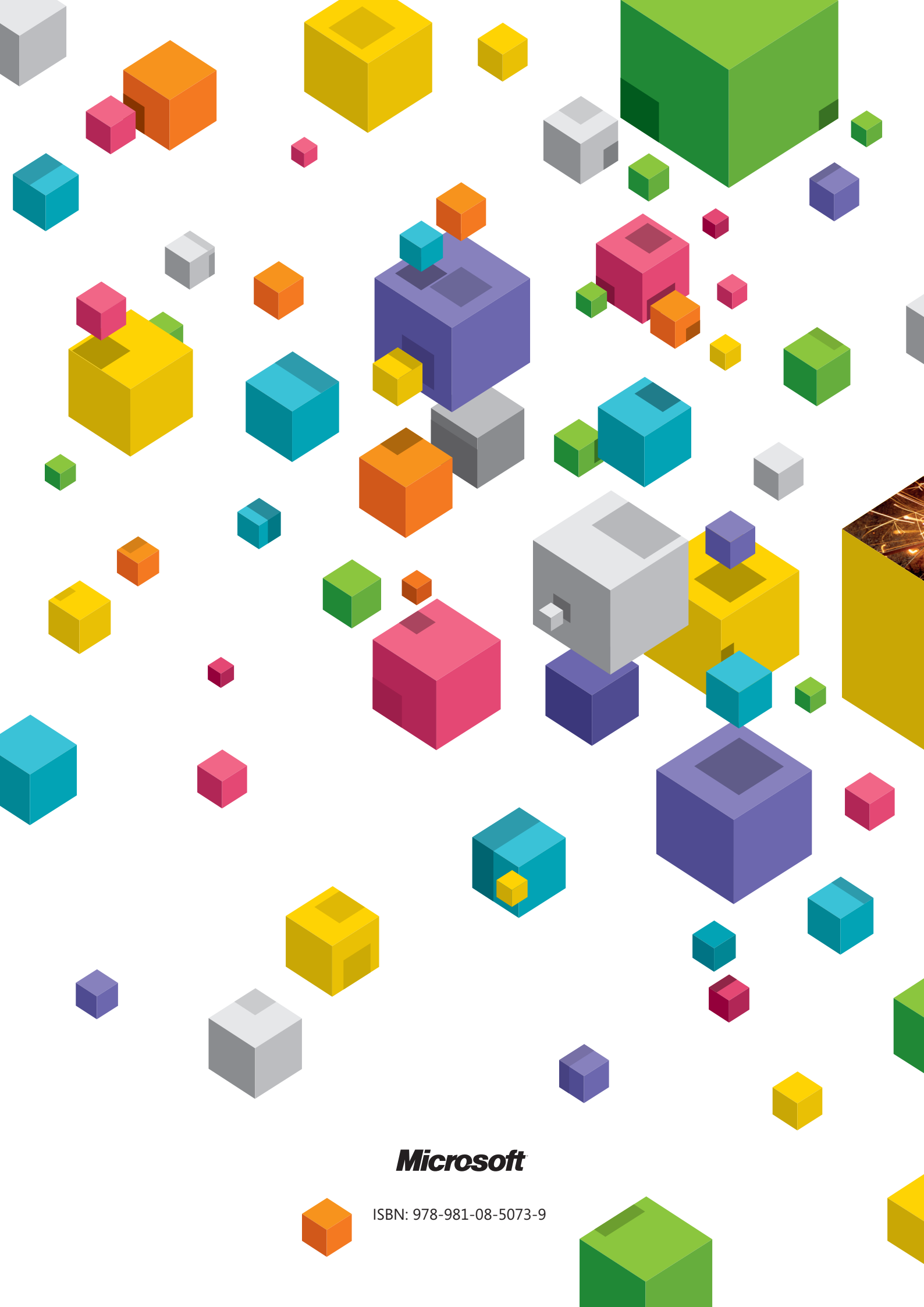
- Evidence-Based ICT-Mediated Practices and ICT-Related Policies
  - ➔ Constant revision is needed to be in tandem with the ICT advancements (evidence-based policies and practices)
  - ➔ Integrated and informed research (based on needs and anticipated trends) –link between research and practice
- Research and Development Funding
- Research and Development Support
- Impact of Research and Development on the Pre-Service Teacher Education Program
- Impact of Research and Development on Schools and the Education System

Evaluation:

- Audit of Existing ICT-Mediated Practices and ICT-Related Policies
- Evaluation of the Use of ICT for Teaching, Learning and Administration

Strategic Dimension **Six**
Research and Evaluation

	Research and Evaluation						
	Research and Development					Evaluation	
	Evidence-Based ICT-Mediated Practices & ICT-Related Policies	**Research and Development Funding**	**Research and Development Support**	**Impact of R&D on Pre-Service Teacher Education Program**	**Impact of R&D on Schools and the Education System**	**Audit of Existing ICT-Mediated Practices and ICT-Related Policies**	**Evaluation of the Use of ICT for Teaching, Learning and Administration**
Undeveloped	ICT-mediated practices and ICT-related policies are not evidence-based.	Absence of research and development funding.	Absence of research and development support.	There is no impact of R&D on pre-service teacher education program.	There is no impact of R&D on schools and education system.	Absence of audit of existing ICT-mediated practices and ICT-related policies.	Absence of evaluation of the use of ICT for teaching, learning and administration.
Fundamental	Only some ICT-mediated practices and ICT-related policies are evidence-based, the majority of the practices and policies are ICT-driven.	There is limited funding for research and development of ICT in education; most of the funding is external and on an ad-hoc and one-off basis.	There is limited support for research and development of ICT in education where most of the support is administrative in nature such as identification of available research funds, submission of research proposals, and preparation of research agreement or contracts.	The impact of the R&D on the pre-service teacher education program is confined to the courses/units that are taught or coordinated by the teacher educators who have been involved in the R&D projects.	The impact of the R&D on the schools and education system is at the micro-level where it is confined to the classrooms or schools that the R&D projects are conducted in.	The audit of existing ICT-mediated practices and ICT-related policies is carried out either on an ad-hoc basis or by a top-down approach that involves only a small group of staff from the institution.	The evaluation of the use of ICT for teaching, learning and administration is summative and is usually carried out at the end of the academic year.
Proficient	Most ICT-mediated practices and ICT-related policies are evidence based but these evidences are based on secondary data (through literature review).	External funding for research and development of ICT in education is complemented with internal funding from the teacher education institution. This facilitates continual funding that supports the sustainability of projects. However, funding is managed at the project level rathe than the institution or research centre level.	Besides administrative support for research and development of ICT in education, there is support for the preparation of research proposals that includes working out a budget, undertaking literature review, consulting \ research designs and methods and providing feedback.	The R&D on ICT in education has enhanced ICT-mediated practices, ICT-related policies, curriculum and assessment in the pre-service teacher education program at the teacher education institution.	The R&D on ICT in education has enhanced ICT-mediated practices, ICT-related policies, curriculum and assessment in schools and their associated education system.	The audit of existing ICT-mediated practices and ICT-related policies involves all stakeholders of the teacher education institution to identify the gaps in practices and policies; however, there is no follow-up activity to address the gaps.	There is both formative and summative evaluation of the use of ICT for teaching, learning and administration. Evaluation data collected and analysed is discussed at the department or program level and follow-up activities are also carried out at the department or program level.
Innovative	Most ICT –mediated practices and ICT-related policies are evidence based and these evidences are from both primary (data collected from the teacher education institution itself) and secondary data.	There are both external and internal funding for research and development of ICT in education; these sources of funding are managed at the institution's or research centre's level to ensure better synergies between and across projects.	Support for research and development of ICT in education is provided by the teacher education institution at all stages of the research project; that is, from the identification of sources of funding and preparation of research proposal to the project implementation and submission of final research report.	The R&D on ICT in education has enhanced not only the ICT-mediated practices, ICT-related policies, curriculum and assessment in the pre-service teacher education program at the teacher education institution, but also the pre-service teacher education programs in other institutions.	The R&D on ICT in education has enhanced ICT-mediated practices, ICT-related policies, curriculum and assessment beyond the schools and their associated education system, to schools in other education system.	The audit of existing ICT-mediated practices and ICT-related policies involves all stakeholders of the teacher education institution to identify the gaps in practices and policies and there are follow-up activities to address the gaps.	There is both formative and summative evaluation of the use of ICT for teaching, learning and administration. Evaluation data collected and analysed is discussed at the teacher education institution level and follow-up activities are also carried out at the institution level.



Microsoft

ISBN: 978-981-08-5073-9