UNESCO Implemented Project on
Training and Professional Development of Teachers/Facilitators
in Effective Use of ICTs for Improved Teaching and Learning

Regional Guidelines on Teacher Development for Pedagogy-Technology Integration

(Working Draft)

Based on a
Series of Workshops in Pedagogy-Technology Integration

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Organized by
UNESCO Asia and Pacific Regional Bureau for Education

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Foreword

*R*apid advances in information and communication technology (ICT) have created unprecedented opportunities in the field of education, and have had a profound effect on the way teachers teach and how learners learn. Mastering ICT skills and utilising ICT towards creating an improved teaching and learning environment is of utmost importance to teachers in creating a new learning culture. Pedagogy-Technology integration plays a key role in this transformation. The desired transformation requires visionary leadership that can command the active involvement of all stakeholders of education: policy makers, the entire education community including teachers, and parents.

The diverse Asia-Pacific region considers education to be a driving force in an improved social structure and sees ICT as an important vehicle in this undertaking. Bridging the digital divide within the Asia-Pacific region is an important challenge. In an age of rapid change and uncertainty, there is one thing that is certain: teachers and policy makers will need to adapt to changes if they are to survive and keep pace with new methods and technology. It may be emphasized that the professional development of teachers and administrators is the key to successful implementation of any ICT-enabled teacher education programme.

Within the framework of the Asia-Pacific Programme on the Use of ICT in Education, with generous support from the Japanese Funds-in-Trust (JFIT), UNESCO Asia and Pacific Regional Bureau for Education has implemented a project on 'Training and Professional Development of Teachers/Facilitators in Using ICT for Improved Teaching-Learning'. An Expert Meeting on Teachers'/Facilitators' Training in Technology-Pedagogy Integration was held in Bangkok during 18-20 June 2003 in order to launch the project and orient its implementation. The Expert Meeting reviewed the use of ICT by teachers in the region and proposed a conceptual curriculum framework for integrating ICT in teacher education.

As a follow-up to the above workshop, a multi-disciplinary meeting was organized to develop regional guidelines and competency standards for integrating pedagogy and technology (in Beijing, China, 27-29 September 2003 and in Bangkok, Thailand, 28-31 March 2004). The draft regional guidelines were subsequently discussed at a workshop for project country team teachers and teacher educators during 24-27 June 2004, in Bangkok, Thailand. The same was again discussed in the Expert Meeting during 20-21 January 2005.

This document is based on the discussions and feedback during the series of workshops and the expert meeting. It helps to integrate ICT with pedagogy in the field of teacher education, and is primarily intented for teachers and teacher educators in this region.

UNESCO-APEID is indebted to the Government of Japan's Funds-in-Trust and to the Director of UNESCO's Asia and Pacific Regional Bureau for Education for making this project possible.

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1 INTRODUCTION

1.1 CHAPTER OVERVIEW

Teachers are the central forces in tapping the learning opportunities created by information-communication technology (ICT). Along with institutional heads and education policy-makers, teachers also contribute to bridging the digital divide in education prevalent between and within countries of the Asia-Pacific region. These educators are instrumental in deciding how teaching and learning take place in classrooms, in institutions and in the community. It follows that these educators need to be at the centre of educational change, using technology for teaching, learning and for development purposes.

This chapter introduces the readers with the global context within which the objectives of promoting ICT for education are encompassed. It looks at the interaction in the areas of development, education and technology, and at the specific challenges that the Asia-Pacific region has been facing.

1.2 THE GLOBAL CONTEXT

ICT means different technologies in different national/local contexts. Appropriate models for the effective use of ICT remain to be developed to suit mixed learning needs in the varied contexts of the Asia-Pacific countries.

New development in ICT has had a huge impact on the role of teachers in an information-intensive society. Many teachers lack the knowledge and skills to effectively use ICT as a tool in facilitating learning in increasingly ICT-pervasive learning environments. The main problem to address, in the use of ICT in and for education, is the question of adequate expertise in terms of knowledge, skills and attitude on the part of the facilitators at individual, institutional and national levels. Many countries have launched teacher training programmes for the use of ICT, but most of the training activities are crash programmes, over-emphasizing computer literacy while not enabling teachers to integrate technology with pedagogy and facilitate ICT-assisted interactive teaching-learning at classroom level.

While many Ministries of Education in the Asia-Pacific region have expressed their intention to 'computerize' institutions, only a few have developed coherent strategies to enable teachers to integrate its use as a pedagogical tool in the classroom. Levels of ICT integration in teacher training, and even patterns of using ICT by teachers and educational managers, vary greatly in the region.

ICT can improve learning outcomes, even in traditional rote learning exercises. The present attempt intends to be experimental and innovative in areas, which are challenging and little explored in the development of pedagogy-ICT integration. Changes may be introduced in both teaching-learning methods and in content. Students can enjoy learning actively, such as by bringing the outside world into the classroom or by interacting with peers, experts and others. Furthermore, the students will have the opportunity to learn new skills, such as locating appropriate information, making informed choices by learning to recognize the authenticity of sources, and collaborating with other learners.

1.2.1 Justification for Present Initiatives

The fundamental role of the teacher is to facilitate learning and to help to create autonomous learners who can continue to learn by themselves, especially with the assistance of new ICT. There is, however, a definite deficit in the knowledge and skills needed to use ICT as an effective teaching-learning tool. Well-trained teachers using ICT are few, and there are some who regard technology as a threat to their confidence as the main source of knowledge. In addition, pupils often have better computer skills than their teachers, further undermining teachers' authority. Consequently, there has been a movement away from the conventional solitary working methodology of teachers towards building multi-disciplinary teams of teachers, curriculum specialists and ICT technicians, who together can provide the range of skills necessary for the preparation of quality IT-based teaching materials.

There is also a strong need for a more systematic approach at the higher policy making level. UNESCO's Regional Clearinghouse on ICT in Education for Asia and the Pacific has already begun disseminating national 'ICT in Education' policies on its website. Many countries have not developed specific policies as yet. The following points can be gleaned:

- Institutions and local communities need strong leadership and management committed to using ICT for pedagogical/educational purposes, and supportive of teachers in professional development towards the better use of ICT.
- There are major constraints in regard to both computer/IT facilities in educational institutions and the availability of relevant software.
- There is a need to enable the ICT training of future teachers, by transforming existing teacher-centred, information-intensive curricula.

Community involvement and support in the use of ICT for educational and community development are also essential. Many parents and community leaders expect teachers to be 'chalk-talk lecturers', or dispensers of information and, in turn, expect children to be obedient rote learners, capable of achieving high-test scores regardless of the applicability of their learning. Parents and communities can create supportive learning environments where the use of technology as an effective teaching-learning tool is both encouraged and supported. This will also reflect a better understanding of the changing roles of teachers and learners.

In building the capacities of teachers and other facilitators, it is vital that an increased awareness of the impact of new ICT on education and on teachers is developed, in addition to learning how to encourage positive perceptions of technology as an aid, rather than as a substitute or a threat.

1.3 THE INTERACTION BETWEEN DEVELOPMENT, EDUCATION AND TECHNOLOGY

A broad understanding of the three-way link between education, technology and development is crucial to the appropriate and effective use of ICT for educational purposes. 'Choosing a particular type of education amounts to choosing a particular type of society' [1]. The use of technology in an information society is dependent on technical considerations as well as on financial, political and social circumstances.

In view of the profound and multi-dimensional impact of new ICT on education and on society, this discussion goes beyond its simple use for teaching-learning purposes. It requires a fundamental rethinking on the three-way interaction between education, technology and development. It also necessitates a general consideration of how knowledge can be made accessible in an information society, through formal education and through non-formal as well as informal systems.

In emerging knowledge-based economies and information-intensive societies, technology now increasingly serves both education and development goals. 'Knowledge and information' are the new forms of wealth and are the driving force for development. The main challenge is how to ensure equal access of all to the means of acquiring necessary skills in a changed environment, and how to use technology to facilitate the education and training of the population for development purposes.

The strong three-way link binding development, education and technology constitutes a deep and systemic argument that ties investment not only with progress in education, but (more importantly) also with the development process itself. It represents the key strand in a reciprocal link through which development, education and technology can become mutually reinforcing within a dynamic framework for progress. It also represents what is increasingly seen as a fundamental human right for every citizen to have access in a global era. This, in a sense, equates education with 'empowerment for development' [2].

1.3.1 Development

Development and peace are the twin goals of the UNESCO member countries and of the international community. Over the decades, the evolving concept of 'development' has been broadened from increasing production of goods and services to include equitable distribution of wealth, active participation in decision-making, protection of the environment, and preservation of cultural identity. Development refers to growth that is equitable, sustainable and people-centred.

The UNDP Human Development Report in 1990 made the far-reaching statement that people are the wealth of a nation and that human development is a process of broadening people's choices. UNDP-proposed Human Development Indicators have included adult literacy and educational attainment level in terms of combined primary, secondary and tertiary gross enrolment. 'Development of the people' denotes investment in human capabilities through education and the development of skills that aid progress. Development by the people also means giving everyone a chance to participate in the process of growth and development. Development,

therefore, has an economic dimension as well as social, environmental, cultural and scientific-technological aspects.

In the broader definition of development, education, whether formal, non-formal or informal, is a means, a constitutional element as well as one of its essential goals. Education has a fundamental role in empowering people of all ages to assume responsibility for creating a sustainable future.

Human development is an important means to technology development. Technological innovation is an expression of human potential. Links between technology and human development have been schematically shown in **Figure 1.1**.
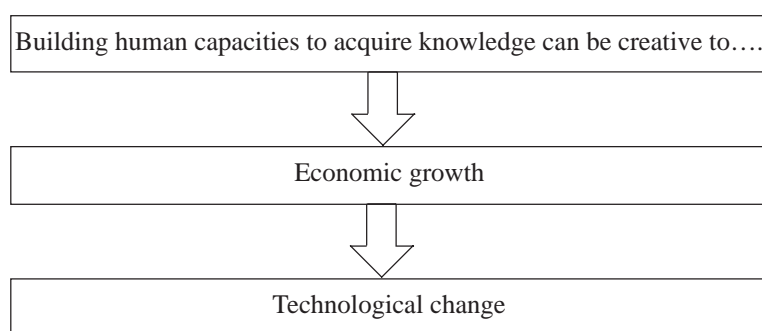
Figure 1.1: Links between Technology and Human Development
[Source: UNDP Human Development Report 2001, p. 28]

1.3.2 Education

Education is both a fundamental means to, and an end to, personal and social development. Education provides a significant knowledge base that underpins technological development. Human development and technological advances can be mutually reinforcing, thereby creating 'a virtuous circle' [3].

In socio-economic terms, education is a tool for poverty alleviation and social inclusion. In cultural terms, education is an instrument for transmission of cultural values from generation to generation and for nurturing creativity in young minds. Education taps the potential of individual learners towards its fullest development. It requires a trained workforce and specialists who can advance new technologies, and it creates new knowledge towards cutting edge technology.

1.3.3 Technology

Technology has always been a powerful tool for human development and a major driving force of national growth. In the 21st Century, it is development that will unleash human capacity and create technological enhancement [3].

No development is possible without the help of science and technology. Meanwhile, the direction and pace of technology development are greatly influenced by national development

programmes. Human development lies at the heart of policy of all countries and high priority is invariably given to strategies for technological as well as educational development.

The new forms of ICT have had a profound impact on human activities concerned with economic production, work and life just as much as with education and training. In today's information society, new technological development is creating a cultural and educational environment capable of diversifying the sources of knowledge and learning.

The new forms of ICT have great potential in contributing to human development in the 21st Century.

Firstly, newly developed ICT provides vital input to almost all human activities and can be used in the most varied locations and for multiple purposes.

Secondly, ICT breaks barriers to human development in at least three ways, which were not possible earlier [3]. ICT facilitates knowledge as it enables universal access to information, which is as central as education is towards enhancing human capabilities. While education develops cognitive skills, information gives content to knowledge. State-of-the-art ICT, especially the Intranet and the World Wide Web, can deliver information to anyone, anytime, anywhere.

New ICT involves innovations in microelectronics, computing (hardware and software), telecommunications and opto-electronics – microprocessors, semiconductors, and fibre optics. These innovations enable the processing and storage of an enormous amount of information and the rapid distribution of information through communication networking.

Networks now have wider reach and falling costs due to accelerated development in ICT and galloping globalisation. For example, the amount of information that required a whole month and the entire Internet to send in 1997 could be sent over a single cable in a second in 2001. Besides, the cost of transmitting a trillion bits of information from one sub continent to another has fallen drastically [3].

Rapid advances in new ICT have brought new possibilities and opportunities for still greater advances in human development. The Internet has grown exponentially, from 16 million users in 1995 to more than 400 million users in 2000 and to an expected 1 billion users in 2005. Connectivity is rising at spectacular rates in Europe, Japan, the USA and in many developing countries [3].

The new ICT has broken down old barriers of time and space. It has made it possible to generate, store, transmit, retrieve and process information and knowledge at increased speeds and with increased efficiency and flexibility. In short, new ICT has opened up almost unlimited possibilities, for teachers and students in terms of information flow and human communication. But it needs to be pointed out that while the advanced ICT offers unprecedented learning opportunities, it does not offer simple solutions to the complex challenges in education and development.

While it is a fundamental human right of children, youth and adults to basic education of relevance and quality, universal basic education is an unfulfilled dream in many countries of the region. To achieve Education for All (EFA) goals, 'improved teaching and learning' implies quality education for *all* learners, and not *only* the 'best education for the best few'. Towards this EFA goal, improved access and equity can be made the precondition or the first principle of quality education. ICT can play a major role in ensuring quality in view of the following aspects:

- ICT improves access and promote equity in education
- ICT improves the quality of teaching and learning
- ICT improves management and efficiency of education

Technologies such as CD-ROM, radio and cable television, or a mix of technologies, can be combined with the Internet to expand its reach. For example, community radio can be used as a gateway to the Internet for its listeners in remote rural areas. Regional/international cooperation can reduce the cost of access to the Internet. The development of ICT has provided improved tools for learning through a global network and wireless technologies enable developing countries with little telecommunications infrastructure to connect to the network [3].

Many universities in the Asia-Pacific region have implemented web-based education systems. Mega or open universities such as the Open University in the UK, the Indira Gandhi National Open University in India and the Central Radio & TV University in China have extended their communication capabilities to impart lifelong education and training, especially to those living in rural or remote areas. The Internet is serving a growing number of learners, in varied learning environments, along with a larger number of those using a wide range of communication technologies.

The quality and orientation of education at each level and the link with the demand for skills are critical for mastering technology [3]. Quality primary education develops basic capabilities for human development and enables the young to be more innovative and productive. Quality secondary and higher education are also crucial to technology development. Universities not only deliver but also create knowledge and create national capacity to adapt technology to the country's needs and help manage the risks inherent in technological change.

1.4 CHALLENGES

Countries in the Asia-Pacific region have all developed policies and strategies to link educational goals to those of technology and development. ICT has been most rapidly spreading across educational systems as well as in businesses, commerce and other areas of activity. The number of Internet users in China alone has grown to more than 80 million in early 2004, second only to the USA.

However, there are large disparities in the levels of development. The digital divide is most apparent both among countries within the region and within the countries. Internet users are predominantly the following population groups [3].

- **Urban, and peri-urban regions:** In China, the 15 least developed provinces, with 600 million people, have only 4 million users, while Shanghai and Beijing, with 27 million people, have 5 million users. Among India's 1.4 million Internet connections, more than 1.3 million are in five States.

- **Better-educated and wealthier:** In Sri Lanka, 65% Internet users have had tertiary education. The rate for China is 70%.

- **Young:** As in other regions, younger people are more apt to be online. In Australia, 18–24 year olds are five times more likely to be Internet users than those above. In China, that share is 84%.

- **Male:** Men make up a much larger number of Internet users though the gender gap in some countries in the region is narrowing down rapidly. For instance, in Thailand, the number of female users jumped from 35% in 1999 to 49% in 2000.

Developed countries like Japan and Australia have been at the cutting edge of technological development. This has helped retain a competitive advantage in their national development. China, India, Malaysia, and the Republic of Korea have an increased investment in new ICT, and use technology to assist their rapid transformation into newly industrializing societies. The least developed countries are concerned with the challenge of using technology as a tool for the reduction of poverty and reducing underdevelopment. For a post-conflict country like Afghanistan, the basic need is to frame national policies, and an infrastructure for scientific and technological development as a means towards restructuring the diminished education system and meeting basic development needs.

1.5 THE JFIT PROGRAMME ON PROMOTING ICT IN EDUCATION

The UNESCO-implemented programme sponsored by the Japanese Funds-in-Trust (JFIT) is based on the fact that the rapid development of ICT presents development agencies with a unique opportunity to take a major multi-pronged approach to the expansion and reforms of education in the Asia-Pacific region. This would help to achieve the overarching goals of EFA.

The UNESCO vision is for a system-wide reform at the macro-level, and for change in teaching and learning processes at the micro-level. It is important to recognize that ICT in itself is not going to radically change education systems for the better or miraculously achieve the goals of EFA. A comprehensive view of what education ideally seeks to achieve is needed for ICT to be utilized to its full potential.

The focus of the programme is on how to use ICT to reduce disparities in both educational access and quality of education. Its special concern for gender issues in use of ICT in education will help promote the call of the EFA Framework for gender equality in education by the year 2015.

UNESCO envisions that the ICT programme will result in an educational environment involving enriched curricula, resources sharing, quality multimedia material, and a cadre of teachers who are competent in facilitating better learning through ICT.

1.6   THE JFIT PROJECT

The most successful ICT-in-education policy would mean nothing without the support of the teachers. Teachers are central to education, and at the core of this proposed programme. The aim of teachers would be to integrate ICT with traditional pedagogy to transform and facilitate learning.

The JFIT project on 'Training and Professional Development of Teachers and Other Facilitators for Effective Use of ICT for Improving Teaching and Learning' focuses primarily on developing the skills of teachers towards integrating ICT into the curriculum. There is an over-all project for the region and three other projects that pinpoint the training needs in specified disadvantaged regions.

In accordance with the priorities identified by JFIT, the Bangkok-based UNESCO Asia and Pacific Regional Bureau for Education, UNESCO Member States, the project is aimed at building national capacity in effective use of ICT in education. The Government of Japan has been one of the main sources of funding for the ICT in Education project.

1.6.1 Development Objectives

The Asia-Pacific Programme of Educational Innovation for Development (APEID), which is coordinated by UNESCO, aims at building the capacity of teachers and other facilitators in integrating ICT as a tool in the teaching-learning process. It also aims at tapping the potential of new ICT for improving educational quality through the professional development of teachers, and for reducing disparities within the region as well as within individual countries in terms of learning achievement.

1.6.2 Immediate Objectives

The immediate objectives are as follows:
1. To improve the capability of teachers/facilitators, through both pre-service education and in-service training, in integrating ICT as a pedagogical tool. It will also seek to enhance educational resources in facilitating ICT-assisted participative/interactive learning for which:

    - Prototype course materials and training modules are to be produced.
    - A regional 'Guidelines on Technology-Pedagogy Integration for Teachers' are to be developed.
    - 'Training of trainers' workshops are to be conducted at national, sub-regional and regional levels, and master teachers/teacher educators in different countries are to be trained in the effective use of ICT for educational purposes.

2. To identify, create and disseminate country/location-specific ICT pedagogies and models of teachers' use of ICT for different learning environments for which:

    - ICT models for various learning environments are to be created.
    - Country-specific, case-based pedagogies for active learning with ICT are to be developed and pilot tested.

- Changes in teaching and learning to be assessed, results and lessons learned are to be shared.

3. To develop and put into operation a regional online teacher resource base and an offline network for sharing teacher-developed education courseware. At the same time, to encourage innovative practices in the effective use of ICT as a teaching tool and as an educational resource. These activities will be undertaken in cooperation with different countries of the region and with UNESCO's Regional Clearinghouse on ICT in Education for Asia and the Pacific.

These can be achieved by:

- developing a regional guideline on technology-pedagogy integration and competency-based standards of ICT infusion by teachers

- creating prototype course materials for pre-service teacher education and training modules for in-service teacher training

- designing templates of ICT-integrated e-lesson plans and evaluation tools for teachers to assess their students' learning using ICT

- training teacher educators through 'training of trainers' workshops at regional/sub-regional and at national/local levels, who will, in turn, train much larger numbers of teachers

- developing and pilot testing country-specific models and pedagogies in ICT integration by teachers, institutional heads and education managers

- cultivating an online teacher resource base to support teachers and institutional heads in integrating ICT in classroom teaching and school-based management

- creating an offline network of teacher training centres to share innovative practices

- sharing products outside the pilot countries to gather feedback, to identify and reward the most innovative e-lesson plans and ICT integration pedagogies, and for the inclusion of international resources

The countries included in this project are Afghanistan, People's Republic of China, Fiji, India, Indonesia, Kazakhstan, Laos PDR, Malaysia, Mongolia, Philippines, Thailand and Vietnam.

1.7 NATURE AND AUDIENCE OF THE REGIONAL GUIDELINES

The present guidelines are normative and guiding principles for undertaking actions that help to integrate ICT with pedagogy in the field of teacher education. The guidelines are primarily addressed to teachers and mainly restricted to teacher educators in institutions from the different countries of the Asia-Pacific region as mentioned in the previous section. The guidelines are generic, flexible and are not to be treated as prescriptions for country-specific teachers' training

programmes. The guidelines would do the justice and serve the purpose for which it has been framed only if it can offer alternatives and motivate teachers to integrate ICT in their teaching-learning system.

1.8 SUMMARY

An attempt has been made in this chapter to introduce the readers with the global context within which the objectives of promoting ICT for education are encompassed. Although many countries of the Asia-Pacific region are enthusiastic for introducing computers at institutional level, coherent strategies to enable teachers to integrate pedagogy with ICT are yet to be developed, because in many cases, training activities are restricted to crash programmes, merely over-emphasizing computer literacy. While developing these strategies, care has been taken about the strong three-way link binding development, education and technology. Further, the implementation process for pedagogy-ICT integration has to take into account large disparities in the levels of development amongst different countries of the region. Against this backdrop, the basic objectives of the JFIT programme on promoting ICT in education have been discussed.

In the six chapters, this guideline highlights the various issues and strategies related to ICT integration in teaching and learning. Chapter 2 articulates the visions and guiding principles of the ICT integration followed by modelling of ICT development in education in Chapter 3. A curriculum framework for integrating ICT and pedagogy in professional teacher education programme has been elaborated in Chapter 4. Based on the proposed model and curriculum framework, a performance standard for competencies has been elaborated in Chapter 5. Professional development of teachers in pedagogy-ICT integration along with various issues and strategies pertaining to the implementation of ICT integration are discussed in Chapters 6 and 7 respectively.

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2

VISION & GUIDING PRINCIPLES

2.1   CHAPTER OVERVIEW

The integration of ICT with teaching and learning is first and foremost about pedagogy, about creating an environment for students' activities that lead to meaningful and sustainable learning experiences. The introductory chapter discusses the global context and the regional challenges that the Asia-Pacific region faces in promoting ICT for education. New developments in ICT have created unprecedented learning opportunities.

This chapter articulates the visions of a new learning culture. It also outlines the guiding principles that may be applied at different stages of realisation of these visions. The outline of this chapter is divided into five sections – (i) why new visions; (ii) new visions; (iii) guiding philosophy of pedagogy - ICT integration; (iv) guiding principles of pedagogy - ICT integration; and (v) a few emerging topics in ICT integration.

2.2   WHY NEW VISIONS?

Clear visions and informed leadership are essential in order to ensure that all the components of planning and implementing a technology integration plan are present and that they support each other.

UNESCO Planning Guide on ICT in Teacher Education [1] proposed a generic framework for ICT in Teacher Education (see **Figure 2.1**), which is composed of four clusters of competencies encircled by four supportive themes.

The curriculum framework suggests that each teacher may be allowed to interpret the framework within his or her context and personal approach to pedagogy. This may always be related to the subject discipline or content area, rather than to the technology itself. Based on the above generic framework, a modified curriculum framework has been elaborated in Chapter 4.
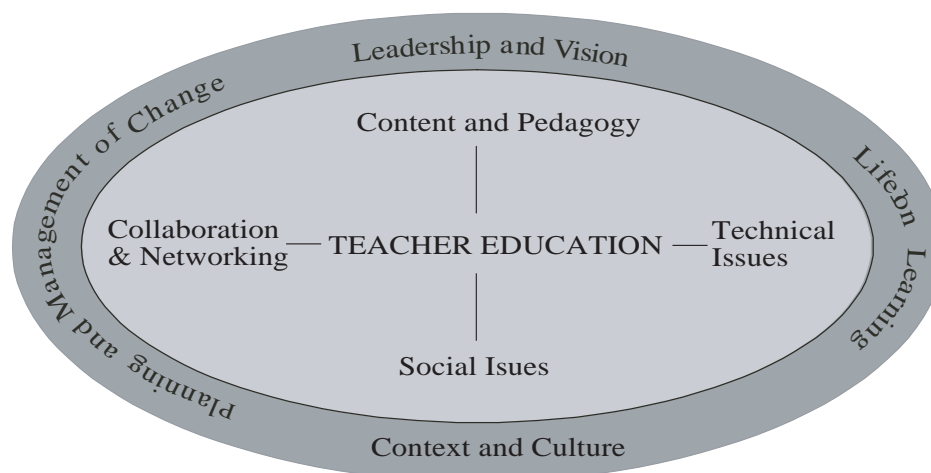
Figure 2.1: *A Framework for ICT in Teacher Education*

The holistic framework defines areas of ICT competency organized in four groups:

1. ***Content and Pedagogy*** focus on instructional practices of teachers and their knowledge of the curriculum. It requires that teachers apply ICT in their respective disciplines to support and extend teaching and learning.

2. ***Collaboration and networking*** showcase the communicative potential of ICT to extend learning beyond the classroom and necessitate the development of new knowledge and skills.

3. ***Social issues,*** which imply that teachers can acquire an understanding of social issues, including the recognition and understanding of legal and moral codes such as copyright and intellectual property rights; participation in debates on the impact of ICT on society; and the use of ICT in the promotion of a healthy society. Awareness of such issues will lead to suitable application of ICT in pedagogy and development.

4. ***Technical issues*** include technical proficiency and the provision of both technical infrastructure and technical support for ICT integration throughout the curriculum.

These core competencies can be seen as 'cluster objectives that are critical for the successful use of ICT as a tool for learning' [1]. They can be developed and utilized in technology-pedagogy integration in the following four supportive themes:

•   ***Context and culture*** identify social, cultural and other contextual factors to be taken into account in infusing ICT into teacher education curriculum. This will include the use of ICT in culturally appropriate ways with respect to pluralistic and diversified cultures and contexts.

- *Leadership and vision* are essential for the effective use of ICT in teacher education and will benefit greatly from the support of the administrations of the teacher education institutions concerned.

- *Lifelong learning* recognizes the nature of capacity building as a long-term process, rather than as a one-stop-for-all training course.

- *Management of change* signifies the importance of planning in effective management of the changing process involved in the use of technology for educational purposes [1].

2.3 NEW VISIONS

In order to develop all these clusters of competencies in teachers, the integration of ICT in teaching and learning may be envisioned as follow:

Vision 1:

Technology, in general, and ICT, in particular, is an aid to teaching and a tool in the facilitation of learning; it is supplementary to the fundamental process of teaching and learning.

Teaching and learning 'involve a process of engaging minds and opening up awareness for exploration and discovery' [2], through such acts as:

- providing information
- explaining concepts
- illustrating principles
- giving examples
- outlining procedures
- demonstrating processes
- advancing arguments
- highlighting points
- asking questions
- giving feedback
- exchanging ideas
- performing tasks

Fundamental and most central to this process are talking and communication through languages. Technologies augment this teaching-learning process in various ways. Human communication, or teacher-pupil interaction, is central to the process of learning. To the extent that technology can facilitate and enhance such communication, it has the potential to improve pedagogy and the quality of education [2].

Vision 2:

Teachers have changing roles in technology-facilitated learning environments and remain fundamental and central to the learning process.

Teachers occupy the central position in strategies for using technology in relation to good pedagogy for improved education. The role of a teacher will change from that of a knowledge transmitter to that of a facilitator, knowledge navigator, co-learner and courseware developer all rolled into one. The new role does not diminish the importance of the role of the teacher but requires news ways of thinking that will culminate in ICT-enhanced pedagogy.

Vision 3:

Learning is the responsibility of the learner and the teacher has the fundamental task of guiding the learner and facilitating learning through good pedagogy and appropriate technology.

Learning means much more than taking in a given amount of information, and/or acquiring a set of skills. Learning includes inculcation of values and behaviour modification. 'Learning is essentially about acquiring tools for living in the broadest possible sense' [2].

The process of education promotes learning in the individual learner through access to an extensive range of tools of learning and to disciplines available in institutions or in non-formal settings. Rote learning, or memorisation of information without understanding, which characterizes much of classroom teaching-learning practices in many countries, is not effective learning.

Learning is facilitated by the teacher through the exploration of the vast world of knowledge. Without the guidance of teachers, most learners are likely to get lost in the seemingly infinite web of information and knowledge. Education provides the learner with both a map and a compass on the journey through an ocean of information and knowledge, and it facilitates learning through the appropriate use of technology.

Vision 4:

Pedagogy, as a key professional attribute and major element of professionalism in teachers, can be supported by technology for an improved teaching-learning process.

Pedagogy is the art of teaching. What distinguishes teachers from other facilitators of learning is that teachers make the most intensive and systematic use of pedagogy to promote effective and efficient learning as part of the process of education. Teachers need a comprehensive bank of pedagogical skills and teaching aids, along with many other professional/personal qualities. Among the major challenges to pedagogy are:

- Promoting relevant, effective and efficient learning in the face of an ever-expanding range of human knowledge.

- Ensuring the learner's ability to relate their learning to the real world. Pedagogy has important role to play in creating holistic understanding of learning and integrating various aspects of the teaching and learning.

Technology can play a major role in promoting pedagogy for the facilitation of effective and efficient learning.

In a conventional education system, technology may be used to support either teacher-centred or learner-centred pedagogical approaches or to use a combination of the two approaches. The aim is to make sound choices about what is best in different circumstances, and selecting and using appropriate technology for improving pedagogy.

Table-2.1 below illustrates the implications of different pedagogical approaches for different technologies.

Table 2.1: Pedagogical Approaches or Teaching Styles vis-à-vis the Use of Technology

Teaching style	*Main pedagogical characteristics and implications for the use of technology*
Teacher-centred approach	The focus is on the teacher as the source of knowledge. The teacher tends to be active while the learner is expected to receive the knowledge being dispensed rather passively. The teacher talks, the learner listens. The teacher acts, the learner watches. This is convenient for large class sizes. *A wide range of technologies can be used to aid the teacher's presentation and performance. Handouts, overhead projector (OHP) slides, models, etc., can all be used to capture and retain the learner's attention.*
Learner-centred approach	The emphasis is on the learner as knowledge-seeker, with the teacher as facilitator and guide. The learner tends to be active, talking and doing things in the process of learning. The teacher designs and manages the setting as well as the process for learning. This is difficult with large class sizes. *Technology can be used extensively to help the learner make sense of the tasks assigned and learn what is required. However, there is usually a need for multiple units of the technology which all the learners need to use at their own pace. Work sheets, models, interactive technology etc., all need to be available to learners on an individual basis or in small groups.*
Combination of the two approaches	This method attempts to strike a balance between the teacher as the main source of knowledge, on the one hand, and the learner as an active seeker of knowledge, on the other. In some cases, the teacher dispenses knowledge and the learner has to take things on trust. At other times, the teacher simply creates the conditions for the learner to explore and discover knowledge. At its best, it is highly interactive, with the focus shifting alternately between teacher and learner at different points in a lesson. *Technology can be used to aid the teacher's presentation as well as to assist learners in their exploration.*

[Source: Cream Wright, Issues in Education & Technology, Commonwealth Secretariat, 2000, p. 107]

Vision 5:

ICT can strengthen attributes of the formal school as a one-stop learning community that is essential for good pedagogy, and provide a remedy for improved learning in alternative settings outside the institution.

Institutions provide a space for learning and for making information available to learners. Institutions have a mission, a curriculum, a culture, and an ethos. They offer 'a one-stop socializing and life-skills development community' [2]. Technology can remove the isolation of the teacher, and tap the potential of the formal institution as a learning community, through improved teacher-pupil, pupil-pupil and teacher-teacher interaction.

The formal system of education has had constraints that have impeded good pedagogy and quality education.

- Its rigid structures group learners into grades based on age.
- Institutions have inflexible learning sequences, expecting each age group to progress through the system at the same pace.
- It has constraints of time and place, as all teachers and students have to follow the one-for-all schedule within a particular classroom/institutional setting.

ICT can help break the barriers of time and space, as the Internet and the World Wide Web can provide learning opportunities beyond the four walls of the traditional institution. These new opportunities can be made available to any one, anywhere, anytime, and it can offer alternative learning paths beyond the formal institutional setting.

Vision 6:

ICT offers new and innovative modes of learner centred learning culture at all levels of education. It can bring classroom without walls and has profound impact on learning environments.

The growth of ICT, the power and diversity of information transfer, allows teachers and students to have access to a world beyond the classroom [1]. It has the potential to transform the nature and process of the learning environment and envision a new learning culture. Interactivity, flexibility and convenience have become the hallmark of the ICT-supported environment.

ICT has caused substantial changes in the learning scenario. Firstly, it helps to explore, access and represent information dynamically and in multi-modal forms. Secondly, flexibility of spatial and temporal dimensions changes the way the teacher teaches and the learners learn. Thirdly, it has opened up immense opportunities for the learners to access, extend, transform and share information and ideas at their own pace and time. The real power of ICT lies in using it as a tool to prompt and encourage critical thinking; it is meant for not just memorizing or engaging with technology for the sake of activity, but for enhancing meaningful learning that promotes learner centred principles. Learners are given more responsibilities for their own learning when ICT is integrated in the curriculum.

ICT enhances deeper understanding of learning and provides tools for collaborative learning environment, where learners are encouraged to construct, evaluate, manipulate and present their ideas and knowledge. It has gone way beyond from the reproductive model of teaching and learning to an independent, autonomous learning model that promotes initiation, inspires creativity, stimulates curiosity and develops skills of innovation.

Vision 7:

ICT integration becomes a necessary, natural, automatic and integral part of teaching and learning rather than an add-on teaching aid.

The biggest challenge of ICT integration into teaching and learning is getting everyone to stop seeing ICT as one more thing teachers need to add-on, adjunct rather than as a part and parcel of the learning process. ICT integration has to become an "authentic" and "automatic" response to teachable moments and learning moments in the classroom. The integration of ICT into the very idea of teaching and learning always places pedagogy over technology. Mere mastering the hardware and software skills is not enough. Teachers need to realize how to organize the classroom to structure the learning tasks so that ICT resources become automatic and natural response to the requirements for learning environments in the same way as teachers use markers and whiteboards in the classroom.

2.4 GUIDING PHILOSOPHY OF PEDAGOGY-ICT INTEGRATION

At the 7th UNESCO-APEID International Conference on Education [3], Sir John Daniel, former UNESCO Assistant Director-General for Education, suggested four guiding philosophical approaches that are to be applied to thought or action that involves ICT for quality teaching, learning and effective management [3]. These approaches are most relevant to the use of ICT in education in the Asia-Pacific region.

Avoid bias

It advocates avoiding assumptions that can misdirect efforts of teachers in using technology. The most prevalent was 'vendor bias', namely, the dotcom fanatics arguing that the Internet was going to replace everything in education that had gone before and that attempts to graft the new onto the old would be doomed to failure.

For teacher training, it will serve the planners well to remember that ICT will always remain an instrument or tool in education, and teachers will utilize technology rather than be manipulated by it. New technology does have great potential for enhancing the effectiveness of the teaching-learning processes and has had profound influence on the role of teachers, but it will never replace the teacher nor will it eliminate exchange between the teacher and the taught. This interaction will remain essential and crucial to education.

Technology by itself does not create miracles or solve all problems in education. The teacher-training programme will not just be technology-driven, but will focus on the integration of technology with pedagogy.

'Dotted bull'

It is necessary to use critical faculties to expose hollow or loose thinking about technology and its application to education. UNESCO may encourage member governments to engage in 'evidence-based policy making', and look for evidence in making statements about technology.

This means that practical consideration should be given to national/location-specific conditions for ICT application to education. For countries and/or communities where there is no electricity, for instance, the Internet and computers might not be the best or appropriate technology for improved teaching and learning.

Think broadly

This suggests a broader view of the use of technology in helping the learners learn. ICT means much more than the Internet, and the Internet will not render obsolete all preceding technologies. Technology always involves people and their social systems.

To the planners, this means that different forms of ICT (including books, blackboard, film, radio, television, programmed learning) can be designed and applied to various modes of technology-assisted learning. The focus of implementation need not be on ICT hardware but on software and on the competence of teachers and teacher educators, taking into account their perspectives on the comprehensive approach. ICT integration can eliminate the isolation of teachers from one another, and encourage online and offline networking that can lead to more effective use of hardware and/or software in improving teaching, learning and the management of education.

Seek balance

Effective implementation will call for a balance on a number of aspects:

- **Balance between enhanced teaching and enhanced learning:** The question will be whether to use technology to expand the range/impact of the teacher, or to create a good learning environment for the student wherever and whenever the student wants to study. 'It is more effective to concentrate on improving access to learning, improving its quality and decreasing its cost'.

- **Balance between developing ICT skills, on the one hand, and using ICT for improving teaching and learning, on the other:** It has been observed that students could learn many things about ICT skills on their own with minimal help from teachers. It is therefore, more effective to acquire the pedagogical skills of using ICT for improvement of the teaching and learning process rather than merely concentrating on technical skills.

For facilitators other than teachers, namely policy-makers and institutional heads, developing leadership that is committed to using technology for educational/pedagogical purposes is very essential. This will provide a favourable environment that is supportive of teachers in the use of ICT to improve teaching and learning. The facilitators can also be enabled, through training,

to develop aggregated cost-benefit as well as qualitative analyses of the potential introduction of the new methodology into a school system.

'Getting the right balance or the right blend between different elements of learning is the key to both pedagogical and economic success' in using technology in teaching and learning [3]. In view of this, high priority on teacher training and professional development in using ICT has to be given in order to enhance a blend of independent learning and interactive learning from the viewpoints of pedagogy and economy. Teachers can learn to harness the potential of ICT in supporting the active learning experience and in providing access to a wide range of learning opportunities.

2.5 GUIDING PRINCIPLES OF PEDAGOGY-ICT INTEGRATION

The most crucial factor in integrating ICT into the teacher education system depends on the extent to which various guiding principles of the integration are formulated and applied. While using ICT for creating a new learning culture, one has to take into consideration the current social and economic conditions, existing telecommunication infrastructure and cultural and linguistic factors. In this context, an overarching framework [4] demonstrating the levels of activities within the classroom that relate ICT integration has been shown in **Figure2.2**. The framework demonstrates a linkage between teachers moving towards ICT integration and ultimately higher quality education, mediated and supported by the tools available (ICT, curriculum, guidelines, training, people support, policy etc.,) and the surrounding community (peers, administrators, parents, learners etc.).
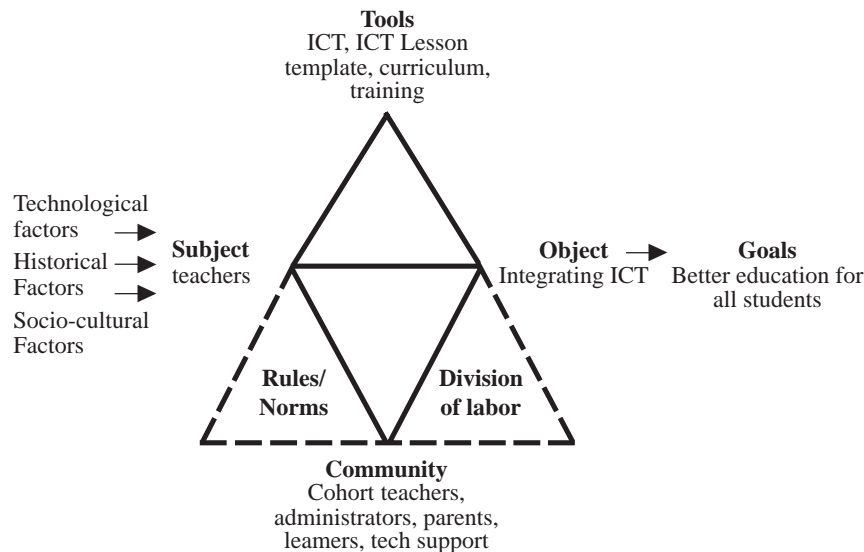
Figure 2.2: An Overarching Framework for Linkages between Teachers and the Surrounding Community

Teachers are required to use ICT so as to fulfill the cherished goal viz., four pillars of education: learning to know, learning to be, learning to live together and learning to do. A number of guiding principles and strategies need to be employed in planning and implementation of various activities of ICT integration. Some such related underlying issues are as follows:

- **Diversity**: The Asia-Pacific region has enormous diversity, and, therefore, it is essential to respect and reflect diversity in terms of policies, content of training/ learning materials, technologies selected, languages of education software and instruction, and models/approaches of technology-pedagogy integration.

- **Relevance**: Different technologies are relevant in different national and local contexts. ICT is only a part of a continuum of technologies in supporting and enriching learning. Different learning environments need different ICT and, as such, a comprehensive approach needs is to be taken prior in selecting technologies.

- **Sustainability**: Teachers cannot be trained once and for all. Teachers' professional development, both for an individual and for the profession, has to be a lifelong process. For this purpose, the planning and implementation should be made with a view to building capacity for both technological and pedagogical expertise, and the major activities shall not be a 'one-shot-training course'. With changing technology, a teacher's competence needs to be upgraded continuously to sustain the positive outcome of ICT integration. For this purpose, there has to be a supporting leadership, clear-cut policy guidelines, an environment for increased use of ICT and a network of centres of excellence for teachers' continued development.

- **Focus**: The integration of ICT in education shall not be technology-driven since ICTs are only tools. A mere learning of ICT skill is not enough but using ICT to learn and improve teaching and learning is the key for pedagogy-technology integration. 'Pedagogical expertise is at the heart of teaching as a profession' [2], and, therefore, ICT has to be used in conjunction with pedagogy. Developing an appropriate range of pedagogical skills in using ICT shall be a process of long-term experiential learning, rather than short-term conceptual learning. This requires initial teacher education with built-in key technology elements, in-service teacher training and on-going support for professional self-development, with teachers taking greater responsibility for core competencies in technology-pedagogy integration.

- **Digital Divide**: There is a widening digital divide prevalent between and within countries of the Asia-Pacific region in the education sector. This digital divide leads to information divide, which, in turn, leads to development divide. Deliberate efforts are required to ensure that teachers and teacher educators in the developing countries form the priority targets to reduce the digital divide in the ICT integration with teaching and learning. ICT offers a scope for transforming the digital divide into digital opportunities in order to enhance pedagogy-technology integration among disadvantaged groups.

- **Building Process**: ICT integration requires teachers to start with known knowledge and what s/he does well in the classroom. They can then continue to build their skills and knowledge in successive steps. During the building process, appropriate learning techniques including reflective practices, exploration, discovery learning and various andragogical approaches are used. It is essential to emphasize the theme of lifelong learning in training and practice experiences. Capacity building of teachers/ teacher educators has to be based on better understanding of the various roles of technology in the educational process and the great potential of ICT in supporting access to a wider range of learning opportunities.

- **Grounded**: All the innovative approaches of ICT integration need to be grounded on a needs assessment that considers the local contexts, access, curriculum, and teachers' requirements. The basic purpose is to support the ultimate aim of the pedagogy-ICT integration in the institution. It should embody and model the forms of pedagogy that teachers can use themselves in the classroom. Teachers shall be trained not only to enhance teaching but also ultimately to facilitate and improve active learning as the very purpose of improved teaching. Therefore, learner-centred approach has to be introduced to increase both teacher-pupil interaction and teacher-teacher peer support that will enhance professional skills development in technology-pedagogy integration.

- **Stakeholders Involvement**: Commitment and support at various levels are crucial in facilitating successful implementation of the pedagogy-technology integration. Teachers may find it impossible to incorporate ICT in the classroom without the support of the stakeholders of education. Therefore, various activities involving the stakeholders are crucial for successful ICT integration.

- **Integration**: ICT has to be integrated in every subject, in every component of institutional activities. Integration of ICT with pedagogy improves the efficiency, effectiveness and quality of teaching and learning processes in a significant ways.

2.6 A FEW EMERGING TOPICS IN ICT INTEGRATION

2.6.1 Introduction

There are various emerging topics in pedagogy-technology integration that are becoming more and more important in the context of innovative teaching and learning practices. The rapid advances of ICT technology principally facilitated these changes. A few selected topics have been described below.

2.6.2 E-learning

The link between distance learning and telecommunications is becoming even stronger, yielding new solutions to old problems, innovative educational resources and new teaching/learning practices. One of the most innovative and promising outcomes of this relationship is e-learning and online education, notably a process whereby teachers and students are linked up in an electronic media/computer network [5].

The concept of e-learning and how it relates to effective use of ICT is critically important for teacher education, because it places the focus firmly where it should be - jointly on pedagogy and the new ICT. The term e-learning, or learning via electronic media, nicely combines this twin concept: first, the changing focus of pedagogy to learning and, second, the new technologies stretching beyond the walls of the traditional classroom. In other words, e-learning for teacher development is learning about, with, and through all electronic media (i.e., ICT) across the curriculum to support student learning. ICT is the means, and e-learning and the effective integration of pedagogy and ICT constitute the goal. There are a number of benefits to e-learning. These include any time learning, anywhere learning, asynchronous interaction and group collaboration.

2.6.3 Blogs

Blogs or classroom web logs are becoming increasingly popular with teachers and teacher education. Many experts predict that blogs will eventually become more successful teaching tools than web sites [6]. A blog is a web page made up of usually short, frequently updated posts that are arranged chronologically-like a "what's new" page of a journal. The contents and the purposes of blogs vary greatly, from links and commentary about other web sites to news about a company/person/idea, photos, poetry, mini-essays, project updates, even fictions. A crucial blog mission is to link to other web sites, or, sometimes even other blogs.

Many blogs are personal. Others are collaborative efforts based on a specific topic or an area of mutual interest. The use of blogs in instructional settings is limited only by one's imagination. There are many ways teachers can use blogs, some of them include content-related blog, networking and personal knowledge sharing, instructional tips for learners, course announcements and readings, annotated links etc., most importantly for the purpose of knowledge management. Learners can also take part in blogs by reflective writing, assignment submission, collaborative work, e-portfolios and sharing course-related resources.

For teachers, blogs are attractive because it needs little efforts to maintain, unlike more elaborate classroom web sites. Teachers can build a blog or start a new topic in an existing blog by simply typing text into a box and clicking a button. Such ease of use is the primary reason to predict that blogs are more successful teaching tools than web sites.

2.6.4 Pedagogical Content Knowledge

Pedagogy cannot exist in isolation to contents. In fact, there is a new beginning to appreciate that the two intertwined into what is described as Pedagogical Content Knowledge (PCK), and is an essential tenet in the current thinking about teacher education. The term content refers to far more than factual information. It encompasses all aspects of a subject: concept, principles, relationships, methods of inquiry and outstanding issues. According to the National Science Teachers Association (NSTA) [7], meaning of content to a science teacher is: (a) concepts and principles understood through science; (b) concepts and relationships unifying science domains; (c) processes of investigation in a science discipline; and (d) applications of mathematics in science research. Similarly, the pedagogy component includes actions and strategies of teaching, organization of classroom experiences, providing for diverse learner needs, evaluation and

implementation based on learner's prior notions, and transformation of ideas into understandable episodes. The NSTA Standards accurately identify major problems with respect to pedagogy and contents. It states:

[There is] "….a poor match between learner needs and teaching methodology", ……."in many traditionally taught courses the emphasis is on learning large amounts of information at a rapid pace", ……and …… "division of knowledge, for convenience into disciplines, fields and sub fields"…… that ……"may contain the development of linkages among concepts across fields". This is similar to what Shulman [8] had observed, "the key to distinguishing the knowledge base of teaching lies at the intersection of content and pedagogy". The blend of content and pedagogical knowledge includes understanding why some learners experience difficulties when learning a particular concept, while others find it easy to assimilate knowledge about useful ways to conceptualize and represent a chosen concept. The basic principles of PCK is to make teaching and learning: (a) engaging and motivating; (b) interactive; (c) contextual; (d) reducing cognitive load; (e) scaffolding; and (f) collaborative [9].

With ICT, there are better ways and opportunities to make above principles more realistic learning experiences. ICT encourages interactions, development of collaborative culture, utilization of active learning and introduction of feedback in proper context. ICT can bring abstract concept to life by bringing into the teaching and learning the real world experiences through simulating, modelling, capturing and analyzing real event.

All instructional designers agree on the need for effective planning of the design and development process. The success of the process largely depends on the preparation of a document, often called a lesson plan with essential elements such as clear indications of what will be done, how it will be done, when it will be done and, more importantly, how technology is going to be used. Let us take a simple example of pedagogical content knowledge with high ICT integrated approach as described below [9].

Introduction/ Set induction	Concept 1	Review and practice	Concept 2	Review and practice	Concept 3	Review and practice	Overall concept	Conclusion/ Summary
❶ ❸	❸	❸ ❹	❺	❶	❺ ❻	❶ ❷	❽	❼ ❶
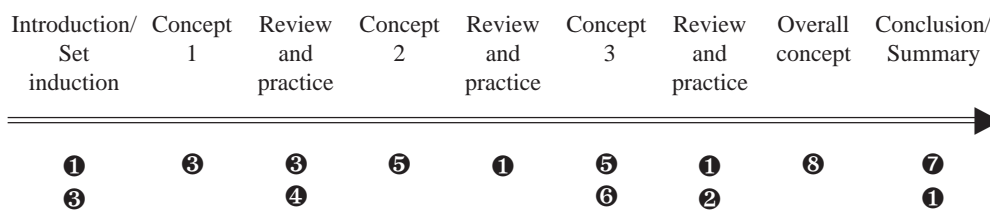
Key:
❶ Teacher-centred   ❺ Teacher teach with web-linked materials
❷ View video clips   ❻ Collaborative work with real examples
❸ CD-ROM materials   ❼ Students preparing folio materials
❹ Q & S from the hub (in Smart Schools)   ❽ Inquiry sessions with scaffolds

Figure 2.3: Pedagogy with ICT integration

Figure 2.3 illustrates a higher degree of embedding ICT in the teaching-learning process. Such an ICT-enabled environment creates well-integrated teaching and learning with ICT that fulfils good pedagogic principles as described above.

It has been observed [1,10] that several prominent theories such as constructivism, socio-cultural concept, situated cognition, multiple intelligences, distributed cognition, problem-based learning etc., play an important role in designing learner-centred environment. Each of these theories is based on the same underlying assumptions that learners are active agents purpose-fully seeking and contributing collaborative knowledge within a meaningful context. ICT offers various tools to implement above theories to create rich and engaging learning environments.

2.7 SUMMARY

The present chapter deals with the importance of vision and guiding principles in pedagogy-ICT integration for teacher education. The vision envisages a new type of learning culture in the context of a paradigm shift in education. For this purpose, a rationale for a new vision has been discussed first, in which four core competencies have been identified as "Clustered Objectives" that are critical for successful use of ICT as a tool. In order to develop all these clusters of competencies in teachers, the integration of ICT in teaching and learning has been envisioned and seven visions have been formulated. The guiding philosophy of pedagogy-ICT integration has then been discussed in the context of the present initiatives. All the stakeholders of education are viewed as crucial partners in the mission to create this learning culture in order to meet the challenges of the new vision. Finally, the major guiding principles of pedagogy-ICT integration have been elaborated followed by a few selected emerging topics in ICT integration.

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3

MODELLING ICT DEVELOPMENT IN EDUCATION

3.1 CHAPTER OVERVIEW

ICT has to be infused into pedagogy in such a way that its uses improve learning. In Chapter 2, the vision and guiding principles of applying ICT in education have been discussed in the context of global and regional challenges.

The present chapter illustrates ICT development in education as a continuum approach along which an educational system or institution can be mapped depending on the stages of ICT development. The proposed model is derived from international and national studies on ICT development that have identified a series of broad stages that educational system and institutions typically proceed through in the adoption and the use of ICT. These broad stages have been termed as Emerging, Applying, Infusing and Transforming stages of ICT development. The model is then mapped on the basis of: (a) stages of ICT usage and (b) pedagogical usages of ICT.

This chapter is divided into four major sections: (i) usefulness of models; (ii) the model; (iii) mapping the model; and (iv) a three dimensional representation of varying instructional approaches.

3.2 USEFULNESS OF MODELS

Countries in the Asia-Pacific region are at different stages of ICT development, in terms of both infrastructure and application of ICT in teaching and learning. Within any such country, there may be uneven development from region to region, area to area, and even from institution to institution. The Asia-Pacific region has a wide range of ICT development stages in education.

In view of the above considerations, it is useful to have a model for ICT development for developing competency standards for teacher development. Such a model can be a representation of the essential characteristics of ICT development to provide a scaffold or a framework. It can also be useful to show the inter-relationship of various components within a system and thus, help to locate its position in the whole framework. Models and frameworks can be useful in portraying how complex systems operate. Usually in visual form, they depict the major

components in a system and the way these relate to each other. A framework for the integration of pedagogy and ICT in teacher education programmes, for instance, can show the major parts and the inter-relationship of these parts.

To the extent that such a framework reflects all that occurs, it may then serve as a blueprint that curriculum developers can take as a starting point in determining content, sequencing, and pedagogical process. Based on the UNESCO publication [1], a model has been presented that can be useful in determining the stage of ICT development reached by a country, a district, or even an individual institution. As mentioned earlier, this model is derived from international and national studies of ICT development that have identified a series of broad stages that educational system and institutions typically proceed through, in the adoption and use of ICT. The model is presented here to provide a framework for stages of pedagogy-technology integration.

The model conceives ICT development as a continuum along which an educational system or an individual institution can pinpoint the stage reached in the growth of ICT for their particular context. This model is referred to as a continuum of approaches to ICT development. The *continuum model* provides us with a holistic framework for identifying the needs for teacher development in different countries at different stages of development.

3.3   THE MODEL

Studies of ICT development in both developed and developing countries identify at least four broad approaches through which educational systems and individual institutions typically proceed in their adoption and use of ICT. Sometimes, the number of stages identified varies. However, there is a general consensus that the introduction and use of ICT in education proceeds in broad stages that may be conceived as a continuum or series of steps. These steps, termed Emerging, Applying, Infusing, and Transforming, are elaborated in **Figure 3.1.**
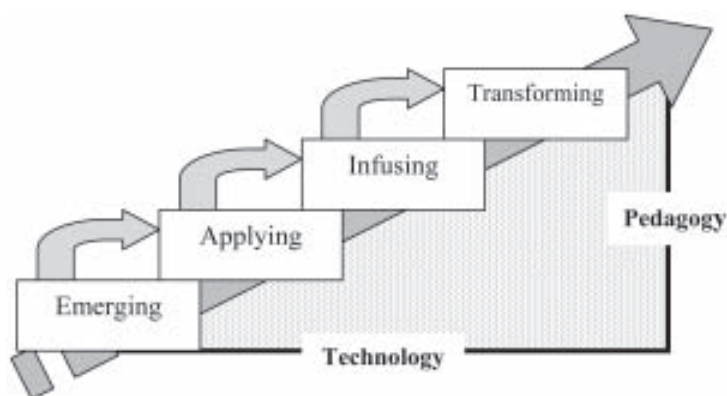
***Figure 3.1:** Stages of ICT development*

3.3.1 Emerging stage

Institutions at the initial stages of ICT development demonstrate the emerging approach. Such institutions have just started their journey in the ICT field with a skeleton computing infrastructure either donated or purchased by the institution authority. To start with, administrators and teachers just begin to explore the possibilities and consequences of using ICT for institutional management and adding ICT to the curriculum. Institutions at this emerging phase are still firmly grounded in traditional, teacher-centred practice. The curriculum reflects an increase in learning how to acquire ICT basic skills such as office automation, e-mail and basic operation of computers, so that it prepares the ground for moving to the applying stage. In the emerging approach to ICT development, the focus is on the technical functions and uses of ICT and on the need for some knowledge and representation of the impacts of ICT on the system as a whole.

This approach often involves teachers' personal use of ICT, such as, the use of word processing to prepare worksheets, locating information on CD-ROMs or on the Internet, or communicating with friends and family by e-mail. Here, teachers are developing their ICT literacy and learning how to apply ICT to a range of personal and professional tasks. The emphasis is on training in a range of tools and applications, and increasing teachers' awareness of the opportunities for applying ICT to their teaching in the future.

3.3.2 Applying stage

Those institutions, in which a new understanding of the contribution of ICT to learning has developed, exemplify the applying approach. In this secondary phase, administrators and teachers use ICT for tasks already carried out in institutional management and in the curriculum. Teachers largely dominate the learning environment. Institutions at the applying approach phase adapt the curriculum in order to increase the use of ICT in various subject areas with specific tools and software such as drawing, designing, modelling and application of specific tools. This curriculum assists movement to the next stages, if so desired.

In the applying stage, teachers use ICT for professional purposes, focusing on improving their subject teaching in order to enrich how they teach with a range of ICT applications. This stage often involves teachers in integrating ICT to acquire specific subject skills and knowledge, beginning to change their teaching methodology in the classroom, and using ICT to support their training and professional development.

Teachers gain confidence in a number of generic and specialized ICT tools that can be applied to the teaching of their subject area. The opportunity to apply ICT in all their teaching is often limited only by a lack of ready access to ICT facilities and resources, which is why it is not fully integrated into all lessons for all students.

3.3.3 Infusing stage

At the third stage, the infusing approach involves integrating or embedding ICT across the curriculum, and is seen in those institutions that now employ a range of computer-based technologies in laboratories, classrooms, and administrative offices. Teachers explore new ways in

which ICT changes their personal productivity and professional practice. The curriculum begins to merge subject areas to reflect real-world applications.

In the infusing approach to ICT development, ICT infuses all aspects of teachers' professional lives in such ways as to improve student learning and the management of learning processes. The approach supports active and creative teachers who are able to stimulate and manage the learning of students, integrating a range of preferred learning styles and uses of ICT in achieving their goals. The infusing stage often involves teachers easily integrating different knowledge and skills from other subjects into project-based curricula.

In this approach, teachers fully integrate ICT in all aspects of their professional lives to improve their own learning, as well as, the learning of their students. Thus, they use ICT to manage not only the learning of their students but also their own learning. They use ICT to assist all students to assess their own learning in achieving specific personal projects. In this approach, it becomes quite natural to collaborate with other teachers in solving common problems and in sharing their teaching experiences with others.

3.3.4 Transforming stage

Institutions that use ICT to rethink and renew institutional organization in creative ways are at the transforming approach. ICT becomes an integral, though invisible, part of daily personal productivity and professional practice. The focus of the curriculum is now learner-centred that integrates subject areas in real-world applications. ICT is taught as a separate subject at the professional level and is incorporated into all vocational areas. Institutions have become centres of learning for their communities.

In the transforming approach to ICT development, teachers and other staff members regard ICT as a natural part of the everyday life of the institutions that they begin to look at the process of teaching and learning in new ways. The emphasis changes from teacher-centred to learner-centred. Teachers, together with their students, expect a continuously changing teaching methodology designed to meet individual learning objectives.

3.4   MAPPING THE MODEL

The continuum model, as discussed in the previous section, can be mapped onto two interwoven tracks for the development of teachers' capacity in harnessing ICT with regard to (a) stages of ICT usage and (b) pedagogical usages of ICT.

3.4.1 Stages of ICT usage

Studies of teaching and learning in schools around the world identify four broad stages in the way that teachers and students learn about and gain confidence in the use of ICT. These four stages give rise to the mapping depicted in **Figure 3.2(a)** that shows the stages in terms of awareness, learning how, understanding how and when, and specializing in the use of ICT tools according to the stages of the proposed model.

Becoming aware of ICT

In the initial phase, teachers and learners become aware of ICT tools and their general functions and uses. In this stage, there is usually an emphasis on ICT literacy and basic skills. This stage of discovering ICT tools is linked with the *emerging stage* in ICT development.

Learning how to use ICT

Following on and from the first stage comes the stage of learning how to use ICT tools, and beginning to make use of them in different disciplines. This stage involves the use of general or particular applications of ICT, and is linked with the *applying stage* in the ICT development model.

Understanding how and when to use ICT

The next stage is to understand how and when to use ICT tools to achieve a particular purpose, such as in completing a given project. This stage implies the ability to recognize situations where ICT will be helpful, choosing the most appropriate tools for a particular task, and using these tools in combination to solve real problems. This stage is linked with the *infusing stage* in the ICT development model.

Specializing in the use of ICT

The fourth and the last stage involves specializing in the use of ICT tools which occurs when one creates and transforms the learning environment with the help of ICT. This is a new way of approaching teaching and learning situation with specialized ICT tools and is linked with the *transforming stage* in the ICT development model.
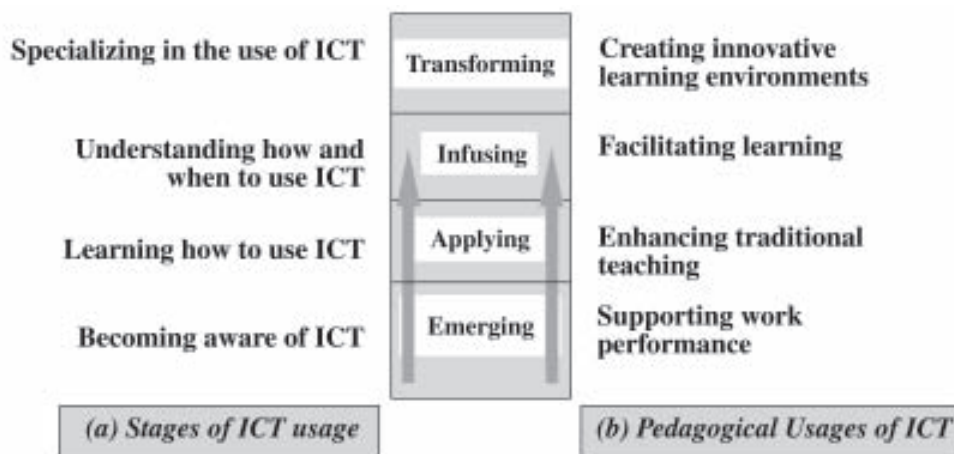
Figure 3.2: *Mapping the Model*

3.4.2 Pedagogical usages of ICT

Adoption of ICT in the classroom generally proceeds in four broad stages in the way the teachers and learners use ICT as a support to teaching and learning. These four stages give rise to the mapping depicted in **Figure 3.2(b)** that have been broadly classified as supporting work performance, enhancing traditional teaching, facilitating learning and creating innovative learning environments, according to the stages of the proposed model.

More than three decades ago, computers and related information technology were introduced to educators for direct teaching and learning purposes. ICT started its journey primarily with productivity tools, proceeded to self-learning courseware and multi-modal instruction, and finally progressed to web-based learning management system. [2].

Supporting work performance

In the initial phase, teachers use productivity tools such as word processor, visual presentation software, spreadsheet, database, email etc., to support their daily work performance. During this stage, there is usually an emphasis on basic operations of electronic office software. This stage of using productivity tools for teaching and learning is linked with the *emerging stage* in ICT development.

Enhancing traditional teaching

Following on and from using productivity software, comes the stage of learning how to use and develop computer-assisted learning software and beginning to make use of such software in different disciplines. This stage involves the technique of integrating computer-based learning [3] in the traditional instructional process, and is linked with the *applying stage* in the ICT development model. Various instructional packages were selected, developed and used to enhance traditional classroom teaching.

Facilitating learning

The next stage involves using various types of instructional software to facilitate student learning. The key point is that the teachers need to learn how to choose the most appropriate tools for a particular task, and using these tools in combination to solve real life problems. This stage implies the ability to recognize situations where various multimedia and specialized software can be utilized for teaching and learning. This stage is linked with the *infusing stage* in the ICT development model.

Creating innovative learning environments

The fourth and last stage involves specializing in the use of ICT to create an innovative learning environment that transforms the learning situation. This is possible by incorporating emerging trends in pedagogy and learning principles in teaching and learning. For this purpose, specialized software including modelling and simulation, expert systems, semantic networking etc., are employed to support pedagogical innovation. It helps to develop, deliver and manage open and flexible learning programme. This stage is linked with the *transforming stage* in the ICT continuum model.

3.5   A 3-D REPRESENTATION OF VARYING INSTRUCTIONAL APPROACHES

Adoption of ICT for varying instructional approaches with respect to complexity and authenticity of learning poses a complex inter-relationship. An attempt has been made for a three dimensional (or 3-D) representation of this complex inter-relationship between various instructional approaches (see **Figure 3.3**) [4]. The figure shows one of the ways of understanding the range and diversity of the model discussed above with regard to instructional approaches to complexity and authenticity of learning from emerging to transformation stages. Such a representation is useful in defining ICT usage that might extend the learning potential of learners. The three axes shown therein may be used to answer three important questions, as discussed below.
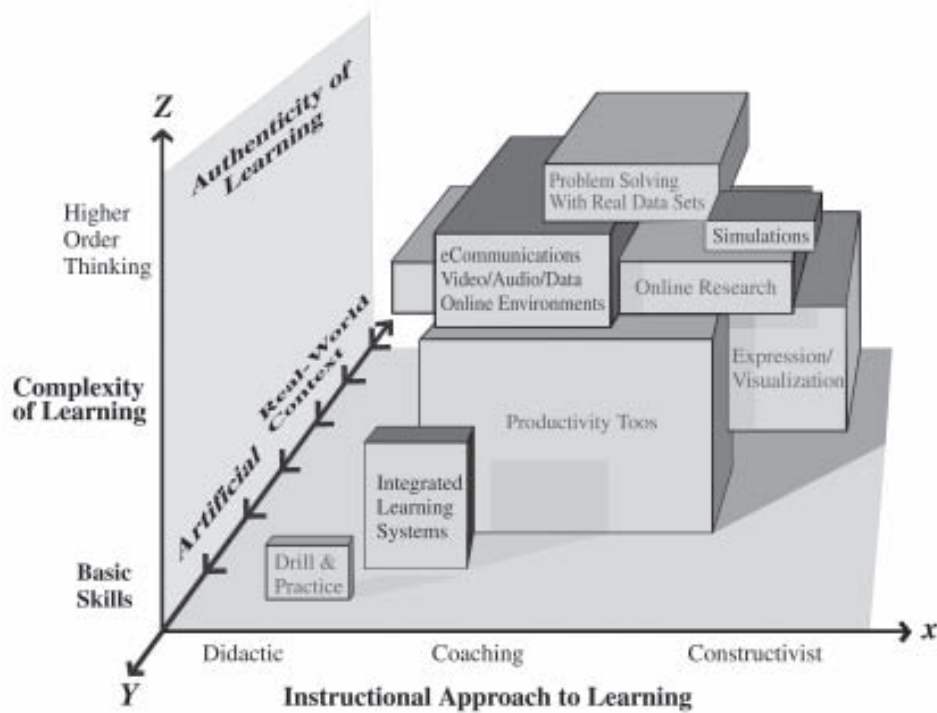
Figure 3.3 *A 3-D representation for gauging which instructional approach with ICT (X-axis) might support students' thinking (Z-axis) in authentic learning situations* (Y-axis) *[Source NCREL 2003, http://www.ncrel.org/engauge/highlite.htm]*

X   What instructional approaches work most effectively with various ICT applications?
The X-axis represents *Instructional Approach to Learning,* ranging from didactic to constructivist.

Y   Which ICT applications can be a springboard for student learning in a real-world context?
The Y-axis represents *Authenticity of Learning*, ranging from artificial to real-world problem solving.

Z   What types of ICT uses support thinking and learning?
The Z-axis represents *Complexity of Learning*, ranging from simple (basic skills) to complex (higher order thinking).

3.6 SUMMARY

An attempt has been made in the present chapter to illustrate ICT development in education as a continuum approach. For this purpose, a model based on UNESCO publication has been developed and expanded which conceives of four stages viz., emerging, applying, infusing and transforming. *Emerging stages* mean that teachers are beginning to become aware of the potential of ICT. *Applying stages* imply to that teachers may be learning how to use ICT for teaching & learning. *Infusing* stages mean that a variety of ICT tools are being appropriately selected and effectively used for teaching and learning. *Transforming stages* involve new and innovative ways of approaching teaching and learning situations with specialized ICT tools for exploring a variety of real-world problems. Finally, the model is mapped onto two interwoven tracks for the development of teachers' capability in manipulating and using technology. A 3-D representation of the complex inter-relationship between various instructional approaches with respect to complexity and authenticity of learning has been attempted. In the following chapters, the proposed model is a guiding reference in developing a curriculum framework and subsequently competency standards.

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4

A CURRICULUM FRAMEWORK FOR INTEGRATING ICT AND PEDAGOGY IN TEACHER EDUCATION

4.1 CHAPTER OVERVIEW

Chapter 3 describes the different stages that institutions go through when integrating pedagogy and ICT across the curriculum. Based on these stages, this chapter goes on to present a holistic curriculum framework of ICT-pedagogy integration to guide programmes of teacher education. Teacher education can be represented as a continuum (see **Figure 4.1**) from initial pre-service education of teachers undertaken in universities or colleges of education and extending to the induction of budding teachers and their continuing professional development in institutions.

Pre-service teacher education → Induction of budding teachers → Continuing professional development
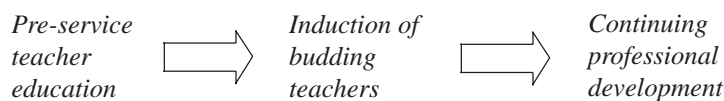
Figure 4.1: *A continuum of professional development of teachers*

The chapter contains three sections. In the first section, the usefulness of frameworks for portraying complex systems is discussed. An example of a complex system is the integration of pedagogy and ICT in a teacher professional development programme. The second section takes as its starting point a curriculum framework described in Chapter 3 and presents a refined model. The different components of this model are elaborated in terms of the stages and other societal developments raised in the preceding chapters. The third section notes what is required for the framework to be developed into a total teacher education curriculum.

4.2   USEFULNESS OF FRAMEWORKS

Frameworks, like models, do not have the property of being true or false. Rather, these may be useful, more useful, or perhaps not at all useful, for particular purposes. The models presented in the previous chapter are useful, for example, in determining where institutions are at, in terms of ICT development, and which instructional approaches support students' thinking in authentic learning situations. The next section describes a curriculum framework for integrating pedagogy and technology in teacher professional development programmes.

4.3   A CURRICULUM FRAMEWORK

A starting point for the curriculum framework presented here is contained in the UNESCO publication, A Planning Guide [1]. After modification in a workshop organized by UNESCO Bangkok [2], this framework shows teacher competencies of pedagogy and technology operating within an environment (the context) that is characterized by change and the need to continue learning throughout life (see **Figure 4.2**).
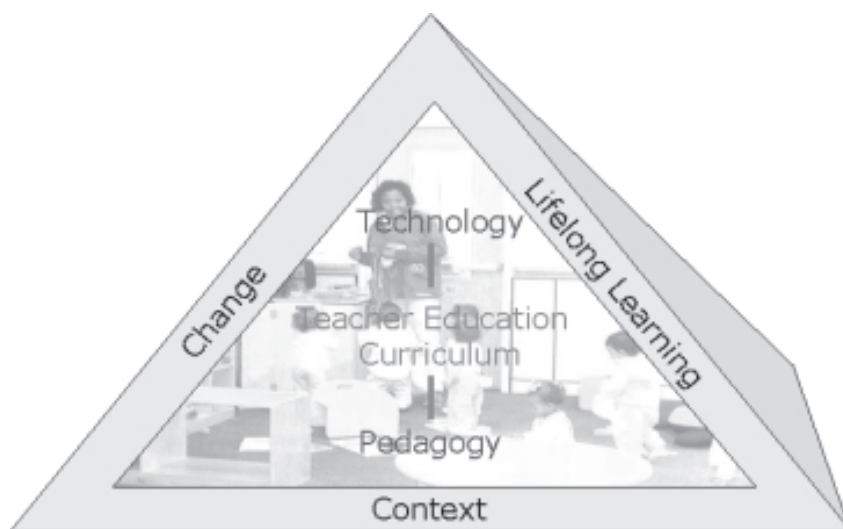
Figure 4.2: A curriculum framework for integrating ICT and pedagogy in professional teacher education programmes

The different components of the framework are considered in Figure 4.2, taking first the contextual factors and next the teacher competencies.

4.3.1 Contextual factors

Every curriculum is a product of the environment in which it is positioned. This environment, called here contextual factors, includes three inter-related sets of factor: context, change, and lifelong learning.

Context

The most obvious contextual factor within which any teacher education curriculum is planned is context. Context has a spatial dimension, which implies that it includes all the physical or environmental conditions about which curriculum planners need to be aware of. These include such factors as the economic conditions within a country, and the quality of the telecommunications infrastructure in place. Included as well are cultural and linguistic factors that arise, for instance, in consideration of whether particular software is appropriate or not.

But context also has a temporal dimension, which implies that a particular curriculum is a product of time. As time changes, for instance, with changing political structures or demands in the workplace for new kinds of skill, the context changes. This needs to be taken into account by curriculum planners.

Change

Change, and increasingly rapid change, characterizes modern societies. Driven by the revolution in ICT, new skills are required by the needs for an increasingly skilled workforce. This societal change, in turn, demands curriculum reforms in education systems around the world. It is this kind of change that the Delors Report of the International Commission on Education for the Twentyfirst Century [3] identifies as creating tension between tradition and modernity. Change, then, is a key contextual factor in developing teacher education curricula.

Clearly, leadership and vision are essential in planning and managing change, as is consideration of key stakeholders. In developing and implementing a curriculum to integrate ICT and pedagogy in teacher education, the UNESCO Planning Guide [1] identifies who are the key stakeholders in the different sections within which a teacher education programme operates. These stakeholders include:

- the dean or professor with responsibility for teacher education
- the teaching staff in a programme of teacher education
- senior administrators in the institution
- pre-service teachers interested in acquiring ICT skills
- teachers and heads of institutions organizing field experiences for teachers in training
- government agencies that set policies for teacher professional development
- business and industries with an interest in the overall quality of graduates

All stakeholders need to: (a) share a common vision with respect to ICT; (b) modify the curriculum in teacher education; and (c) focus on making technology and sufficient resources available.

Lifelong learning

Lifelong learning, and indeed life-wide learning are other contextual factors since it is now recognized that learning does not stop after formal education ends. Again, the Delors Report recognized that learning throughout life is the only means to manage the tension between the extraordinary expansion of knowledge and capacity of human beings to assimilate it.

The nature of ICT is one such change that curriculum planners need to build into teacher education curriculum, in order to enable budding teachers to continue their learning after graduating from the institution.

4.3.2 Teacher competencies

The inner core of the teacher education curriculum pyramid shown in Figure 4.2 comprises core teacher competencies, which are grouped into two major clusters of pedagogy and technology. These two clusters of teacher competencies, although discussed individually below, are not independent of each other in a curriculum where ICT is infused in pedagogical practice. As such, the basic philosophy of competencies of integration has also been highlighted separately.

Pedagogy

The UNESCO Planning Guide nominates pedagogy, along with content, as "the most important aspect of infusing technology in the curriculum"[1]. Infusion of ICT begins with teachers' mastery of the content of the subjects. With incorporation of ICT in teaching, teachers develop new ways of doing things, gradually changing the focus of classroom activities from an emphasis on teaching to an emphasis on learning.

The adoption of ICT in the classroom generally proceeds in stages as depicted in the model of ICT development in the previous chapter. At first, teachers discover ICT tools such as, presentation software. This is followed by application of ICT tools in place of previous instructional activities, such as preparing a PowerPoint presentation in place of a lecture. As teachers become more familiar with ICT in the subjects, new ways of using ICT are explored so that their previous classroom delivery mechanism begins to change. In time, their classroom practice becomes transformed as the focus of the classroom becomes learner-centred and students use ICT to solve real-world problems that cut across traditional subject boundaries.

Pedagogy includes much more. It includes theoretical knowledge and pedagogical skills. East China Normal University in Shanghai [4] has developed a strong pre-service teacher education programme that focuses on educational uses of ICT and meaningfully integrates theory, pedagogical practice, and technology.

The key to the integrated curriculum approach at East China Normal University is, first, integrating on-campus training in ICT with field practice; second, integrating theoretical learning

with pedagogical practice; and, third, integrating hands-on activities with minds-on activities – that is, learning by doing in combination with mental activities such as peer evaluation and self-reflection.

Pedagogy that further engages learners in critical thinking, creative thinking and problem solving skills is the core component of ICT integration. Whereas learning through facts, drill and practices, rules and procedures was more adaptive in earlier days, learning through projects and problems, inquiry and design, discovery and invention, creativity and diversity, action and reflection is more fitting now in the ICT-supported environment. Learning becomes constructivist, self-directed, flexible, interactive, deep and collaborative processing of knowledge.

Collaboration and networking are other aspects of pedagogy. The real power of ICT comes from new ways of communicating beyond the four walls of the classroom and by locating information from worldwide sources wherever these may be located. The implication for teachers as they assist their students in collaborating with other learning groups and using networks to research assignment topics is that they cease to be the main source of knowledge in the class-room. Instead, teachers' roles change from being "a sage on the stage" to becoming "a guide on the side". Teachers need to accommodate a philosophical shift in their approach to teaching. The UNESCO Planning Guide asserts that the development of teachers' competencies in collaboration and networking is essential to infusing ICT in the curriculum:

Through collaboration and networking, professional teachers promote democratic learning within the classroom and draw upon expertise both locally and globally [1].

Technology

Advances in technology and the way technology is incorporated into a system constitute a dynamic process. Each institution has to work within the context of its own system to fit choices to what best suits its unique situation and culture. The adoption of technology into the curriculum generally proceeds in stages as depicted in the continuum model in the previous chapter. The stages can be considered as hierarchical with the emerging stage as a starting point, and the transforming stage as a goal, which many perceive as the future of education.

In the emerging stage, the focus is on the basic technical functions and uses of ICT. This stage involves teachers' competencies in word processing, spreadsheet, database, presentation software and uses of Internet and e-mail. Besides the kinds of ICT competencies relating to concepts and operations, there are many social, legal and ethical issues associated with the use of ICT about which teachers need to know. The facilities required to access information easily from remote sources, the ability to download it to a personal computer, and the utilization of the information in a classroom assignment, brings with it a host of social, legal, and ethical issues relating to copyright, evaluation of information sources, and appropriate forms of acknowl-edging electronic information.

In the applying stage, teachers use ICT for professional purposes, focusing on improving the teaching of subjects so as to enrich how to teach with a range of ICT tools. In the infusing stage, teachers infuse ICT in all aspects of professional life to improve student learning and the

management of learning processes. ICT enables teachers to become active and creative in stimulating and managing the learning process, by infusing a range of preferred learning styles and uses of ICT in achieving educational goals. Teachers are required to master authoring tools, animation tools and multimedia tools to develop instructional software in different subjects.

The transforming stage is linked with schools that have used ICT creatively to rethink and renew school organization. ICT becomes an integral part of daily personal productivity and professional practice. The focus of the curriculum is now much more learner-centred and integrates subject areas in real-world applications, both in real and virtual environments. Teachers need to master special software, learning management system simulation and modelling tools, expert system, semantic networking and various web tools, in order to innovatively transform the teaching and learning system.

Although the approaches above are not a necessary hierarchical, these are intended to illustrate the steps towards growing ICT confidence and competence that many teachers go through, before beginning to transform teaching practice and the learning of their students.

Bearing in mind the contextual factors of change and lifelong learning, teachers are required to be competent in using new hardware and software. Technological competencies also have an attitudinal dimension. Cabanatan [5] emphasized the importance of a positive attitude towards ICT and a clear understanding of the potential of ICT in education.

Integration

The inclusion of both pedagogy and technology as core competencies for teachers acknowledges that integrating ICT in education for teaching and learning is far broader than the simple acquisition of these two sets of competencies. Competencies of integration are neither competencies of technology alone nor are they competencies of pedagogy. Rather competencies of integration are about the appropriate selection, use, mix, fusion and integration of many sets of competencies including those covered under pedagogy and technology.

The following analogy of 'interdisciplinary thinking' illustrates (**Figure 4.3**) the spirit of integration of pedagogy and technology [6].
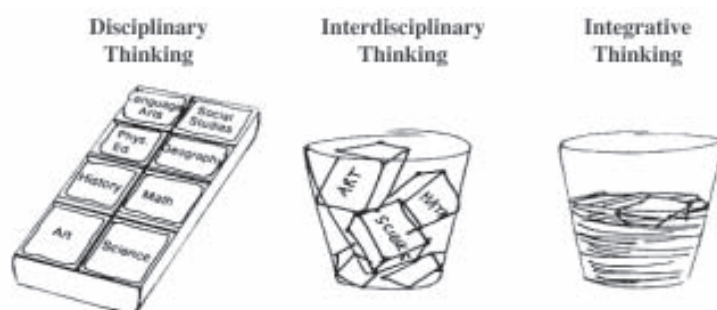
Figure 4.3: Interdisciplinary thinking illustrating the spirit of integration of pedagogy and technology

4.4 TOWARDS FORMULATING A TEACHER EDUCATION CURRICULUM

Having established a curriculum framework for teacher development in pedagogy-technology integration, a subsequent step is to begin the task of formulating the curriculum. As described in the UNESCO-IBE Training Guide for Curriculum Specialists [7], the term curriculum implies the following:

- It refers to a contract between society, the State, and educational professionals with regard to educational experiences that learners should undergo during certain phases of their lives.
- It answers the why, what, when, where, how, and with whom the learning is to take place.
- It defines the foundations and content of education, their sequencing in relation to the amount of time available for the learning experiences planned, in terms of:
  - methods to be used
  - resources for learning and teaching, such as textbooks and new technologies, and
  - evaluation.

Accordingly, pedagogy-technology integration forms an essential component of the overall curriculum for teacher education. As such, pedagogy-technology integration has to be referred to and even incorporated into the curriculum reforms for both pre-service teacher education as well as in-service teacher training in different countries of the Asia-Pacific region. In this way, all courses and subjects in teacher education/training programmes will be conducted on the basis of integrating ICT with curriculum. The expected teachers graduated from universities will, therefore, be qualified for the teaching profession in new knowledge and lifelong learning society, while in-service teachers can be continuously trained and updated.

In addition, the relationship between both curriculum reforms in basic education and teacher education need to be emphasized. This is mainly because of the current disparity between both these reforms. In some countries, curriculum reforms in basic education have gone ahead, but curriculum reforms for teacher education have lagged far behind, and this has had disadvantages for preparing tomorrow's teachers of the 21st century. The relationship between these curricula is shown in **Figure 4.4**.
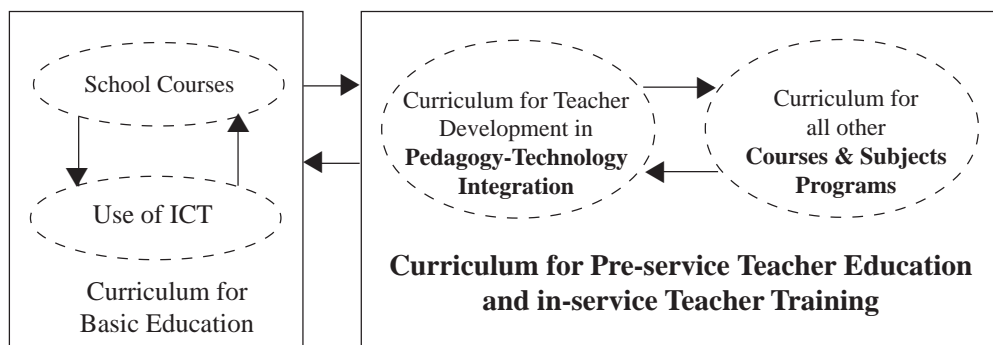
Figure 4.4: *Close relationship of curriculum reforms in basic education and teacher education*

A further application of the curriculum framework for teacher development developed in this chapter is to serve as a structural foundation for formulating competency standards for teachers and teacher educators in pedagogy-technology integration.

4.5 SUMMARY

An attempt has been made in the present chapter to develop a curriculum framework for integrating ICT and pedagogy in teacher education. For this purpose, usefulness of frameworks has been discussed first followed by establishing a curriculum framework showing teacher competencies of pedagogy and technology operating within an environment (the context) that is characterized by change and the requirement for lifelong learning. Finally, the needs for incorporating pedagogy-technology integration into the curriculum reforms for both pre-service as well as in-service teacher training, on one hand, and close relationship of curriculum reforms in basic education and teacher education, on the other, have been established.

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5

PERFORMANCE STANDARDS FOR COMPETENCIES

5.1 CHAPTER OVERVIEW

The curriculum framework presented in Chapter 4 includes both pedagogy and technology as core competencies for teachers, acknowledging that integrating ICT in education for teaching and learning is far broader than simply acquiring technical skills to use ICT. Furthermore, placing pedagogical competencies at the base of the pyramid in Figure 4.2 reinforces the key place of pedagogy in ICT integration. This means that learning activities involving ICT have to be embedded in a real-world context, and that students engage in such activities not only because they are required, but also because they are intrinsically interesting.

It also means that an infusion of ICT, like any other learning activity, has to have clear and specific goals, and encourage learners to collaborate with one another. The competency standards recommended for teachers are not just about technical skills. It also covers pedagogical skills, integration strategies and new ways of using ICT that help students think, understand, and learn.

This chapter presents a rationale for the use of standards and how these relate to the curriculum framework. An example of competency standards is included, as well as a rubric to evaluate the effectiveness of infusions of ICT into learning. The rubric is intended for use by those responsible for teacher development and by teachers themselves.

5.2 WHAT ARE COMPETENCY STANDARDS?

A competency is a set of attributes covering knowledge, skills and attitudes for enabling one to effectively perform the activities of a given occupation or function to the standards expected in employment. The notion of competence with regard to the use of ICT in education is broader than the technical skills needed to use ICT. To take a technical view of competence is to deny the plethora of skills needed by teachers to create meaningful and productive learning contexts for learners. Therefore, whilst it may be easy to take a technical view of ICT competence, this is not sufficient to equip teachers to understand, and make effective use of, ICT in the classroom.

The type of ICT competence needed by teachers is a collection of knowledge, skills and attitudes that are inextricably bound up with the context and pedagogy. Competence needs to be embedded in teacher practices. A number of countries have developed national or regional ICT competency standards including Australia, Canada, People's Republic of China, India, New Zealand, United Kingdom and the United States.

Commonly, standards are developed first to describe what students have to do with ICT at different levels of schooling. Based on expected student outcome, a subsequent step is usually to describe what competencies their teachers are required to possess. In some cases, a further development is to create standards for educational administrators. All are particularly important to those who are responsible for providing pre-service and in-service teacher education.

Competency standards can be stated either generally or quite specifically. A UNESCO publication [1] is a useful reference here. An example of a general standard is that:

- Learners should be able to search the Internet.

By contrast, a more specific standard is that:

- Learner should be able to search the Internet skilfully and intelligently to locate, evaluate, and collect information.

5.3   HOW STANDARDS ARE RELATED TO THE CURRICULUM FORMAT?

There is an important relationship between continuum models, curriculum frameworks and competency standards in ICT. When agreement is reached within a country or region for a curriculum framework for integrating ICT into learning, the development of competency standards for students and their teachers can follow. Furthermore, once a clear statement about ICT competency standards is arrived at, it is then possible to adapt or develop training modules for teachers.

Standards do not imply a prescribed course of study for all teachers across subject areas, nations, and regions. Generally, standards present a set of competencies that each local group of educators can interpret and translate into classroom practice based on their local context, the particular subject being taught, and their vision of ICT in education. While educators throughout the region share many common goals and beliefs about education, they come from different cultures. These cultures dictate that calls for fuller integration of ICT into education are sensitive to these cultural differences. Change will not occur in the same manner in each nation or within different locations in any one nation. Competency standards, therefore, are often closely tied to local standards for students, so that expected student outcome in a particular field of study implies a set of competencies with ICT that their teachers should possess.
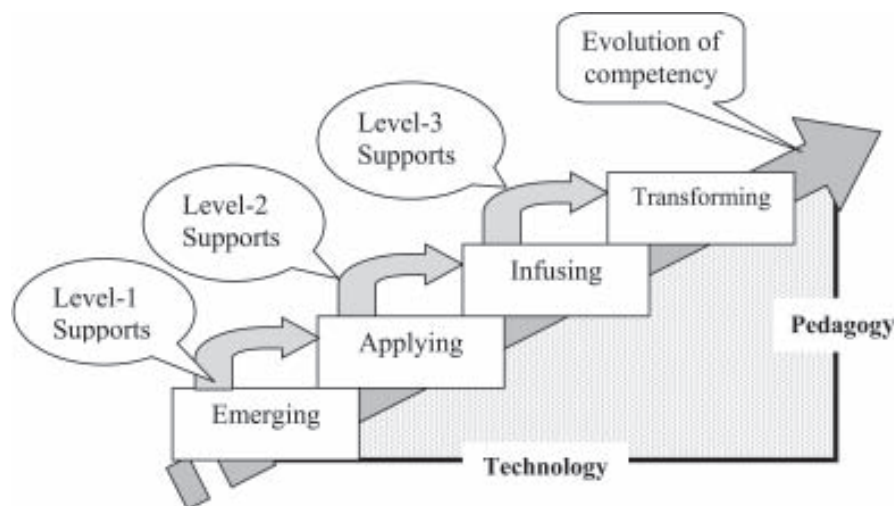
Figure 5.1: Points of support provided by teacher education to promote movement through the stages of ICT development

From the ICT continuum model, depicted in Figure 3.1, competency levels can be derived that reflect a teacher's continuous development of technology capability and pedagogical capability based on a curriculum framework. **Figure 5.1** shows how a programme of teacher development can help individual teachers move through the four stages in ICT development.

To be most effective, the ICT activities that a development programme provides are likely to deepen in complexity as a teacher's understanding and skills improve. The activities, therefore, have to be carefully designed to promote a teacher's movement into the next stage. Level-1 supports promote movement from stage 1 to stage 2, level-2 supports promote movement from stage 2 to stage 3, and level-3 supports promote movement from stage 3 to stage 4. Each stage of the ICT development model characterizes the expertise the teacher is required to possess in pedagogy clusters, technology clusters and integration strategies.

For example, teachers who are in the *emerging stage* are first becoming aware of the potential to use ICT in teaching and learning. The development programme might provide basic support through guidance by a mentor who helps these teachers to use ICT within their subject areas in simple but important ways. This will encourage the movement of these teachers into the *applying stage*, in order to be engaged in more complex activities that promote deeper understanding. Here, the development programme might provide support through opportunities for discussion with colleagues doing similar work, or by providing collections of effective ICT infusions on a resource website. This encourages further growth into the *infusing stage*, when these teachers begin to apply knowledge and skills from other subjects into project based curricula.

In the fourth and final stage i.e., *transforming stage*, teachers specialize in the use of ICT tools to create an innovative learning environment. This is a completely new way of approaching teaching and learning using ICT. In this stage, various software like experts systems, semantic networking, modelling and simulation etc., can be utilized to support innovative pedagogical approach.

Teachers just beginning to develop pedagogical skills are to be measured by standards represented by the emerging level of pedagogy. They progress through the standards as they further develop their skills. It is important to note that some teachers who have strong pedagogical skills and understanding may have limited skills with technology; for this, such teachers would be evaluated by the infusing standards in pedagogy, and the emerging standards in technology skills and integration strategies. Again, the standards for integration strategies at all levels have to reflect infusions of technology that support meaningful learning. With this approach, teachers are stimulated to develop through a natural progression implied by the standards, gaining both competence and confidence as they do so.

Why are such careful support strategies required? This is because teachers resist ICT innovations that do not match the context in which they work, but tend to integrate technology when it addresses real classroom problems, situations and learning goals. Teachers adapt to change when it is possible to set the goals, to have opportunities to acquire the needed skills, and to reflect on learning. It is the desire of teachers to infuse ICT directly into students' academic lives so that student activities are authentic and meaningful from the earliest stages. A similar approaches towards teacher training needs to be adopted. Teachers are required to develop the simplest ICT skills in the midst of authentic teaching and learning activities that are seen as viable ways to solve existing professional and pedagogical problems.

Teacher development is to be carefully planned, which is appropriate to a teacher's understanding and skills. This means that teachers learn to use ICT always within their zone of proximal development [2], so that activities are simple enough that teachers can place new ideas within the context of previous understanding, but are challenging enough to give their work meaning and purpose. Standards can play a key role in facilitating this kind of support.

5.4 AN ANALYTICAL FRAMEWORK OF COMPETENCY STANDARDS

Based on the continuum model and support described above, competency levels can be identified and grouped into four major clusters as shown in **Table 5.1**. These four major clusters are categorized as (a) integrating productivity tools in learning context, (b) enhancing teaching and facilitating learning, (c) processing curriculum resources and learning materials, and (d) integrating ICT for pedagogical innovations encompassing the four stages in ICT development namely, emerging, applying, infusing and transforming stages. Table 5.1 further elaborates the major pedagogical and ICT skills with corresponding integration strategies required for every cluster of competency standards stated above.

This analytical framework of competency standards reflects that teachers' ICT-integrated competencies start with pedagogy. As teachers apply the latest technologies to enhance the

effectiveness and efficiency of teaching, new questions are raised. When and how do teachers adopt and utilize educational possibilities of ICT in their teaching practices and professional development?

From a pedagogical perspective, flexible use of technology is likely to facilitate teaching and learning. Teachers may choose different ways of using technology to achieve various learning objectives under different pedagogical philosophies. Technology use means methods or techniques to those who favour "teacher-centred" instructive theories; technology use might be more of a philosophy to those who favour "learner-centred" teaching theories, especially constructivism. Different educational viewpoints lead to different approaches and varied learning outcomes.

Teachers are not meant for operating as "sages on the stage" in this information age. Taking up roles as mentors, motivators, administrators, and designers of learning means sharing more responsibilities in promoting students' higher learning standards. They are expected to master and continually apply changing technology in the learning environment. When integrating technology into instruction, there have to be enough learning opportunities for teachers to equip themselves with the necessary skills. It is critical to make teachers realize that incorporating technology into the fabric of classroom activities not only provides opportunities for teachers to enhance their teaching efficiency and effectiveness but also enables them to migrate from the traditional role of directing learning to a new role: facilitating learners to become self-directed.

The stages of competency levels reflect teachers' continuous development and assume that from the earliest understanding and experience with ICT, teachers are working in an actual classroom context so that ICT is infused into teaching and learning.

Table 5.1: An analytical framework of competency standards

Clusters of Competency	ANALYTICAL FRAMEWORK		
	Major Pedagogy/ Instructional Science	**Salient ICT Technology**	**Major Integration Strategies**
EMERGING: Integrating productivity tools in learning context	Design authentic & realistic tasks based onpedagogical principles	Demonstrate expertise with ICT productivity tools	Apply productivity tools in learning context
APPLYING: Enhancing teaching and facilitating learning	Apply learning theory and principles in developing interactive learning environment	Demonstrate expertise with various instructional software development tools	Integrate multimedia-based instructional software in different subjects
INFUSING: Processing curriculum resources & learning materials	Stimulate learner directed resources for knowledge construction	Demonstrate expertise in developing & organizing web-based flexible learning materials	Integrate open & flexible learning strategies in an online learning
TRANSFORMING: Integrating ICT for pedagogical innovations	Incorporate emerging trends in pedagogy and learning principles	Demonstrate expertise with various specialized software	Integrate innovative learning strategies for pedagogical innovation

5.5   AN EXAMPLE OF COMPETENCY STANDARDS

Based on the analytical framework described above, an example of competency statements is proposed below, which consists of four major competency items under each cluster. A separate document on competency standards for ICT integration elaborating performance indicators and covering assessment components will be published soon by UNESCO Bangkok. The International Society for Technology in Education's National Educational Technology Standards for Teachers have been included in Annexure 2.

Cluster 1. Integrating productivity tools in learning practices
1.1   Demonstrate expertise in working with productivity tools that are applicable for teaching and learning work.
1.2   Design authentic and realistic tasks-based on pedagogical principles.
1.3   Demonstrate positive attitude in utilizing productivity tools for professional competence.
1.4   Demonstrating knowledge and skills of using ICT in ethical, legal and secure ways.

Cluster 2. Enhancing teaching and facilitating learning

2.1   Identify, plan and locate ICT resources to design and manage learner centred instruction and to support diverse needs of learners.

2.2   Demonstrate expertise with various instructional software development tools.

2.3   Design meaningful learning experiences and integrate interactive multimedia learning environments.

2.4   Apply ICT to facilitate a variety of assessment and evaluation strategies.

Cluster 3. Processing curriculum resources & learning materials

3.1   Demonstrate expertise in developing multi-modal resources using ICT to support curriculum.

3.2   Demonstrate expertises in developing web-based open and flexible learning (OFL) materials.

3.3   Stimulate and integrate learner directed research by using ICT to support knowledge construction.

3.4   Use ICT resources to collect, analyze, interpret and communicate findings to improve instructional practices.

Cluster 4. Integrating ICT for pedagogical innovation

4.1   Apply ICT to develop higher order skills and creativity.

4.2   Integrate ICT in meeting the needs of pedagogical innovations and learning strategies.

4.3   Employ specialized software tools to support pedagogical innovation.

4.4   Apply current research on teaching and learning with ICT while planning learning environment.

5.6   ASSESSING INFUSIONS OF TECHNOLOGY

Those responsible for teacher development may work with local teachers to create effective ICT infusions that are suitable to local context and specific curricula. Criteria like those given below, refined to the local context and subject area, may be used: (a) to evaluate and improve infusions as they are designed and applied during teacher development, and (b) for the teachers (and their supervisors) to use later as they begin to create infusions with their own students, so that they can evaluate and improve use of ICT within their own classroom context and practice.

To evaluate how meaningfully instructional activities are embedded in each discipline, they can be assessed according to the criteria in **Table 5.2** below [3, 4]. These criteria help teachers think about the value of a learning activity. Activities that generally score well can be refined so that they are even better; those, which are poor, can be revised or abandoned. Again, the rubric can itself be adjusted and refined according to the local context.

Table 5.2: *Criteria for Assessment of Instructional Activities Infusing ICT*

1	To what extent is the ICT activity naturally complex and embedded in a real-world context?
2	To what extent do the learners observe and reflect upon their actions?
3	To what extent is ICT contributing to the attainment of specific goals?
4	Do learners engage in this because it is required or because it is of intrinsic interest?
5	Do learners wrestle with new experiences and become more skilled in identifying problems?
6	To what extent do learners spend time engaged with other learners?
7	To what extent do learners improve in their ability to negotiate with other learners?
8	Do learners simply memorize or do they generate hypotheses, evaluate, assess and predict?
9	To what extent is there one 'right' answer, or does the activity foster generation of multiple complex solutions of varying quality that can be analyzed and evaluated?

The types of assessment instrument used need to be sufficiently varied and flexible to enable competence to be demonstrated in a variety of ways reflecting the rich diversity of teaching and learning practice [5]. The assessment processes are required to be equitable and affordable so that all potential candidates have the same opportunities in terms of access to assessment. The nature of the assessment process needs to be made clear to all potential assessment candidates in terms of how it operates, what is expected from the candidates and how best to prepare. A mechanism for detailed feedback to all candidates requires to be established following completion of the assessment. Feedback has to be an integral part of the assessment process and with provision for including opportunities for further development. Involvement of all stakeholders in the assessment process is crucial for assessment of teacher professional standards.

5.7   SUMMARY

An attempt has been made in the present chapter to outline how competency standards can be developed for teachers with a view to integrating ICT in education. For this purpose, a rationale for the use of standards and how they relate to the curriculum framework has been discussed, along with the points of support provided by teacher education to promote movement through the four stages of ICT development. Based on this analytical framework, competency levels have been identified and clustered for *emerging, applying, infusing, and transforming stages* to characterize the expertise which teachers have in pedagogy, technology skills and integration strategies. Finally, an example of competency standards has been included as well as a rubric to evaluate the effectiveness of infusions of ICT into learning.

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6

DEVELOPING CAPACITY FOR CONTINUING TEACHER DEVELOPMENT

6.1   CHAPTER OVERVIEW

The most critical factor in the successful integration of ICT into teacher education is the extent to which the teacher educators have the knowledge and skills for modelling the use of ICT in their own teaching practices. A well-conceived and sustained programme of professional development is, therefore, required to enable the teacher educators to develop these skills. Keeping this in view, a rationale for the use of standards and how they relate to the curriculum framework have been discussed in Chapter 5. But since the role of a teacher today is that of a facilitator, it is his/her primary responsibility for integrating ICT in the teaching-learning processes.

This chapter focuses on the capacity building for teacher development with regard to pedagogy-technology integration. The major objectives and guiding principles of professional development is discussed along with the basic strategies and various approaches to capacity building.

Professional development can make a powerful difference in performance of both learners and teachers. Capacity building requires sustained and ongoing efforts with support from all the stakeholders of the education system. As such, the perception of teachers to face the challenges of an ICT enriched teaching and learning environment is crucial.

6.2   CAPACITY BUILDING : MAJOR OBJECTIVES

Teachers constitute the largest professional group in most of the countries of the Asia-Pacific region. Ensuring continuing professional development of teachers presents a formidable challenge by itself. Integration of ICT into the various strategies for teaching and learning not only presents a new set of challenges, but also holds great opportunities that are intrinsic to the nature of the newer ICT. The rapid and inexorable movement towards a knowledge society places new demands on the knowledge, skills and competencies of teachers. At the same time, technology development gives rise to newer opportunities and advantages.

Applications of ICT have served to bridge temporal and spatial barriers that have long mitigated against introduction of new knowledge, approaches and techniques to teachers who work in far-flung areas. Productivity tools can give a teacher more time for professional growth and knowledge enrichment: this is over the time that is now spent on repetitive classroom management tasks. Accessing the global knowledge and information resources requires development of an environment that supports pedagogy-ICT integration at the national, local and institutional levels. Optimal use of the knowledge tools and resources demands adequate preparation and skills of teachers in order to reap the maximum benefits of the emerging information society.

The most important criterion for effective professional development is to tailor it to the learning needs and skill levels of individual teaching staff. This suggests that, ideally, an institution is required to, based on the availability of resources, provide a variety of options for professional development for the teachers. In structuring professional development options and resources, it is helpful to explore collaboration opportunities with partners outside the institution. The opportunities for ICT to create new paradigms of teaching and learning will depend largely on leadership and a shared vision, and on appropriate and continuing professional development.

There are three major components of capacity building objectives:

- The improvement of teachers' knowledge base, their skills and attitudes (KSA) in ICT integration
- The motivation of teachers to apply innovative pedagogical approaches and models in the classroom
- Making teachers competent in developing online/offline-learning resources.

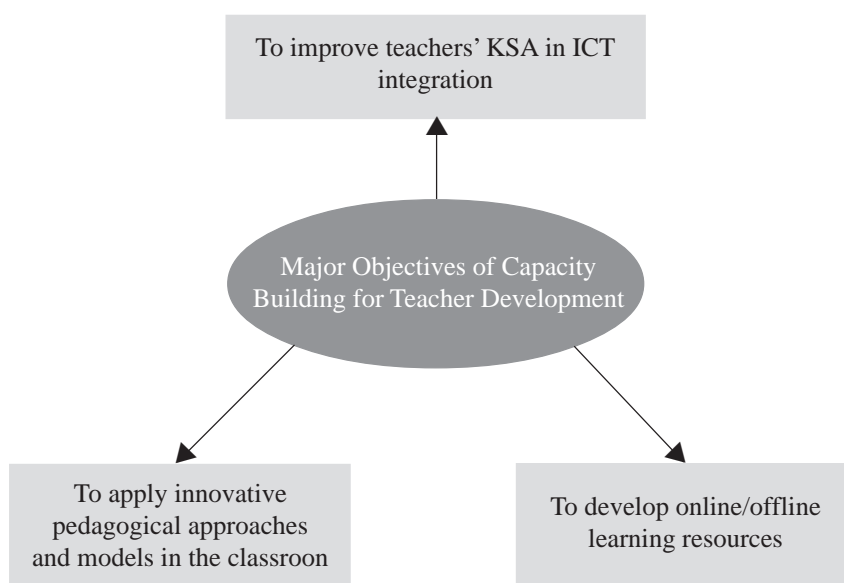The major objectives of the capacity building are shown in **Figure 6.1.**

Figure 6.1: *Capacity building for teacher development in ICT integration*

6.3 BASIC STRATEGIES TOWARDS PROFESSIONAL DEVELOPMENT OF TEACHERS

Professional development refers to a variety of activities, both formal and informal, designed for the personal and professional growth of teachers with respect to pedagogy-technology integration. Professional development includes individual development, continuing education, in-service education or staff development, as well as, various professional developmental activities. It involves a wide variety of curricula to ensure that the teachers acquire and maintain the required competencies to face the diverse challenges of pedagogy-technology integration. It is concerned with the development of new insights into pedagogy and stimulates an on-going reflection into one's own practices.

Various professional development strategies exist for the successful implementation of pedagogy-technology integration. The strategies recognize the diversity within the region in terms of culture, languages and ethnicity. They encourage innovative practices. The strategies also focus on incorporating ICT development, education reforms and professional development of teachers in national policies and plans.

National plans and programmes require taking into account teachers' needs and concerns, particularly those related to their professional development. Commitment and support at various levels (facilitators, policy makers, communities and other stakeholders) are crucial in facilitating successful implementation of any national policy. Teachers may find it impossible to incorporate ICT into their work without support from peers, parents, leaders and other stakeholders. To bring this about, these community members may also need professional development along with the teachers. Countries that have initiated efforts to infuse ICT into teacher education have found the following professional development strategies to be helpful in successful technology integration:

a) Professional development programme on ICT integration places pedagogy over technology. The focus lies in teaching and learning rather than hardware and software alone. In other words, it is not only about mastering ICT skills but also utilizing ICT to improve teaching and learning.

b) Professional development of teachers requires adequate access to ICT resources in the classroom. The better the access to ICT, the more likely it will be used for in structional purposes. This is a big challenges across the Asia-Pacific region because of the diversity of institutions and the difference in resources [1].

c) A 'Just in Time' (JIT) approach to professional development is a model that works well. In this approach, professional development is provided to teachers on a as-and-when-required basis.

d) Capacity building is a sustained, continuing and lifelong process. It is not a one-time activity. Teachers need to update their knowledge and skills as the school curriculum and technology change. Individuals develop in stages and mature over time.

e) Professional development is a building process. Preferably it starts with what teachers do well in the classroom. Teachers can then gradually build their skills and knowledge in successive steps, towards pedagogy-technology integration.

f) Capacity building should be based on learning needs and skills of individuals. A detailed needs assessment is essential in order to identify gaps between the present status and the target to be achieved.

g) ICT has the potential to break the professional isolation from which many teachers suffer. ICT provides a suitable means of connectivity with universities, peers, mentors, centres of excellence and the sources of teaching and learning materials.

While developing professional development strategies, one requires to take into account the following guiding principles to promote pedagogy-ICT integration in its proper context:

- Infuse ICT into the entire teacher education programme: pre-service, in-service, and both formal and informal teacher education.
- Integrate ICT in all activities of education: teaching, learning and administration.
- Empower teachers to develop knowledge, skills and positive attitudes actively towards integrating ICT in teaching and learning.
- Integrate ICT in all aspects of learning, and in all phases of the learning process.
- Integrate ICT for lifelong learning.
- Innovate ICT to embody and model the forms of pedagogy that teachers can use themselves in their classrooms.
- Apply hands-on, learner-centred principles in designing professional development programme.
- Use ICT for empowering teachers to use a variety of learning strategies.
- Apply ICT to promote higher order thinking skills.
- Emphasize the professional development of teachers to reduce the digital divide within and among the member/participating countries.
- Use ICT to remove barriers between learners and facilitators.
- Provide an authentic learning environment for ICT integration.
- Encourage teachers to be mentors, tutors, guides and facilitators.
- Encourage self-directed learning independent of space and time.

6.4   APPROACHES TO CAPACITY BUILDING

There is a variety of approaches to capacity building and an overview of the approaches may prove to be helpful in determining the specific requirements of each country in the context of diverse environments in the region. The various planning guides adopted by the different countries suggest a number of useful approaches for high quality professional development programmes. Some of these are discussed below:

1. Professional development programmes respect and encourage the leadership development of teachers. There is a variety of such roles including mentoring new teachers, acting as consulting teachers, coordinating alliances and networks among teachers, and doing advocacy work etc.

2. A balance between collaborative work and individual learning is required. Central to the professional development enterprise is a learning culture that is collaborative. Examples of collaborative activities are joint planning, problem solving, study groups, team teaching, and participation in alliance.

3. Accountability and evaluation of professional development programmes provide a basis for future planning. All professional development plans have to be evaluated against data about student learning, institutional needs and goals, and teaching and content standard.

Inadequate training is one of the major obstacles to the effective use of ICT in teaching and learning. If teachers do not not receive adequate training at the pre-service stage, the learning gaps may be filled through in-service training. The development of ICT influences two important aspects of delivering professional training programmes. One is the way the institutions train prospective teachers and the other is how institutions design continuing education for teachers to learn on-the-job either at the physical workplace or through virtual learning. There are various merits and demerits of different approaches of professional development programmes.

A popular strategy for delivering professional programmes is to provide centralized training offered through direct contact mode. This has limited success unless followed up by training and support for the effective use of ICT by trained teachers. Another useful approach to professional development is school-based training. School-based training is an on-site, customized teacher-training programme for in-service teachers. The training course is arranged in a small group of maximum twenty persons that ranges in duration from 2 to10 days, depending on the content.

Several organizations such as the Institute for Teacher Education: In-Service Department (UK, Australia), the Princess Sirindhorn IT Project (Thailand), and World Links (funded by the World Bank in various countries) use this approach with their teacher training projects. According to these sources, institution-based training approach is cost-effective. Some factors based on experiences regarding on-site training from Australia, Maldives, Thailand, United Kingdom and the United States are the need for:

- teacher reform policy-putting the emphasis from teacher training organizations to institutions
- teachers' initiative for professional development
- team-work building
- familiarizing teachers with computer equipment at the institution

It is difficult for teachers to take time out from their regular teaching schedules to attend extended training courses; therefore, providing on-site training at their institutions is more convenient and specific to their needs.

Successful models for professional development reflect the holistic nature of capacity building rather than focusing only on technological skills. Mentoring and reciprocal mentoring [2] is an example of a professional development model that builds capacity within an organization.

In the early stages of this process, many teachers develop confidence in working with ICT from the primary level and slowly keep pace with growing confidence and autonomy. ICT has increased the access and flexibility to reach learners any time and anywhere.

Mentorship can be fostered across geographical boundaries by using synchronous and asynchronous interaction. Training programmes can be organized for intensive face-to-face sessions, followed by long term follow-up, using online learning strategies. This hybrid approach to capacity building is becoming popular in most of the developing countries. Apart from the face-to-face, on-site institution-based training, online training and direct mentoring methods, there are various other capacity building exercises. They include:

- exchange programme
- workshop at local, regional, national and international levels
- case study
- web-based learning
- self-directed instructional resources including multimedia packages

While the potential of technology to offer creative opportunities for individual and collaborative learning for teachers is no longer debated, the realities of education in the developing countries in the region include the fact that computers in institutions are inadequate, connectivity is still limited and most other technology resources are unevenly distributed. Can ICT in this context still promote the best practices of professional development? The following show examples of ways in which teachers can make optimum use of ICT for professional development [3].

1. Teachers of the same subject area can take turns researching on professional development issues or topics that could be discussed, articles could be downloaded, indexed, hyper-linked to actual sites and saved in staff development folders for using offline.

2. A small number of computers may be set aside exclusively for professional development purposes. Departmental committees may be formed to determine the web-based resources related to ICT integration for professional development purposes.

3. Copies of files and folders of professional development articles and web-based resources can be made available on CDs to rural schools that have no Internet connectivity.

4. Use of an intranet system, which features a discussion or "knowledge forum", can be a useful approach for professional development. Young teachers may seek assistance from experienced teachers by posting questions relating to ICT integration. Teachers can join online study groups where connectivity is strong in order to explore better ways of teaching and sharing experiences.

5. Videos of lessons demonstrating seamless technology infusion in various subject areas can be viewed and critiqued by teachers during staff development meetings.

6. Visits to institutions that have rich pedagogy-technology environments can help to understand and benchmark ICT integration.

An institution can adopt or develop a competency continuum for pedagogy-ICT integration. Based on this, individual professional growth plan of a teacher can be benchmarked. Teacher training institutions, professional societies, institutional administrators and educational policy makers continue to identify, study and disseminate examples of pedagogy-ICT integration that respond to professional needs.

6.5 ONLINE KNOWLEDGE RESOURCES AND OFFLINE NETWORKING

Teachers may find it impossible to incorporate ICT into their work without support from peers, parents, leaders and other stakeholders of the education system. To bring this about, there is a need to form a support group comprising parents, local business groups, NGOs, and the community at large with teachers at the core to facilitate integration of ICT into the teaching and learning system. This will create a local knowledge base for infusing ICT integration. This local knowledge needs to be integrated with regional and international knowledge base of ICT for teacher development.

Regional and international collaboration can provide ongoing mentoring and support for those who lead ICT in teacher education within and outside institutions. They engage in discussions on topics more relevant to their needs and practices such as ways of customizing software to local contexts. Such collaborative problem solving among the countries within the region and outside is important to many teachers who have relatively little access to technical support or opportunities to view new developments.

Knowledge can be availed of, extended, shared and transformed using knowledge portals and gateways. Global gateways provide a necessary filter to help reduce information overload. Even more importantly, the filtered information has been evaluated before placement in a portal, and often links to sources and resources are accompanied by brief descriptions.

Like the rapid growth in information, the number of web portals has similarly increased and so also guide to online knowledge networks. The large store of resources at a particular portal is easy to navigate and useful for capacity building. The ICT portal for teachers developed by UNESCO Asia and Pacific Regional Bureau for Education is one example [4].

There is a strong need to develop online teacher resource bases in the area of pedagogy-technology integration at national levels and link them with the portals at regional levels. Content development, teacher designed e-lesson plans, knowledge base on ICT integration and various innovative practices can be shared for effective use of ICT to improve teaching and learning. The best innovative approaches and high quality teaching materials produced by the teachers call for reward and encouragement.

Based on experiences, offline networks can be developed in centres of excellence such as universities, research centres and teacher training institutions. In this context, it has to be

emphasized that an inquiry system that helps teachers find the right resources, at the right time, for the right audience, etc., easily and efficiently, is required to be set up for online knowledge resources in order to ensure optimal use of the resource base.

6.6 IMPLICATIONS FOR PROFESSIONAL DEVELOPMENT

ICT has provided a new perspective and opportunity to motivate and engage teachers in professional development programmes. ICT can contribute significantly to all the three components of professional development:

- Firstly, it can bring world experiences into professional training by providing good teaching and learning materials, facilitating simulations and capturing and analyzing best practices of teaching.
- Secondly, ICT can open a world of flexible lifelong professional development programme by offering training any time and anywhere.
- Finally, ICT can break the professional isolation of teachers by connecting them in a virtual network and with valuable resources of teaching and learning materials.

Unless teachers are given due recognition for the key role that they can play and thus encourage them towards innovation, the transformation level of ICT integration becomes a harder target to reach. In order to create successful programme for capacity building and for teachers to become pioneers, inventors and shapers of the new culture of learning, professional development programmes should consider the following elements:

- inspire teachers to invent
- focus on experiential learning
- conduct need assessments
- provide greater opportunities for feedback and reflections
- improve teacher competence in ICT integration

6.7 SUMMARY

An attempt has been made in the present chapter to highlight the importance of capacity building for teacher development with regard to pedagogy-technology integration.

Three major components of capacity building objectives have been discussed followed by an elaboration of basic strategies that are required for professional development of teachers. Various approaches to capacity building have then been discussed taking into account the country-specific contexts and traditional cultures, highlighting the need for a holistic nature of capacity building rather than focusing only on technical skills.

Against this backdrop, the need for online knowledge resources and offline networking has been highlighted with a note on implications of ICT approaches for the professional development of teachers.

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7

ISSUES AND STRATEGIES FOR IMPLEMENTATION

7.1 CHAPTER OVERVIEW

Paradigm shifts in education in recent years, that envision a new type of learning culture, demand ICT integration with pedagogy. In the preceding chapters, a vision of technology integration with guiding principles, ways to model ICT development within a curriculum framework, professional standards for competencies, and capacity building for teacher development have been discussed. Implementing the pedagogy-technology integration in teacher development and managing the changes are highly complex and possibly one of the most challenging tasks for any academic leadership. The present chapter discusses various issues and strategies for implementation and evaluation of teacher development for pedagogy-technology integration in the Asia-Pacific region.

This final chapter presents a number of approaches that countries may profitably take towards building and implementing an effective programme of professional development. The chapter begins by presenting an overall context and scenario of effective ICT integration, discusses the systems approach to implementation and describes several implementation approaches that have been effective, including pedagogical and motivational issues that influence the implementation. Potential online, offline, and content-based resources for development are then described.

The chapter ends with a discussion on a few suggested steps for continuous monitoring, which the various organizations can take for successful implementation of pedagogy-ICT integration in the teaching and learning, with a view to harnessing ICT for quality teaching, learning and effective management.

7.2 ARTICULATING VISION WITH A SCENARIO

It is important in leadership to establish and articulate a clear vision toward change. It is helpful, as one can seek a profound shift in the way teachers approach their craft, to continually remind them and oneself of what it looks like when active, motivated students use technology in a meaningful way.

Consider this vignette:

With the help of the Internet, students embarked on a virtual field trip to a Natural History Museum about three thousand miles away [1]. After touring exhibits, students interviewed and questioned experts and curator via two-way video conferencing. As students broke into teams to study specific species, teacher guided and managed their individual research and learning plans.

One group of students narrowed their investigation to ants. Unlike hundreds of students of a particular teacher over the years who simply drew pictures to memorize ant anatomy, these students used an animation simulator. With this tool, the students created a three-dimensional moving ant model. When they forgot to include all the limbs, their creation hobbled jerkily. This humorously reinforced basic facts about movement and structure.

In the field, members of the team carried hand-held personal digital assistance to record and send data regarding the population, habitat, soil quality and moisture levels instantaneously via their wireless connection to the Internet. The four collaborators back at the institution built and organized their findings into a database. This gave a baseline to compare and analyze their findings against those from other parts of the world.

As the group searched for a more original way to report on the ants' activities, the teacher gave expert guidance as to how to record video clips with footage using video editing software. The entire class voted to include these video clips, built up a web page and shared their profiles with students of China. E-mail correspondence with China generated not only surprising information about the different kinds of red ants living in China, but also knowledge of Chinese cultural traditions.

Thus, digital learning integrates technology, connectivity, content and human resources. Otherwise, the students would have listened passively to a particular teacher standing in front of a classroom and describing the anatomy of ants and showing a drawing on blackboard.

One can name several attributes of meaningful learning that are evident in this example: students are actively engaged with the material, are doing an authentic task in the field that is intrinsically interesting, and are collaborating as they do so. It is helpful for the leadership to have a number of examples of this kind of learning, which are always available to illustrate the vision of ICT integration, and to inspire others to reach for it.

ICT has provided a large array of tools and environment to implement instructional techniques that address divergent or creative thinking of learners. Various software now exist to-nurture curiosity, openness to experience, broad interest, originally, imaginative play, intuition, attraction to novelty, artistic ability, metaphorical thinking, problem solving, elaboration of ideas and breaking away from norms-all of which are attributes of creative people [2]. It will be the responsibility of teachers to help learners think critically and develop understanding through the use of appropriate ICT tools.

7.3   SYSTEMS APPROACH FOR IMPLEMENTING THE PROPOSED GUIDELINES

Integration of regional guidelines in teaching and learning requires a systems approach for implementation. Multiple strategies and a blended approach work better when coping with diverse and challenging environments. Four major phases for guidelines implementation have been discussed briefly. The phases, along with a brief scope of work, are described below.

7.3.1 Organizing phase

The first phase in guidelines implementation is the organizing phase in which the initial task is to establish a country-based team with multi-disciplinary membership involving all the stake-holders. Selection of the team leader is crucial, as is determining the scope and activity based action plan. It is important to organize local support teams that may facilitate the pedagogy-technology integration in the institutions.

7.3.2   Analysis phase

The second major phase of implementation is the analysis phase. In this phase, the team has to review the status of pedagogy-ICT integration and determine its position with respect to the stages of ICT integration continuum model as described in Chapter 3. The major tasks included in this phase are:

- assessing the country's position on the continuum model of Chapter 3
- reviewing or developing national or state competency standards
- developing a framework of criteria applicable/adaptable to the national and local context-based on the review of the guidelines
- identifying the teachers' training needs and support systems
- accessing the ICT infrastructure and resources currently available in the teacher-training programme
- creating readiness for the assessment process of the guidelines

7.3.3   Formulation phase

In this phase, a detailed work plan of action needs to be developed. This phase also identifies specific goals and timelines for completion of each component with responsibilities. The plan should show how ICT will support the curriculum and enhance meaningful learning. It will answer who-, when-, where-, why- and how- type questions related to achieving the vision of integrating ICT in teaching and learning. The major tasks involve:

- planning and organizing teacher training programmes and workshops
- formulating strategies for programme delivery depending on the local context
- identifying, creating and disseminating country-specific local ICT pedagogies and models
- identifying types and quality of hardware and software infrastructure along with network connectivity

- creating models of ICT integration and developing pilot project for exemplary application
- planning, organizing national level master teacher educators programmes and workshops
- evolving strategies to develop high quality online teaching resources
- developing networks and partnerships with local, regional and international organizations involved in ICT integration
- developing an online/offline network for sharing teacher developed courseware and innovative practices in effective use of ICT
- motivating and rewarding the best practices of ICT integration

7.3.4 Monitoring and evaluation phase

A result-oriented monitoring and evaluation system identifies how the intended outcome of the plan may be monitored and evaluated. It describes the purpose and focus of the evaluation, methods of data collection and specifies the indicators that may be used to monitor the progress. It identifies how the intended outcome of the plan may be assessed, and how progress towards the outcome can be monitored, including the indicators that can be used to monitor progress towards achieving goals.

The main objective of the evaluation component is evaluation for programme improvement. Evaluation information is for both formative and summative decision-making. Through regular information sharing and "Teaching through Technology Portfolios," teachers will work collaboratively with the team, using evaluation information to develop, guide, and implement ICT infusions [3].

The proposed evaluation employs a mixed-method design that focuses on evaluation for programme improvement. The major elements of the evaluation design are discussed below:

- use "Teaching through Technology Portfolios" (details discussed under section 7.5.1).
- outline the purpose and goals of the sharing sessions to facilitate the sessions in a manner that most efficiently achieves these goals.
- implement sharing sessions and support team sharing sessions concurrent with the development of the Teaching through Technology Portfolios.
- work with team leaders to collect assessment and evaluation information.
- work continuously to refine teacher development activities.

The management structure [4] for teacher education with focus on pedagogy-ICT integration, showing linkages between teams at regional and national levels, is shown in **Figure 7.1.**
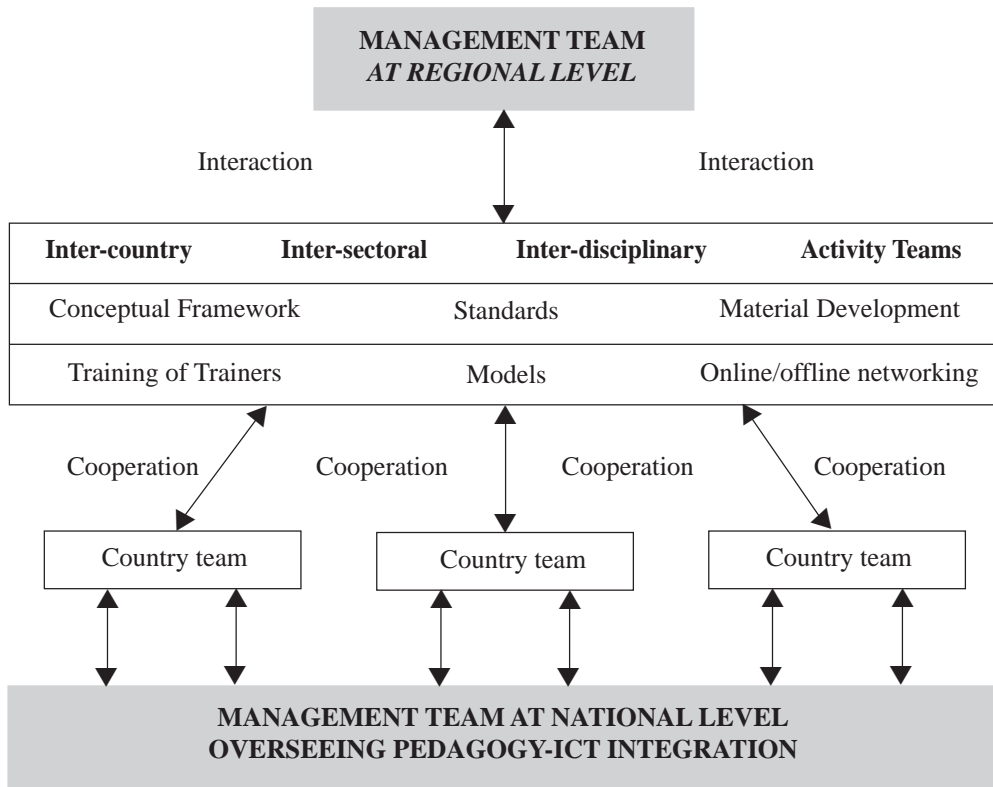
Figure 7.1: Management structures for teacher education

7.4 SUPPORT STRUCTURES FOR IMPLEMENTATION

7.4.1 Local support teams

A central feature of this approach is the development of focused, multi-disciplinary teams at the local level that will help teachers and students infuse technology meaningfully into academic activities [5]. A team assigned to each subject area can assist teachers to more fully integrate technology into learning of that discipline. The teams can be modelled after the overall regional and national level teams that develop a coherent strategy and a set of guidelines for ICT, create sample lesson plans in core subjects, and conduct a series of training workshops and online courses, each potentially discipline-specific. This way, the team is effectively replicated throughout the region with following objectives:

- Engage teachers in activities during subject area preparation and teacher assignments so that they develop the skills to use technology effectively in their classrooms.
- Provide technical support, instructional support, incentives, and ongoing development for in-service teachers to help them effectively practise and model technology integration.
- Investigate meaningful infusions for each discipline, refining and adopting those that seem most effective.

- Encourage teachers within and between disciplines to collaborate on meaningful instructional uses of technology and to share problems, strategies and solutions.

Local support teams develop techniques for assessing the quality of proposed infusions of technology according to rubrics like the one presented in Table 5.2 in Chapter 5. The teams will then support teachers through the stages of ICT development and model the forms of pedagogy that teachers can use themselves in their classroom.

This modelling and support will encourage teachers to develop their own innovative models and practices. Local teams work to create or adapt infusions for the target teachers and subject areas, and will consider local factors such as resources, infrastructure, curricula, student characteristics, and teacher practices. This will ensure that the infusions are suitable for the people involved and are likely to support meaningful learning in their community context. By working locally, the teams are likely to devise unique, innovative infusions that are custom designed for specific contexts. The local teams will have overall responsibility for evaluating the extent to which the infusions succeed, and for providing ongoing support for the teachers.

At the same time, there will be conventional approaches to training such as institution-based face-to-face training followed by on-site institution-based training, direct mentoring and online training. The mode of the training programme will depend on the context and cultural tradition of the country. Whatever be the mode, the training has to emphasize hands-on-practice and inquiry-based learning, modelling the pedagogy that teachers can employ in their classrooms.

7.4.2 Development of resource materials

The Resource Kit [6] is a valuable collection comprising various media: videos of classroom practice, audio interviews with teachers on cassette, sample lesson plans and teaching modules on CD-ROM, and printed materials. The diverse teaching and learning materials contained in the Resource Kit will be collected in-house, continually expanded and refined over a period of time, and packaged in a convenient form for use. It can be promoted as a resource for teacher educators at regional workshops and at international meetings in the region.

7.4.3 E-resources for teacher development

A number of the e-resources produced by UNESCO Asia and Pacific Regional Bureau for Education on training and professional development of teachers are available on CD-ROM [7]. Building on these promising starts, additional e-resources for teacher educators might include a range of materials in electronic format such as-policy documents, reports and databases, multimedia courseware, online educational journals, electronic books, newspapers online, glossaries, and online tools.

Along with the Internet, provision has to be made to create master CD-ROMs for distributing e-resources to every educational institution in the Asia-Pacific region. E-resources for teacher educators would contain copyright-free resource materials, together with links to other freely available online resources so that, wherever an Internet connection is available, teacher educators would enjoy access to a library of information that had been already been evaluated, filtered, and judged useful.

As with other products generated, e-resources for teacher educators could be promoted at regional workshops, international conferences, and through UNESCO's Regional Clearing-house on ICT in Education for Asia and the Pacific. Besides, an introductory packet containing e-resources together with a rationale and value statements that help the stakeholders learn about integrating ICT can be made available to users at national, local and individual levels which would go a long way in implementing ICT integration.

7.4.4 Database of exemplary practices

It is very useful for teachers to have access to a database of exemplary practices of ICT integration in different subjects across the curriculum. An expert group has to be formed to evaluate practices and select those that are most effective. These curriculum materials are required to be organized, for dissemination to every teacher education institution in the region, with permission to freely copy for further distribution. A website for this purpose has be established to share the resources within and outside the region on integrating ICT in teacher education, and integrated in the regional website hosted by UNESCO Bangkok for wider dissemination.

7.5 VARIOUS APPROACHES TO SUCCESSFUL IMPLEMENTATION

7.5.1 Teaching through technology portfolio

Participating teachers have to develop and maintain a "Teaching through Technology Portfolio" as a means to document and reflect on their own learning and to provide evidence of success. The portfolios form an integral component of the regularly scheduled sharing sessions with the peers and team leaders. Examples of content are:

- lesson plans used to facilitate technological support for learning in curricular areas
- assessment and measurement strategies in particular curricular areas
- evaluation strategies and uses of evaluation information in particular curricular areas
- measures of student achievement/performance
- critical Incident Logs that focus on increased content knowledge
- peer observations and feedback on technological support for learning
- affective measures of student perceptions of use of technology

7.5.2 Sharing sessions

The sharing sessions provide an opportunity for open and on-going discussion on: (a) how and the degree to which teachers are engaging in activities that enable them to bring technology into effective use in their own classrooms; and (b) the effectiveness/adequacy of support provided to local teams as they model technology integration.

Participants discuss technological support for teaching in terms of curriculum implications, successes, teaching strategies, resources, and any other pertinent concerns or ideas. By sharing information and knowledge, teachers will have the opportunity to continuously develop their

portfolios as well as to provide valuable information to the successful implementations of the pedagogy-ICT integration in the institutions. Continuous integration of information provides a mechanism to ensure that the evaluation becomes an integral part of the development. Furthermore, the participants have the opportunities to observe how the evaluation is used to describe the overall programme and develop benchmarks for programme success. By observing direct application of the evaluation information and participating in the development of the benchmarks, it is positive that key teachers will have increasing motivation to implement and improve ICT supports for learning in their classrooms.

Teachers have to analyze and interpret information provided from sharing sessions in a manner that: (a) describes the overall programme activities; (b) allows for continuous collection and use of evaluation information pertaining to ICT support for learning; and (c) develops quantitative and qualitative benchmarks pertaining to ICT use and activities.

7.5.3 Checklist of teachers' performance as indicators of using ICT

A checklist can be developed for effective infusions based on pedagogy and local contexts that carefully support teachers in their use of infusions. This, in turn, helps the teachers in becoming effective in using ICT in their classrooms. Teachers (or prospective teachers) could download checklists of skills appropriate to their disciplines. They could then complete as many of the skills on the list as they can and show evidence of their proficiency to their local teams, or to other individuals.

Teachers can be observed in their classrooms as they teach an instructional unit. The activities made use of can be assessed according to the criteria for ICT infusions listed in Table 5.2. The teachers themselves can, in turn, be evaluated according to a rubric designed for their specific content area and context, to assess their competencies with ICT integration. A rubric needs to be developed based on the competency standards incorporating the local context and requirements. The learning activities associated with attainment of the competencies are complex and have to be assessed both during the process of learning and at the completion of the activity. In this regard, UNESCO Asia and Pacific Regional Bureau for Education, will publish a separate document on detailed competency standards with performance indicators on ICT integration.

7.6 CHANGE CURVE MODEL

It has been observed that any prevalent system resist changes. Systems seek to maintain as much as of the status quo as possible; therefore, systems are conservative in nature, and education systems are no exceptions. Every country has a long and deeply embedded tradition, which determines how institutions are supposed to organize, teach, learn and act. It is critical to remember that teachers like all learners, learn new skills most effectively when there is a need to do so. Teachers, in general, resist any innovation that does not match the context in which it woks and when these technologies do not address real classroom and learning goals.

Even if teachers accept the ICT integration and support it wholeheartedly, productivity and efficiency of teachers are often reduced when implementing new innovation, at least initially. Learning and subsequent assimilation the new innovation takes time. But once the new

innovations are integrated into daily routine, the productivity and efficiency start rising. It is unjust to assume that integration of ICT immediately improves the productivity, efficiency and quality of teaching-learning process. However, after the initial "teething" period, teaching and learning are finally bound to be more efficient than earlier. A change curve model, schematically representing these changes, which are likely to be experienced while adopting ICT, is shown in **Figure 7.3.**
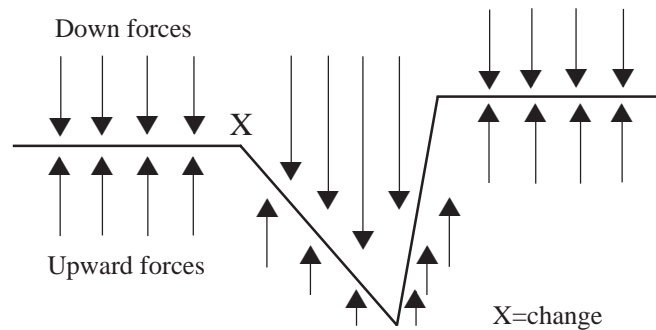

Figure 7.2: Change curve model

7.7 SUMMARY

While all educators realize that the use of ICT can be a valuable resource for improving teaching and learning, the process of integrating ICT into the curriculum and the teaching-learning process is not an easy task that can be quickly accomplished. It challenges all educators to reconsider teaching practices, the curriculum, the role of teachers and the ways in which ICT can be infused into teaching and learning.

This guideline discusses various ways in which ICT can be infused in teaching and learning. It highlights the new visions and guiding principles of pedagogy-ICT integration in Chapter 2 and proposes a model of ICT development in education in Chapter 3. A curriculum framework for ICT integration based on the model has also been proposed in Chapter 4. The performance standards for competencies along with the professional development of teachers have been highlighted in Chapters 5 and 6 respectively to identify various issues involved in the integration of ICT. In this final chapter, various implementation issues and strategies of pedagogy-ICT integration have been discussed with adequate emphasis on systems approach and support structures for implementation. The chapter begins by articulating the vision with a scenario. The chapter ends with a discussion on a change curve model schematically representing the changes that are likely to be experienced while adopting ICT at the institutional level.

Any implementation calls for substantial rethinking of educational practices. Teachers need to go beyond technical training and lay emphasis on pedagogical skills and, more importantly, to the integration of competencies. Unquestionably, it is the teachers who hold the key to the effective use of ICT to improve learning. Persistent efforts can achieve a flowering of ICT-based innovative teaching-learning system that makes profound impact in the learning scenario of the Asia-Pacific region in the years to come.

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GLOSSARY[1]

Active Learning
The learner interacts with the teacher, author, or the learning programme to construct his/her own meaning. It is the child's individual or meta-cognitive act of observation, hypothesis generation and testing, and reflection.

Application Software
Computer programmes that are used to accomplish specific tasks not related to the computer itself. Examples are word processors, spreadsheets, and accounting systems.

Assessment
A broader term than paper and pencil testing that includes all types of activity that can be used to have learners demonstrate their ability to perform.

Assessment Rubric
An established set of rules that define the quality of a performance or a product.

Asynchronous Communication
A time-delayed communication through some type of recording device. It is replayed at the convenience of the user. An example is e-mail communication in which interaction between sender and receiver does not take place simultaneously (e.g., e-mail or fax).

Authoring Software
High-level computer programmes designed for creating computer-based training, interactive presentations, and multimedia. Commands are often presented as simple terms, concepts, and icons. Authoring software translates these commands into programming code.

BBS (Bulletin Board System)
A network-based application system dedicated to the sharing or exchange of messages or other files for a particular interest.

Browser
Software that lets you locate, view, and retrieve information on the World Wide Web using a graphical interface.

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[1]   The definitions were taken mostly from Resta, P. and Semenov, A. (Eds). 200. *Information and Communication Technologies in Teacher Education: A Planning Guide.* Paris: UNESCO.

CAI

Computer-Assisted Instruction. Instruction mediated by computer in which the system allows for remediation based on answers, but not for a change in the underlying programme structure.

CBT

Computer-Based Training. Instruction primarily delivered by computer, with a more complicated branching programme of remediation and answering. (See Hypertext media).

CD-ROM

Compact Disc-Read Only Memory. A round, silver plastic disk that comes with massive amounts of information embedded and ready to be used. Unlike diskettes, any type of computer with a CD-ROM drive can read CD-ROM disks.

Central Processing Unit (CPU)

The brain of the computer that processes instructions and manages the flow of information through a computer system.

Cognitive Strategies

An individual's skills for "learning how to learn."

Collaborative Learning or Cooperative Learning

Students of varying abilities and interests work together in small groups to solve a problem, complete a project, or achieve a common goal.

Computer-Based Instruction

Computer programmes that teach or reinforce concepts and skills.

Computer Conferencing

Interactive sessions between networked computers whereby data, documents, and/or video and audio are shared. The term encompasses both data conferencing and desktop video conferencing. Web chat, whiteboards, and web-based conferencing may be used in computer conferencing.

Constructivism

The learner constructs knowledge; learning is a personal interpretation of experience; learning is active, collaborative, and situated in real-world contexts; and assessment of learning is integrated within the learning context itself.

Courseware

Instructional materials in a complete mediated format. May refer to a single instructional component, such as a computer-assisted instruction programme, or a multiple instructional entity, such as guidebooks, videodiscs, ad computer-assisted instruction.

Curriculum (plural curricula)

A plan of instruction that details what students are to know, how they are to learn it, what the teacher's role is, and the context in which learning and teaching will take place.

Curriculum Frameworks
Describe what should be taught in order for students to acquire certain skills.

Data Base Software
The computer programmes that allow the storage of large amounts of information and give the capacity to search, retrieve, sort, revise, analyze and order data.

Digital Camera
A still or Video Camera that captures and stores images in digital format.

Directed Instruction
A teaching and learning model based on behavioural and cognitive theories; students receive information from teachers and do teacher-directed activities.

Discovery Sequence
Learners often take on more of the processing responsibilities, engaging cognitive strategies as wall as domain knowledge.

Distance Education
A subset of distance learning that includes evaluation by distance educators and two-way communication, which usually includes the structuring of media content and use by the educator.

Distance Learning
Using some electronic means (e.g., modems, satellite transmissions) to make possible teaching and learning at separate sites.

Downlink
A television dish used to capture signals off a satellite transponder for distribution in a local area.

Download
The process of transferring (copying) data files from a main host computer to a smaller computer. It is the opposite to upload.

Drill and Practice
An instructional software programme that presents items for students to work (usually one at a time) and gives feedback on correctness; designed to help users remember isolated facts or concepts and recall them quickly.

Electronic Mail
E-mail (electronic mail) is messages stored and sent via a computer system, transmitted across networks typically accessible only by the addressee.

Electronic Mail (e-mail) Software
The computer programmes that facilitate computer-to-computer communications among users in any location.

Electronic Portfolio

An electronic portfolio is a selective and purposeful collection of digital samples of student work. This work may be created in digital form, scanned from original handworks or photographs, or captured from a digital camera or video camera. Electronic Portfolio can be used to profile multiple dimensions to form an authentic assessment of students' academic progress. They may be kept on a server, a CD, or the World Wide Web.

Ethical Issues

Issues that deal with the ethical use of software and computers and related technologies by students and educators, e.g., privacy, piracy, integrity of information, responsibility for content, and use of recreational applications.

Experiential Learning

A learning situation is set up which presents a problem or a complex task for the learners to deal with. The learners are encouraged to draw general conclusions and establish general principles that may explain or predict across a range of similar situations.

Expert Systems

Knowledge databases that are sorted and selected by an algorithm programmed with a set of rules derived from an expert. The systems help to formulate solutions to problems. In education, future possibilities include the development of expert systems to aid in making instructional design decisions based on current databases of instructional research. Therefore, an optimal instructional strategy can be recommended for implementation.

Facilitators

Teachers, school head masters, education policy makers, and technologists.

Formative Evaluation

Evaluation of materials to determine the weakness in instruction so that revisions can be made to make instruction more effective and efficient.

Groupware

A computer software programme that allows the same information to be shared among several computers simultaneously. With some applications, users can see each other and from their own computers, add to or edit text and graphics in a single document.

Hardware

The computer equipment used to do the work (i.e., operate software programmes). It consists of items you can touch, such as the computer case and the peripherals (e.g., monitor, keyboard, mouse) that are attached to the computer.

Higher-order Thinking

Understanding difficult concepts and applying sometimes-conflicting information to solve a problem (that may have more than one correct answer)

Hyperlink

A connection among documents in a hypermedia or hypertext format.

Hypertext

The linking of information together by highlighted key words that have been marked up creating paths through related material from different sources such as footnotes and encyclopedias. It is the ability to present connected documents.

Hyper Media

A combination of hypertext and multimedia that allows users to move in a non-linear fashion through text, images, sounds, video and other elements in the form typical of Web documents. Hypermedia is a superset of hypertext and even the modern extension of hypertext. Hypermedia attempts to offer a working and learning environment that parallels human thinking–that is, one in which the user can make association between topics, rather than move.

ICT

Information and communication technology (ICT) generally relates to those technologies that are used for accessing, gathering, manipulating and presenting or communicating information. The technologies could include hardware (e.g., computers and other devices); software applications; and connectivity (e.g., access to the Internet, local networking infrastructure, videoconferencing).

Indigenous Knowledge (See also Local Knowledge)

Another word indicating local knowledge, which is the unique part belongs to certain culture and society and contrasts to international knowledge. That is a knowledge system produced, shared and delivered during the lives and development of local people, which is impartible with the living environment and history of local people.

Instruction

Intentional facilitation of learning toward identified learning goals.

In-service Teacher Education

Professional development training provided to certified practicing teachers.

Instructional Design

The systematic and reflective process of translating principles of learning and instruction into plans for instructional materials, activities, information resources, and evaluation.

Instructional Software

The computer programmes that allow students to learn new content, practice-using content already learned, and/or be evaluated on how much they know. These programmes allow teachers and students to demonstrate concepts, do simulations, and record and analyze data. Often administrative applications like database programmes and spreadsheets are used within the instructional context to help analyze and present information.

Instructional Strategies

Covers the various aspects of sequencing and organizing the information and deciding how to deliver it.

Integrated Learning System (ILS)
A network that combines instructional and management software and usually offers a variety of instructional resources on several topics.

Interaction
Exchange of information, ideas, and opinions between and among learners and teachers, usually occurring through technology with the aim of facilitating learning.

Just in Time (JIT)
A term used to describe a system or information that is available for the user at the exact time the user needs it.

LAN
Local Area Network. The linkage of computers and/or peripherals (e.g. printer) confined to a limited area that may consist of a room, building or campus that allows users to communicate and share information.

Learner-centred Classroom
Students are encouraged to choose their own learning goals and/or projects, based on the belief that people have a natural inclination to learn; learn better when they work on authentic tasks; benefit from interacting with diverse groups of people; and learn best when teachers understand and value difference in how each student learns.

Learner-controlled Instruction
A mode of instruction in which one or more key instructional decisions are delegated to the learner.

Listserv
A special interest discussion group that corresponds via e-mail. A predetermined group exchange messages in an area of shared interest. A message is posted on a list server and is automatically sent to all members of the group. A listserv is different from newsgroups in that an individual must subscribe (sign on) to participate in a listserv group.

Learning Styles
Individual's preferred or best manner(s) in which to think, process information, and demonstrate learning. Several ways to name and describe learning styles exists. One of the most common classifications identifies four styles as abstract-random., abstract-sequential, concrete-random, and concrete-sequential. To simplify a complex topic: the concretes like to deal with specifics, are more intellectually-based than emotionally-based, and focus more on task than reasons; the abstracts like to deal with large issues and reasons and are more emotionally-based than intellectually-based; the sequential like structure and order and prefer to focus on single topic at once and tend to be more inventive.

Lifelong Learning
Learning throughout the lifetime with emphasis on independent study determined by contextual personal needs.

LMS

Learning Management System. The system allows the local course team LMS administrator to assign privileges, link learning resources and modules to individual learners and groups of learners, monitor individual and group performance, collect assessment data and transfer it to the student management system for reporting and recording purposes.

Modelling

Demonstrating to a pre-service teacher or student how to do a task with the expectation that the student will copy the model. Modelling often involves talking about how to work through a task or thinking aloud.

Multimedia Systems

Include technology such as CD-ROMs and laserdiscs. This technology provides a gallery of images and programming in an accessible format. Advances in screen resolution have made possible the effective use of these applications.

Network

A group of computers connected to each other to share computer software, data, communications and peripherals. Also, the hardware and software needed to connect the computers together.

Online

The status of being connected to a computer or having information available through the use of a computer.

Pedagogy

The science or profession of teaching.

Pedagogical

Of, relating to, or befitting a teacher or education, especially with regard to a process of learning.

Peripheral

A device that is attached to a computer, such as a monitor, keyboard, mouse, modem, CD-ROM, printer, scanner, and speakers.

Portfolio Assessment

A portfolio is defined as a purposeful collection of student work that exhibits to the student and others the student's efforts, progress, or achievement in a given area. This collection must include 1) student participation in selection of portfolio content, 2) the criteria for selection, 3) the criteria for judging merit, and 4) evidence of student self-reflection. Portfolios, even more so than other forms of performance assessment, call on the learner to be highly involved in planning the entries, choosing what to include, and providing the rationale behind those decisions. Portfolios thus attempt not only to assess the end products, but to some extent, the process that went into creating them as well.

Pre-service Teacher Education

Initial education or preparation of individuals prior to their being certified and becoming practising teachers in schools.

Problem-solving

Refers to a learned capability involving selection and application of multiple rules.

Project-based Learning

Each group is assigned a project, or chooses one. They collaborate to complete the project, detailing their basic goals and objectives, timeline, budget, etc.

Performance Indicators

Descriptions of behaviours that demonstrate acquisition of desired knowledge, attitudes, or skills.

Problem Solving Skills

Skills that we use when we are faced with new problem.

Profile

A collection of performance indicators that, when taken together, make definitions of expected characteristics or behaviours.

Professional Development

Refer to career-long development of profession as teachers whose capacities; expectations and actions greatly influence the teaching and learning environment.

Role Playing

A type of simulation in which team members, sometimes with the aid of computers, act out roles as parts of the problem being analyzed. For example, one member of the group could act out the role of editor; another could be a reporter, etc.

Scaffolding

The cognitive processing support that the instruction provides the learners, allowing them to learn complex ideas that would be beyond their grasp if they depended solely on their own cognitive resources, selectively aiding the learners where needed.

Search Engine

A tool used to search the Internet for information. It searches a defined database. A word or phrase is entered on a search engine and a number of "hits" will appear. Different search engines use different search strategies. By clicking on the term, you will be brought to that Web page.

Self-paced Learning

Education in which the learner is on their own, studying without interaction with others. Sometimes used to refer to asynchronous modes of delivery. CBT has been the most common form of self-paced learning, but web-based asynchronous systems are catching up quickly.

Simulation

Software that enables the user to experience a realistic reproduction of an actual situation. Computer-based simulations often substitute for situations that are very costly or high risk.

Simulation Programme

A computer programme that simulates an authentic system such as a city, pond, company or organism and responds to choices made by programme users, e.g. Oregon Trail II, SimCity.

Software

Stored digital information on magnetic disks or tapes or as electronic information in the computer's memory that determines what the computer does. Software can be divided into two groups, operating system software and application software.

Student Management Systems

A system that helps educators and administrators gather, manage, analyze, and apply student data to enhance student achievement.

Summative Evaluation

The process of collecting, analyzing and summarizing data to present to decision maker in a client organization in order to make judgements regarding the effectiveness, and perhaps appeal and efficiency, of the instruction at the end of any programme.

Surfing

Exploring locations and scanning the contents of WWW sites on the Internet.

Synchronous Communication

Communication in which interaction between sender and receiver takes place simultaneously (e.g., telephone or video conferencing).

Technology

The systemic and systematic application of behaviour and physical sciences concepts and other knowledge to the solution of problems.

Template

Something that serves as a master or pattern from which other similar things can be made.

URL

Uniform Resource Locator. An address on the World Wide Web.

Vision

The ideal state or condition you would like to achieve.

Web-based Instruction

Teaching method that utilizes the web resources to support teaching-learning with the attributes and resources of the Internet.

Web-based Training (WBT)

A form of computer-based training in which the training material resides on pages accessible through the World Wide Web. Typical media elements used are text and graphics. Other media such as animation, audio, and video can be used, but require more bandwidth and in some cases additional software. The terms "online courses" and "web-based instruction" are sometimes used interchangeably with WBT.

Word Processing

The most common computer application to process text files which enables users to create a document, store it electronically on a disk, display it on a screen, modify it by entering commands and characters from the keyboard, and print it out with a printer.

WWW

World Wide Web. A system that allows access to information sites all over the world using a standard, common interface to organize and search for information. The WWW simplifies the location and retrieval of various forms of information including text, audio and video files.

Zone of Proximal Development (ZPD)

A level or range in which a student can perform a task with help.

A

Annexure-I
SELECTED PAPERS/
PRESENTATIONS

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[12]   Gregorio, L.C. 2003. *Managing Curriculum Renewal in Basic Education: Building Capacities to Respond to Change*. Presentation to Expert Meeting on Teachers/Facilitators Training in Technology-Pedagogy Integration, Bangkok, Thailand. June 18-20.

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A

Annexure-II
ISTE NATIONAL EDUCATIONAL TECHNOLOGY STANDARDS FOR TEACHERS

Curriculum and Content Area Standards*NETS for Teachers*

Building on the NETS for Students, the ISTE NETS for Teachers (NETS•T), which focus on pre-service teacher education, define the fundamental concepts, knowledge, skills, and attitudes for applying technology in educational settings. All candidates seeking certification or endorsements in teacher preparation should meet these educational technology standards. It is the responsibility of faculty across the university and at cooperating schools to provide opportunities for teacher candidates to meet these standards.

The six standards areas with performance indicators listed below are designed to be general enough to be customized to fit state, university, or district guidelines and yet specific enough to define the scope of the topic. Performance indicators for each standard provide specific outcomes to be measured when developing a set of assessment tools. The standards and the performance indicators also provide guidelines for teachers currently in the classroom.

I. TECHNOLOGY OPERATIONS AND CONCEPTS
Teachers demonstrate a sound understanding of technology operations and concepts. Teachers:

- A. demonstrate introductory knowledge, skills, and understanding of concepts related to technology (as described in the ISTE National Education <u>Technology Standards for Students</u>)
- A.B. demonstrate continual growth in technology knowledge and skills to stay abreast of current and emerging technologies.

II. PLANNING AND DESIGNING LEARNING ENVIRONMENTS AND EXPERIENCES
Teachers plan and design effective learning environments and experiences supported by technology. Teachers:

- design developmentally appropriate learning opportunities that apply technology-enhanced instructional strategies to support the diverse needs of learners.
A. apply current research on teaching and learning with technology when planning learning environments and experiences.
A.B. identify and locate technology resources and evaluate them for accuracy and suitability.
B.C. plan for the management of technology resources within the context of learning activities.
C.D. plan strategies to manage student learning in a technology-enhanced environment.

III. TEACHING, LEARNING, AND THE CURRICULUM

Teachers implement curriculum plans, that include methods and strategies for applying technology to maximize student learning. Teachers:
- facilitate technology-enhanced experiences that address content standards and student technology standards.
A. use technology to support learner-centred strategies that address the diverse needs of students.
A.B. apply technology to develop students' higher order skills and creativity.
B.C. manage student learning activities in a technology-enhanced environment.

IV. ASSESSMENT AND EVALUATION

Teachers apply technology to facilitate a variety of effective assessment and evaluation strategies. Teachers:
- apply technology in assessing student learning of subject matter using a variety of assessment techniques.
A. use technology resources to collect and analyze data, interpret results, and communicate findings to improve instructional practice and maximize student learning.
A.B. apply multiple methods of evaluation to determine students' appropriate use of technology resources for learning, communication, and productivity.

V. PRODUCTIVITY AND PROFESSIONAL PRACTICE

Teachers use technology to enhance their productivity and professional practice. Teachers:
- use technology resources to engage in ongoing professional development and lifelong learning.
A. continually evaluate and reflect on professional practice to make informed decisions regarding the use of technology in support of student learning.
A.B. apply technology to increase productivity.
B.C. use technology to communicate and collaborate with peers, parents, and the larger community in order to nurture student learning.

VI. SOCIAL, ETHICAL, LEGAL, AND HUMAN ISSUES

Teachers understand the social, ethical, legal and human issues surrounding the use of technology in PK-12 schools and apply those principles in practice. Teachers:
- model and teach legal and ethical practice related to technology use.
A. apply technology resources to enable and empower learners with diverse backgrounds, characteristics, and abilities.
A.B. identify and use technology resources that affirm diversity

B.C.   promote safe and healthy use of technology resources.

C.D.   facilitate equitable access to technology resources for all students.

GENERAL PREPARATION

Upon completion of the general preparation component of their programme, prospective teachers:

1. demonstrate a sound understanding of the nature an operation of technology systems. (I)*
2. demonstrate proficiency in the use of common input and output devices; solve routine hardware and software problems; and make informed choices about technology systems, resources, and services. (I)*
3. use technology tools and information resources to increase productivity, promote creativity, and facilitate academic learning. (I, III, IV, V)
4. use content-specific tools (e.g., software, simulation, environmental robes, graphing calculators, exploratory environments, Web tools) to support learning and research. (I, III, V)*
5. use technology resources to facilitate higher order and complex thinking skills, including problem solving, critical thinking, informed decision making, knowledge construction, and creativity. (I, III, V)*
6. collaborate in constructing technology-enhanced models, preparing publications, and producing other creative works using productivity tools. (I, V)*
7. use technology to locate, evaluate, and collect information from a variety of sources. (I, IV, V)*
8. use technology tools to process data and report results. (I, III, IV, V)*
9. use technology in the development of strategies for solving problems in the real world. (I, III, V)*
10. observe and experience the use of technology in their major field of study. (III, V)
11. use technology tools and resources for managing and communicating information (e.g., finances, schedules, addresses, purchases, correspondence). (I, V)
12. evaluate and select new information resources and technological innovations based on their appropriateness to specific tasks. (I, III, IV, V)*
13. use a variety of media and formats, including telecommunications, to collaborate, publish, and interact with peers, experts, and other audiences. (I, V)*
14. demonstrate an understanding of the legal, ethical, cultural, and societal issues related to technology. (VI)*
15. exhibit positive attitudes toward technology uses that support lifelong learning, collaboration, personal pursuits, and productivity. (V, VI)*
16. discuss diversity issues related to electronic media. (I, VI)
17. discuss the health and safety issues related to technology use. (VI)

* Adapted from the ISTE National Educational Technology Standards for Students.

PROFESSIONAL PREPARATION

Prior to the culminating student teaching or internship experience, prospective teachers:

1. identify the benefits of technology to maximize student learning and facilitate higher order thinking skills. (I, III)
2. differentiate between appropriate and inappropriate uses of technology for teaching and learning while using electronic resources to design and implement learning activities. (II, III, V, VI)
3. identify technology resources available in schools and analyze how accessibility to those resources affects planning for instruction. (I, II)
4. identify, select, and use hardware and software technology resources specially designed for use by PK-12 students to meet specific teaching and learning objectives. (I, II)
5. plan for the management of electronic instructional resources within a lesson design by identifying potential problems and planning for solutions. (II)
6. identify specific technology applications and resources that maximize student learning, address learner needs, and affirm diversity. (III, VI)
7. design and teach technology-enriched learning activities that connect content standards with student technology standards and meet the diverse needs of students. (II, III, IV, VI)
8. design and peer teach a lesson that meets content area standards and reflects the current best practices in teaching and learning with technology. (II, III)
9. plan and teach student-centred learning activities and lessons in which students apply technology tools and resources. (II, III)
10. research and evaluate the accuracy, relevance, appropriateness, comprehensiveness, and bias of electronic information resources to be used by students. (II, IV, V, VI)
11. discuss technology-based assessment and evaluation strategies. (IV)
12. examine multiple strategies for evaluating technology-based student products and the processes used to create those products. (IV)
13. examine technology tools used to collect, analyze, interpret, represent, and communicate student performance data.(I, IV)
14. integrate technology-based assessment strategies and tools into plans for evaluating specific learning activities. (IV)
15. develop a portfolio of technology-based products from coursework, including the related assessment tools. (IV, V)
16. identify and engage in technology-based opportunities for professional education and lifelong learning, including the use of distance education. (V)
17. apply online and other technology resources to support problem solving and related decision making for maximizing student learning. (III, V)
18. participate in online professional collaborations with peers and experts. (III, V)
19. use technology productivity tools to complete required professional tasks. (V)
20. identify technology-related legal and ethical issues, including copyright, privacy, and security of technology systems, data, and information. (VI)
21. examine acceptable use policies for the use of technology in schools, including strategies for addressing threats to security of technology systems, data, and information. (VI)
22. identify issues related to equitable access to technology in school, community, and home environments. (VI)

23. identify safety and health issues related to technology use in schools. (VI)
24. identify and use assistive technologies to meet the special physical needs of students. (VI)

STUDENT TEACHING / INTERNSHIP

Upon completion of the culminating student teaching or internship experience, and at the point of initial licensure, teachers:

1. apply troubleshooting strategies for solving routine hardware and software problems that occur in the classroom. (I)
2. identify, evaluate, and select specific technology resources available at the school site and district level to support a coherent lesson sequence. (II, III)
3. design, manage, and facilitate learning experiences using technology that affirm diversity and provide equitable access to resources. (II, VI)
4. create and implement a well-organized plan to manage available technology resources, provide equitable access for all students, and enhance learning outcomes. (II, III)
5. design and facilitate learning experiences that use assistive technologies to meet the special physical needs of students. (II, III)
6. design and teach a coherent sequence of learning activities that integrates appropriate use of technology resources to enhance student academic achievement and technology proficiency by connecting district, state, and national curriculum standards with student technology standards (as defined in the ISTE National Educational Technology Standards for Students). (II, III)
7. design, implement, and assess learner-centred lessons that are based on the current best practices on teaching and learning with technology and that engage, motivate, and encourage self-directed student learning. (II, III, IV, V)
8. guide collaborative learning activities in which students use technology resources to solve authentic problems in the subject area(s). (III)
9. develop and use criteria for ongoing assessment of technology-based student products and the processes used to create those products. (IV)
10. design an evaluation plan that applies multiple measures and flexible assessment strategies to determine students' technology proficiency and content area learning. (IV)
11. use multiple measures to analyze instructional practices that employ technology to improve planning, instruction, and management. (II, III, IV)
12. apply technology productivity tools and resources to collect, analyze, and interpret data and to report results to parents and students. (III, IV)
13. select and apply suitable productivity tools to complete educational and professional tasks. (II, III, V)
14. model safe and responsible use of technology and develop classroom procedures to implement school and district technology acceptable use policies and data security plans. (V, VI)
15. participate in online professional collaboration with peers and experts as part of a personally designed plan, based on self-assessment, for professional growth in technology. (V)

FIRST-YEAR TEACHING

Upon completion of the first year of teaching, teachers:

1. assess the availability of technology resources at the school site, plan activities that integrate available resources, and develop a method for obtaining the additional necessary software and hardware to support the specific learning needs of students in the classroom. (I, II, IV)
2. make appropriate choices about technology systems, resources, and services that are aligned with district and state standards. (I, II)
3. arrange equitable access to appropriate technology resources that enable students to engage successfully in learning activities across subject/content areas and grade levels. (II, III, VI)
4. engage in ongoing planning of lesson sequences that effectively integrate technology resources and are consistent with current best practices for integrating the learning of subject matter and student technology standards (as defined in the ISTE National Educational Technology Standards for Students). (II, III)
5. plan and implement technology-based learning activities that promote student engagement in analysis, synthesis, interpretation, and creation of original products. (II, III)
6. plan for, implement, and evaluate the management of student use of technology resources as part of classroom operations and in specialized instructional situations. (I, II, III, IV)
7. implement a variety of instructional technology strategies and grouping strategies (e.g., whole group, collaborative, individualized, and learner centred) that include appropriate embedded assessment for meeting the diverse needs of learners. (III, IV)
8. facilitate student access to school and community resources that provide technological and discipline-specific expertise. (III)
9. teach students methods and strategies to assess the validity and reliability of information gathered through technological means. (II, IV)
10. recognize students' talents in the use of technology and provide them with opportunities to share their expertise with their teachers, peers, and others. (II, III, V)
11. guide students in applying self — and peer-assessment tools to critique student-created technology products and the process used to create those products. (IV)
12. facilitate students' use of technology that addresses their social needs and cultural identity and promotes their interaction with the global community. (III, VI)
13. use results from assessment measures (e.g., learner profiles, computer-based testing, electronic portfolios) to improve instructional planning, management, and implementation of learning strategies. (II, IV)
14. use technology tools to collect, analyze, interpret, represent, and communicate data (student performance and other information) for the purposes of instructional planning and school improvement. (IV)
15. use technology resources to facilitate communications with parents or guardians of students. (V)
16. identify capabilities and limitations of current and emerging technology resources and assess the potential of these systems and services to address personal, lifelong learning, and workplace needs. (I, IV, V)

17. participate in technology-based collaboration as part of continual and comprehensive professional growth to stay abreast of new and emerging technology resources that support enhanced learning for PK-12 students. (V)

18. demonstrate and advocate for legal and ethical behaviors among students, colleagues, and community members regarding the use of technology and information. (V, VI)

19. enforce classroom procedures that guide students' safe and healthy use of technology and that comply with legal and professional responsibilities for students needing assistive technologies. (VI)

20. advocate for equal access to technology for all students in their schools, communities, and homes. (VI)

21. implement procedures consistent with district and school policies that protect the privacy and security of student data and information. (VI)

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