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Research and Development of the Asia-Pacific Regional Guideline of ICT-Pedagogy Integration and Teacher Training

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Abstract In 2003 UNESCO Bangkok launched a three-year project on training and professional development of teachers/facilitators in the effective use of ICTs for improved teaching and learning ICT as one of the projects under the Japanese-Funds-in-Trust Programme, the JFIT ICT in Education Programme. As a result, coping with the disparity and diversity, which mark the Asia and Pacific Region, and considering the major two target groups such as teachers and managers, the Regional Guideline of ICT-Pedagogy Integration and Teacher Training has been developed with the Standards for Competency in ICTs.

This paper describe the strategic and innovative process of research and development of the Regional Guideline of ICT-Pedagogy Integration and the Standard Curriculum for Teacher Training.

1 GUIDING PRINCIPLES OF PEDAGOGY-TECHNOLOGY

At the 7th UNESCO-APEID International Conference on Education, Sir John Daniel, former UNESCO Assistant Director-General for Education, suggested four principles that should be applied to thought or action that involves information and communication technology for quality teaching, learning and effective management [1]. These principles are most relevant to the JFIT-supported projects on ICT in education in Asia and Pacific region.

1. '*Avoid bias'*, namely avoiding those assumptions that can misdirect our efforts in using technology, with the most prevalent 'vendor bias', or the dot.com fanatics arguing that Internet was going to replace everything in education that had gone before and that attempts to graft the new onto the old were doomed to failure.

For the JFIT Project on teacher training, this implies that no matter advanced ICT will remain instruments or tools in serving education purposes, rather than teachers manipulated by technologies. New technologies do have great potential in enhancing effectiveness of teaching-learning processes and have had profound impacts

on the role of teachers, but they will never replace the teacher and the human interaction between the teacher and the pupil, which will remain essential and crucial to education. Technology will not create miracles and solve all problems in education. Therefore, the teacher training project will not be technology-driven, but focus on technology-pedagogy integration. We need to be realistic about the roles which ICT could play and take an evolutionary approach to technology; we need to be critical in reviewing research and evaluation on application of ICTs in teaching and learning at schools; and we need also to avoid bias or prejudice in favor of private sector provision over public provision.

2. *'Doted bull',* namely, to use critical faculties and expose hollow or loose thinking about technology and its application to education. UNESCO needs to encourage member governments to engage in 'evidence-based policy making', and look for evidence in making statements about technology.

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

3. *'Think broadly',* namely to take a broader view of the use of technology in helping the pupils learn. ICTs mean much more than the Internet, and the Internet won't render obsolete all preceding technologies. Also, technologies always involve people and their social systems.

This implies for the JFIT Project that different ICTs (including books, blackboard, film, radio, television, programmed learning, etc.) should be designed and applied to different technology-assisted learning and that the focus of the project implementation should not be on ICT 'hardware' but on software and teachers'/facilitators' competencies in attitudes to ICT integration, on breaking teachers' isolation from each other and on on-line/off-line networking for capacity building in more effective use of hardware/software in improving teaching, learning and management of education.

4. *'Seek balance',* namely, striving balance on a number of dimensions:

- balance between enhanced teaching and enhanced learning: whether to use technology 'to expand the range/impact of the teacher', or to use technology 'to create a good learning environment for the student wherever and whenever the student wanted to study'. 'It is both more effective and more cost-effective to concentrate on improving access to learning, improving its quality and decreasing its cost'. The JFIT project shall train teachers in using ICT to facilitate learner-centered approach and support active/earning experience with technology.

- balance between IT for teaching/learning about computers and IT for teaching/learning about everything else: while 'IT is best taught with IT; children could learn many things about IT skills on their own with minimal help from adults, and it is, therefore, possible for self-learning of IT skills 'to scale up' to millions of learners.
- The JFIT project shall not focus on training about computers/ICTs, but on training about computers or other building capacity of integrating ICT into teaching of all school subjects/curriculum content domains.

'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 [2]. In view of this, the JFIT project should place high priority on teacher training and professional development in using ICTs to enhance a blend of independent learning and interactive learning from viewpoints of pedagogy and cost-effectiveness. Teachers should thereby develop competencies in harnessing the potential of ICTs in supporting active learning experience and in supporting access to a wide range of media and learning opportunities.

2 OTHER PRINCIPLES

Apart from the major guiding principles, as discussed above, there are some other principles of pedagogy-technology integration as follows.

- Capacity building of teachers/facilitators should be based on better understanding of the roles of technology in educational process and the great potential of ICTs in supporting access to wider range of learning opportunities and in supporting active learning experience should be fully tapped. Meanwhile, deliberate efforts should be made to ensure that teachers and teacher trainers in developing countries or disadvantaged regions shall be priority targets to reduce the digital divide in education between and within countries.
- ICTs are supplementary to the fundamental process of teaching and learning. Human communication and teacher-pupil interaction remain central to the process of learning.
- 'Pedagogical expertise is at the heart of teaching as a profession' [3], and, therefore, ICTs should be used for or with good pedagogy.
- Developing an appropriate range of good pedagogical skills in using ICTs 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 and in-service teacher training and on-going support for professional self-development, with teachers taking greater responsibility for core competencies in technology-pedagogy integration.
- Teachers shall be trained not only to enhance teaching but ultimately to facilitate and improve active learning as the very purpose of improved teaching. Therefore, learner-centered approach should be

introduced to increase both teacher-pupil interaction and teacher-teacher peer support that will enhance professional skills-development in technology-pedagogy integration.

- Relevance: New advanced ICTs may not be the most appropriate technologies in a given context. Different learning environments need different ICTs. A comprehensive approach needs to be taken in selecting technologies.
- Diversity: As Asia-Pacific is a region of greatest diversity, it is significant for the project 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.
- Sustainability: For effective use of technology in education, teachers cannot be trained for once and for all. Teachers' professional development, both for an individual and for the profession, has to be a lifelong process. Though the project has limited period of duration, the planning and implementation should be made with a view to building capacity for both technological and pedagogical expertise, and the major project activities shall not be the kind of 'one shot of training'. By means of teachers' visions and understanding of the nature of teaching-learning process, the quality training modules, supporting leadership and policy environment for increased use of ICT, the network of centers of excellence for teachers' continued development, the outcomes of the project can be sustained even after its completion.

3 MODELING ICT DEVELOPMENT IN EDUCATION

3.1 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 school to school. The Asia and 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 should be a representation of the essential characteristics of ICT development to provide a scaffold or framework. It can also be useful to show the inter-relationship of various components within a system and thus helping 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 programs, for instance, could show the major parts and the inter-relationship of these parts one with another. 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 [4], 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 school. This model is derived from international and national studies of ICT development that have identified a series of broad stages that educational system and schools 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 school 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 model provides us with a holistic framework for identifying the needs for teacher development in different countries at different stages of development.

3.2 A CONTINUUM MODEL

Studies of ICT development in both developed and developing countries identify at least four broad approaches through which educational systems and individual schools typically proceed in their adoption and use of ICT. Sometimes the number of stages identified varies, though 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.

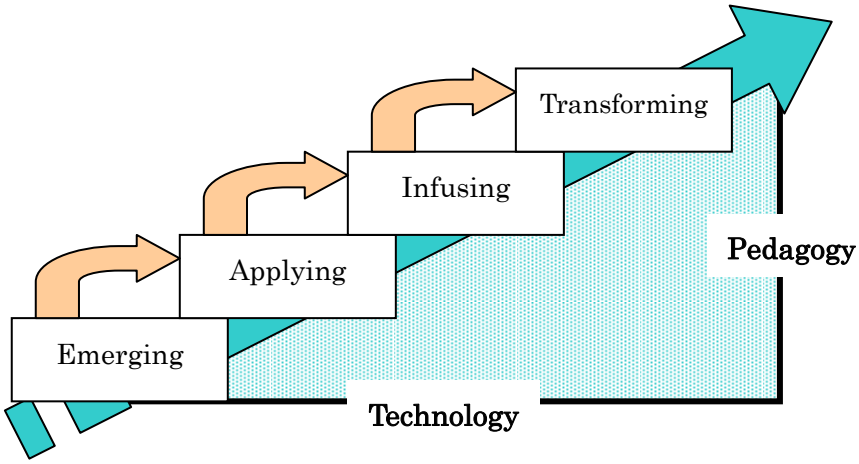

Figure 3.1: Stages of ICT development

3.2.1 Emerging stage

Schools at the beginning stages of ICT development demonstrate the emerging approach. Such schools have just started on their journey in the ICT field with a skeleton computing infrastructure either donated or purchased by the school authority. In this initial phase, administrators and teachers just start to explore the

possibilities and consequences of using ICT for school management and adding ICT to the curriculum. Schools at this emerging phase are still firmly grounded in traditional, teacher-centered 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 to move 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 systems as a whole. This approach often involves teachers' personal use of ICT, such as, for instance, 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.

3.2.2 Applying stage

Those schools, 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 school management and in the curriculum. Teachers largely dominate the learning environment. Schools 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, modeling and application specific tools. This curriculum assists movement to the next approach, if so desired. In the applying approach, 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 approach often involves teachers in integrating ICT to teach specific subject skills and knowledge, beginning to change their 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.

3.2.3 Infusing stage

At the third stage, the infusing approach involves integrating or embedding ICT across the curriculum, and is seen in those schools 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 approach 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 also 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 to share their teaching experiences with others.

3.2.4 Transforming stage

Schools that use ICT to rethink and renew school 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. Schools have become centers of learning for their communities.

In the transforming approach to ICT development, teachers and other school staff regard ICT as so natural and part of the everyday life of schools 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.

3.3 MAPPING THE MODEL

The continuum model can be mapped on the dual basis of (a) the stages of teaching and learning of ICT integration and (b) ICT as delivery medium of teaching and learning.

3.3.1 Based on the level 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.

1 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.

2 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.

3 Understanding how and when to use ICT

The next stage is understanding 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.

4 Specializing in the use of ICT

The fourth and the last stage involves specializing in the use of ICT tools which occurs when one enters more deeply into the learning environment that creates and transforms the learning situation 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.

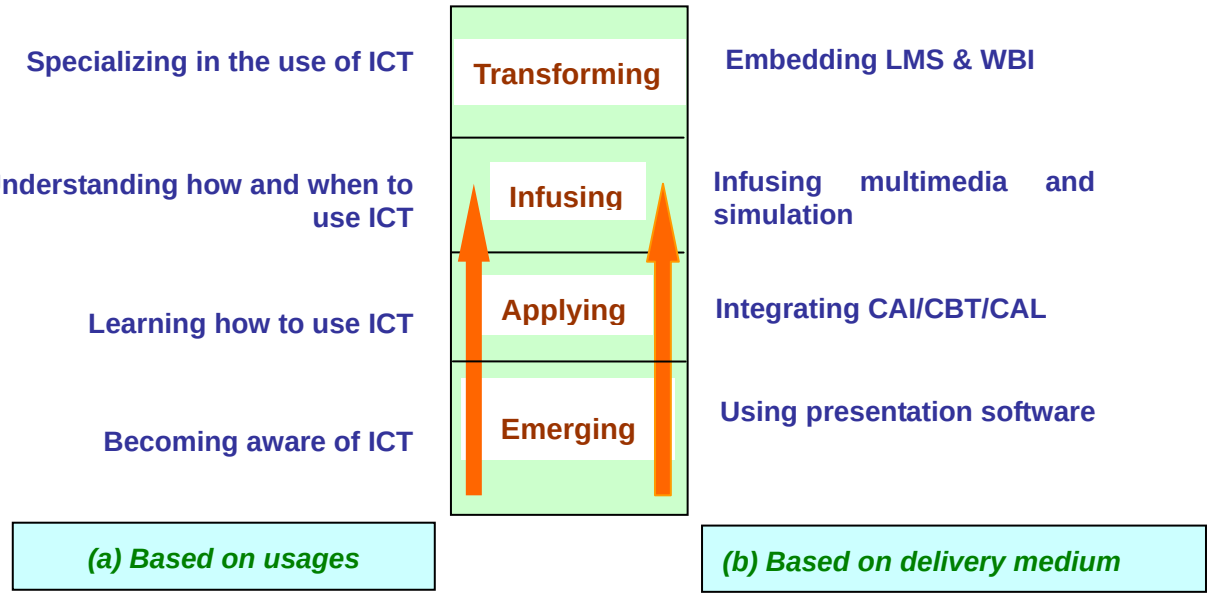

Figure 3.2: *Mapping the Model*

3.3.2 Based on ICT as delivery medium

Studies of teaching and learning in schools around the world identify four broad stages in the way the teachers and learners use ICT as a medium of teaching and learning. These four stages give rise to the mapping depicted in Figure 3.2(b) that have been broadly classified as presentation, computer assisted instruction, multimedia based instruction, and finally web based instruction, according to the stages of the proposed model. More than three decades ago, computers and related information technologies were introduced to educators for direct teaching and learning purposes. It started with presentation software to CAL/CBT/CAI, then moved to Multimedia courseware and finally to Learning Management System (LMS) and Web Based Instruction (WBI) [5].

1 Using presentation software

In the initial phase, teachers use presentation software to supplement classroom lecture by illustrating a concept, an idea or a complex diagram. In this initial stage, there is usually an emphasis on basic operations of presentation software. This stage of using presentation software as a medium of teaching and learning is linked with the *emerging stage* in ICT development.

2 Integrating CAI/CBT/CAL

Following on and from presentation 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 CAI/CBT/CAL [6] in the instructional process, and is linked with the *applying stage* in the ICT development model. Various self-paced instructional packages were developed to supplement classroom teaching and created a significant impact in the teaching and learning process.

3 Infusing multimedia and simulation

The next stage involves understanding of how to develop and use multimedia instructional software to achieve instructional goals. This stage implies the ability to recognize situations where multimedia and simulation 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.

4 Embedding learning management system & WBI

The fourth and last stage involves specializing in the use of LMS and WBI so that it occurs when one enters more deeply into the shared learning environment [7] that creates and transforms the learning situation. This is a completely new way of approaching teaching and learning using software. It helps to develop, deliver and manage flexible learning program. This stage is linked with the *transforming stage* in the ICT continuum model.

4 A CURRICULUM FRAMEWORK FOR INTEGRATING ICT AND PEDAGOGY IN TEACHER EDUCATION

4.1 USEFULNESS OF FRAMEWORKS

By teacher education is understood 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 beginning teachers and their continuing professional development in schools.

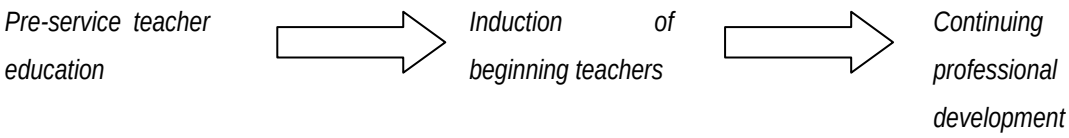

Figure 4.1: A continuum of professional development of teachers

Frameworks, like models, do not have the property of being true or false. Rather, they may be useful, more useful, or perhaps not at all useful, for particular purposes. The models presented in the previous section are useful, for example, in determining where schools 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 programs.

4.2 A CURRICULUM FRAMEWORK

A starting point for the curriculum framework presented here is contained in the UNESCO publication, A Planning Guide [2]. After modification in a workshop organized by UNESCO Bangkok [8], 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).

We now consider the different components of the framework in Fig. 4.2, taking first the contextual factors and next the teacher competencies.

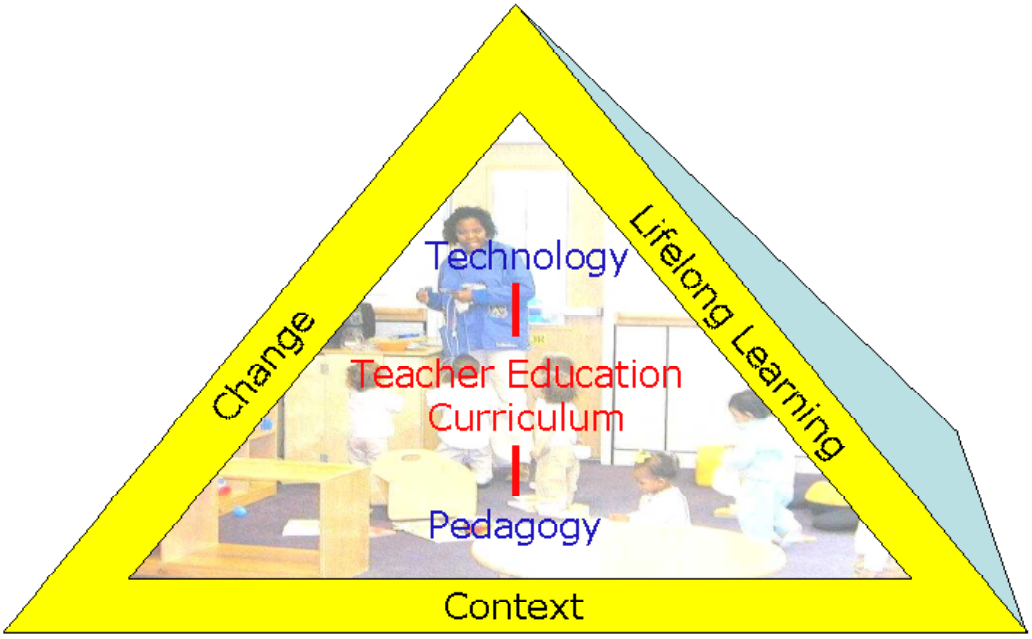

Figure 4.2: *A curriculum framework for integrating ICT and pedagogy in professional teacher education programs*

4.2.1 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.

1 Context

The most obvious contextual factor within which any teacher education curriculum is planned is context. Context has a spatial dimension by which is understood 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 considerations of whether particular software is appropriate or not.

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

2 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 these kinds of change that the Delors Report of the International Commission on Education for the Twenty-first Century [9] 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, A Planning Guide[2] identifies who are the key stakeholders in the different sections within which a teacher education program operates. These stakeholders include:

- the dean or professor with responsibility for teacher education
- the teaching staff in a program of teacher education
- senior administrators in the institution
- student teachers wishing to acquire ICT skills
- teachers and principals in schools who collaborate in organizing field experiences for teachers in training
- government agencies that set policies for teacher professional development, and
- business and industry, which have an interest in the overall quality of graduates.

All stakeholders need to share a common vision with respect to ICT; they also need to modify the curriculum in teacher education, which, in turn, requires a focus on making technology and sufficient resources available.

3 Lifelong learning

Lifelong learning, and indeed life-wide learning, are other contextual factors since it is now recognised that learning does not stop after formal education ends. Again, the Delors Report recognised 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 of such constant and rapid change that curriculum planners need to build into teacher education curriculum the capacity, motivation and skills for student teachers to continue their learning after graduating from the institution.

4.2.2 Teacher competencies

The inner core of the teacher education curriculum pyramid shown in Fig. 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 separately below, are not independent of each other in a curriculum where ICT is infused in pedagogical practice.

1 Pedagogy

A Planning Guide nominates pedagogy, along with content, as "the most important aspect of infusing technology in the curriculum"[2]. Infusion of ICT begins with teachers' mastery of the content of the subjects. As they begin to incorporate ICT in their teaching, they 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 Section 3. At first, teachers discover ICT tools such as, for example, presentation software. They then begin applying 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 they teach, they explore new ways of using ICT, and so their previous classroom delivery mechanism begins to change. In time, their classroom practice becomes transformed as the focus of the classroom becomes learner-centered 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 [10] has developed a strong pre-service teacher education programme that focuses on educational uses of ICT and meaningfully integrates theory, pedagogical practice, and technology. This integrated curriculum approach comprising these three components is illustrated in Table 4.1 where pedagogy is seen to occupy a central position facilitating convergence of theory and ICT tools.

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.

Table 4.1: Integration of theory, pedagogy and technology in the pre-service teacher education curriculum at East China Normal University, China

Theory (Lectures)	Pedagogy (Activities)	Technology (Tools)
• Learning theories	• Studying theories	• PowerPoint
• Media and instruction	• Searching for information	• Internet Explorer
• Learning resources	• Discussing pedagogical issues	• Search engines
• Instructional process	• Designing lesson plans	• E-mail
• Instructional design	• Creating e-works	• Bulletin boards
• ICT and instructional innovations	• Self/peer evaluation	• Chat rooms
• Evaluating technology	• Communicating/ publishing	• Word processing
		• Desktop publishing

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 classroom. 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. A 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. [2].

2 Technology

Advances in technology and the way technology is incorporated into a system constitute a dynamic process. Each school must 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 described in previous Section 3. The approaches are hierarchical with the emerging approach as a beginning point, and the transforming approach as a goal which many perceive as the future of education.

In the emerging approach, the focus is on the basic technical functions and uses of ICT. This approach 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, health, legal and ethical issues associated with the use of ICT about which teachers need to know. The facility, for instance, to access information easily from remote sources, download it to a personal computer, and then utilize 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 acknowledging electronic information. In the applying approach, teachers use ICT for professional purposes, focusing on improving the teaching of their subjects so as to enrich how they teach with a range of ICT tools. In the infusing approach, teachers infuse ICT in all aspects of their professional life to improve student learning and the management of learning processes. ICT enables teachers to become active and creative, able to stimulate and manage the learning of students, as they infuse a range of preferred learning styles and uses of ICT in achieving their educational goals. Teachers are required to master in authoring tools, animation tools and multimedia tools to develop instructional software in different subjects. The transforming approach is linked with schools that have used ICT creatively to rethink and renew school organization. ICT becomes an integral though invisible part of the 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 environment. Teachers need to master special software, learning management system and various web tools to apply innovatively to transform the teaching and learning system. Although the approaches above are not a necessary hierarchy, they are

intended to illustrate the steps towards growing ICT confidence and competence that many teachers go through, before they begin to transform their teaching practice and the learning of their students.

Allied to the contextual factors of change and lifelong learning, further technology competencies required of teachers are the constant need to update their skills with hardware and to familiarize themselves with new generations of software.

Technological competencies have an attitudinal dimension also for among desired ICT competencies for teachers are: a positive attitude toward ICT and a clear understanding of the education potential of ICT.

4.3 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. In this regard, it is useful to note the term curriculum as described in the UNESCO-IBE Training Guide for Curriculum Specialists, 2003 [11] which states that curriculum

- 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
- answers the why, what, when, where, how, and with whom the learning is to take place, and
- 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 member countries of the Asia-Pacific Region. In this way, all courses and subjects in teacher education/training programs 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 member 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 4.3.

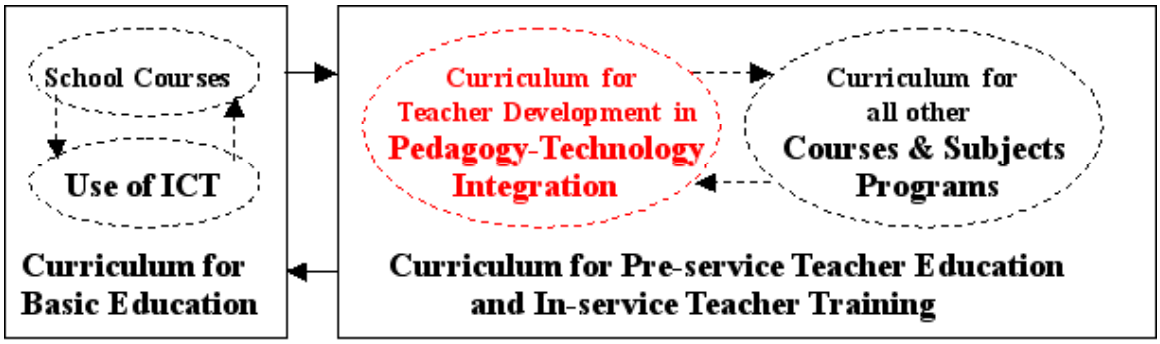

Figure 4.3: Close relationship of curriculum reforms in basic education and teacher education

A further application of the curriculum framework for teacher development developed here in this Section 4 is to serve as a structural foundation for formulating competency-based standards for teachers and other facilitators in pedagogy-technology integration.

5 COMPETENCY BASED STANDARDS

5.1 WHAT ARE COMPETENCY STANDARDS?

The curriculum framework presented above 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 Fig. 4.2 reinforces the key place of pedagogy in technology-pedagogy integration. This means that learning activities involving ICT should be embedded in a real-world context, and that students engage in such activities not only because these are required, but because these are intrinsically interesting. It also means that an infusion of ICT, like any good learning activity, should have clear and specific goals, and should encourage learners to collaborate with one another. The competency based standards we recommend for teachers, then, are not just about technology. They involve theories of learning, pedagogical skills of selection, presentation and assessment, and new ways of using ICT that help students think, understand, and learn.

In this regard, a competency based standard is simply a statement of what a person will be able to do after a period of training or instruction. As with curriculum frameworks, it is fortunate that we do not have to start from scratch in developing competency based standards to guide the implementation of ICT integration in teacher education programs. Among countries that have developed national or regional ICT standards are the United States, Canada, New Zealand, the United Kingdom, Australia and most recently, China, India and Japan. A number of other countries in the Asia-Pacific region make use of the International Computer Driving Licence (ICDL), originally developed in Europe.

Insofar as the development of competency standards normally follows a vision statement about the use of ICT

in education, it can be seen how standards relate quite closely to curriculum frameworks, since a vision is part of the perceived need for change recognized by governments and institutions (see the outer layer of the pyramid curriculum framework in Fig. 4.2).

Commonly, standards are developed first to describe what students should be able 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 should 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 generally or they may be stated quite specifically. UNESCO's publication [2] is a useful reference here. An example of a fairly general standard is:

- Learners should be able to use a word processor.

By contrast, a more specific standard is:

- Learner should be able to use a word processor skillfully and intelligently to produce various readable and structured documents.

5.2 HOW STANDARDS ARE RELATED TO THE CURRICULUM FORMAT

There is an important relationship between continuum model, curriculum framework 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-based 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 plan 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. It presents 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. Teacher competency based ICT 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.

From the ICT continuum model, depicted in Fig. 3.1, we can derive three competency levels viz., level-1, level-2 and level-3 capability, which reflect a teacher's continuous development based on a curriculum framework. Figure 5.1 shows how a good program of teacher development can help individual teachers move through the four stages of continuum model in ICT development.

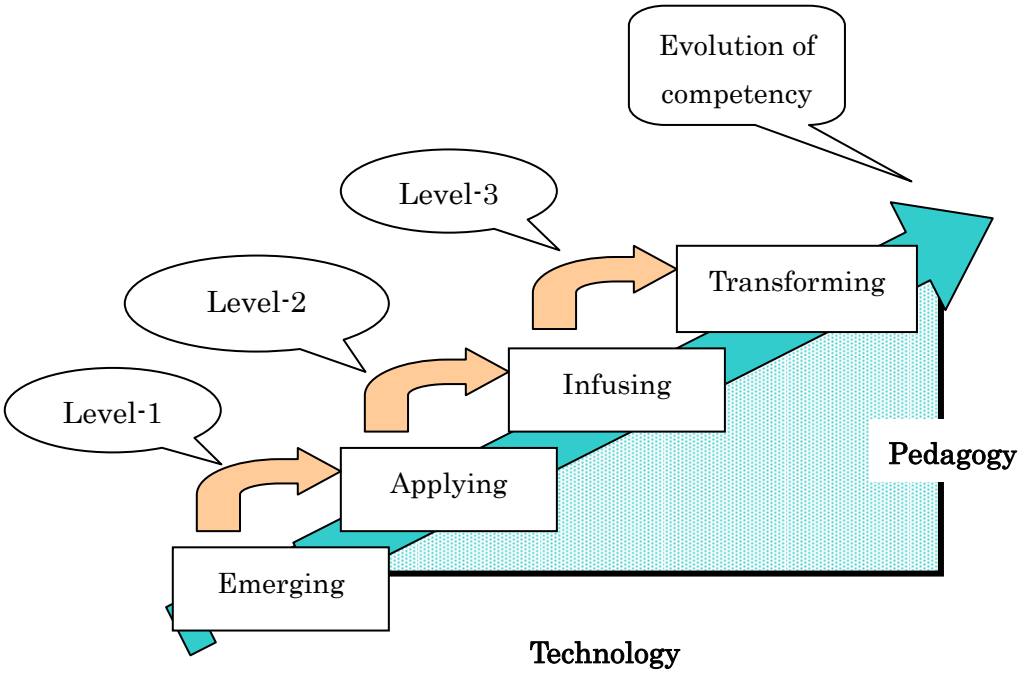

Figure 5.1: Points of support provided by teacher education to promote movement through the stages of ICT development

To be most effective, the ICT activities that a development program provides should deepen in complexity as a teacher's understanding and skills improve. The activities should be carefully designed to promote a teacher's movement into the next stage. Level-1 capability will cover movement from stage 1 to stage 2, level-2 capability will cover stage 2 to stage 3 and level-3 capability will cover from stage 3 to stage 4. Each capability characterizes the level of expertise that the teacher should have in pedagogy clusters, technology clusters and integration strategies. Figure 5.2 illustrates the systematic approach for understanding the components of each capability in an analytical framework. Based on this analytical framework, competency based standards can subsequently be developed.

For example, teachers who are in the *level-1* are first becoming aware of the potential to use ICT in teaching and learning. The development program might provide basic support through guidance by a mentor who will help them to use ICT within their subject areas in simple but important ways. This will encourage their move into the *level-2*, where they are ready to engage in more complex activities that promote deeper understanding. Here the development program might provide intermediate support through opportunities for discussion with colleagues doing similar work, or by providing collections of effective ICT infusions on a resource web site. This will encourage further growth into the *level-3*, when they begin to apply knowledge and skills from other subjects into project based curricula.

Teacher development is carefully constructed so that it is appropriate to a teacher's understanding and skills. This means that teachers will learn to use ICT always within their zone of proximal development [12], 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.

Levels of Competency	Broad Competency Clusters		
	Pedagogy Cluster	Technology Cluster	Integration Cluster
Level-1	Basic Pedagogical Capability	Basic Technological Capability	Basic Integration Capability
Level-2	Intermediate Pedagogical Capability	Intermediate Technological Capability	Intermediate Integration Capability
Level-3	Advanced Pedagogical Capability	Advanced Technological Capability	Advanced Integration Capability

Figure 5.2: Two dimensional framework for developing competency standards

5.3 AN ANALYTICAL FRAMEWORK OF COMPETENCY BASED STANDARDS

Based on the analytical framework described above, stages of competency levels are identified and clustered as level-1, level-2 and level-3 as shown in Table 5.1. This framework reflects teachers' continuous development, and assumes that from the earliest experience with ICT, teachers are working in an actual classroom context so that ICT is infused into teaching and learning. The terms level-1, level-2, and level-3 are used to characterize the level of expertise teachers have in pedagogy, technology skills, and integration strategies, and also to suggest the types of support which might be provided by those responsible for teacher education.

The major integration strategies for level-1 should broadly encompass the application of productivity tools in learning context such as word processor, spreadsheet, presentation and database software. Learning to use Internet and e-mail to communicate is also another aspect of the integration strategies of level-1. Knowledge of pedagogy/instructional science such as authentic learning, active learning, intentional learning and collaborative learning are required for effective integration of learning in context. Similarly in the level-2, the major integration strategies include development of multimedia based instructional software in different subjects/disciplines. These require expertise in multimedia tools and techniques such as authoring software, animation software, graphics tools and digital audio and video technology etc. Development of meaningful courseware depends on proper understanding of discovery learning, learner centered learning and different modes of courseware development. In level-3, the major integration strategy is to create and transform the learning situation by creative use of ICT. The major goal of this strategy is to manage online digital learning with meaningful learning

discourse. These require mastery in Web tools, special software and Learning Management System (LMS) software. Proper understanding of project based learning, case based learning and team-centered learning will facilitate successful implementation of learning management system.

Table 5.1: An analytical framework of competency based standards

Levels of Competency	ANALYTICAL FRAMEWORK		
	Major Pedagogy/ Instructional Science	Salient ICT Technology	Integration Strategies
Level-1	Design meaningful learning using the following attributes: - Authentic - Active - Intentional - Collaborative	Demonstrate expertise with productivity tools like: - Word Processor - Spread sheet - Database - Presentation - E-mail	Apply productivity tools in learning context and use e-mail to share and collaborate
Level-2	Develop courseware applying the following principles: -Discovery learning -Learner Centered learning -CAI/CBT/CAL modes	Demonstrate expertise with multimedia tools like: - Authoring Tool - Animation Tool -Graphics Tool - Audio & Video	Design of multimedia based instructional software in different subjects
Level-3	Incorporate insights from emerging trends in learning theory: - Project Based - Case Based - Learning team centered strategies	Demonstrate expertise with Web Tools, Learning Management Software and Specialized Software	Manage online collaborative learning, effectively support student-directed research and meaningful and innovative learning discourse

For example, teachers who are being introduced to e-mail and personal contact software might do so as part of normal classroom activities, using e-mail to correspond with students and colleagues, participate in an appropriate listserv, and build their own set of important personal contacts. They might learn about Internet Explorer by taking part in a threaded discussion group so that they can link to teachers in other settings to discuss reforms or to solve problems.

In both of these cases, teachers' abilities would be measured by competency standards similar to the examples

shown in Table 5.1 for level-1 of technology skills and level-1 of integration strategies. Later, as they become more skilled with ICT, they could manage a discussion group to support student collaboration and discourse, or use authoring tool to develop a resources for their students. The standards applicable to these activities are shown in the level-2 of technology skills. Still later, they might create more powerful ICT integrations, such as supporting student-directed research and guiding students in hypermedia and innovative learning discourses.

In the same way, teachers just beginning to develop their pedagogical skills will be measured by the standards represented by the level-1 of Pedagogy. They will 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 which they would be evaluated by the level-3 standards in pedagogy but the level-1 standards in technology skills and integration strategies. Again, the standards for integration strategies at all levels should 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 such careful support strategies are required? This is because teachers resist ICT innovations that do not match the context in which they work, and tend to integrate technology when it addresses real classroom problems, situations and learning goals. Teachers adapt change when they are able to set the goals, have opportunities to acquire the needed skills, and reflect on their learning. Just as teachers want to infuse ICT directly into student's academic lives so that student activities are authentic and meaningful from the earliest stages, their attitude towards training should also follow the same way: instead of presenting skills in a vacuum so that they have little meaning, teachers can develop even the simplest ICT skills in the midst of authentic teaching and learning activities so that they are seen as viable ways to solve existing professional and pedagogical problems.

5.4 AN EXAMPLE OF COMPETENCY STANDARDS

Based on the analytical framework described above, an example of competency statements is proposed below according to the different levels specified.

Sample Competency Standards for Level-1

- Demonstrate expertise in basic computer operation and utilizing computer peripherals
- Demonstrate expertise in productivity tools: word processor, spreadsheet, database, presentation and e-mail
- Apply productivity tools in learning context in authentic environment: using spreadsheet to create class lists for assessment or using presentation software for developing instructional lecture
- Differentiate functional differences of various digital and non-digital technologies to support teaching and learning

- Apply active, intentional and collaborative learning principles while designing learning and teaching materials
- Develop positive attitudes of utilizing ICT for learning
- Demonstrate knowledge and skills of using ICT in ethical, legal and environment friendly way
- Develop meaningful, enjoyable and self directed learning using ICT
- Use ICT to support learner centered strategies that address the diverse needs of learners

Sample Competency Standards for Level-2

- Demonstrate expertise in multimedia tools: authoring, animation, graphics, audio and video
- Apply discovery learning and learner centered paradigm in designing courseware
- Apply proper CAI modes like tutorials, drill and practice, simulation, games etc., in developing courseware
- Design proper human computer interface
- Create rich learning environment by integrating technologies in cross discipline
- Apply ICT in assessing, evaluating and generating items
- Apply ICT to develop learners' higher order thinking skills and creativity
- Design and plan strategies to manage student learning using ICT
- Design and develop multimedia based instructional software using learning principles
- Communicate, share and collaborate learning spaces with others
- Promote safe and healthy use of technology resources
- Facilitate equitable access to technology resources for all students
- Model and teach legal and ethical practices

Sample Competency Standards for Level-3

- Demonstrate expertise in web based learning management systems and tools
- Develop web based instructional software for collaborative learning
- Use ICT for project based, case based and learning team centered instructions models
- Manage effectively student directed learning discourses using ICT
- Explore global web resources and publish local knowledge
- Promote autonomous learning by sharing responsibilities with students using ICT
- Distinguish synchronous and asynchronous learning models in web application
- Be aware about copyright issues while using web resources created by others
- Manage learning process with ICT supported strategies: electronic portfolio, grading books, computer generated tests and learning style inventories

5.5 ASSESSING INFUSIONS OF TECHNOLOGY

Those responsible for teacher development may work with local teachers to create effective ICT infusions that are suitable to local contexts and specific curricula. Criteria like the one given below, refined to the local context and subject area, may be used: (1) to evaluate and improve infusions as they are designed and applied during teacher development, and (2) 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 enlisted in Table 5.2 below[13]. These criteria help teachers think about the value of a learning activity. It is not that all the criteria are equally important; however, when available information are all taken together, it will provide at least some idea about the degree or extent of ICT infusion. 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 the 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 expert at 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, 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?

Concluding Remarks

The ICT-Pedagogy Integration is right now one of the crucial issues in terms of ICT and education trends under the globalization and localization.

At the beginning of the JFIT-ICT in Education Programme started in 2001, UNESCO Bangkok designed and formulated 10 projects, and right now through the evaluation process organized by the Japanese Government and strongly continuous endeavor by the staff at UNESCO Bangkok collaborated with experts in the Asia and Pacific region, these ten projects have been merged into four newly expected projects in 2005.

The ICT-Pedagogy Integration under the teacher training has become a top priority, coping with the International and Regional trends in ICT and Education.

Several participating countries such as Mongolia, Malaysia, Vietnam, the Philippines, and Thailand have started to formulate experts groups for adaptation and implementation of this Regional Guideline to train teachers and facilitators in collaboration with regional centers like SEAMEO-INNOTECH and SEAMOLEC as well.

References

[1]Daniel, John. 2003. 'Using ICT for Quality Teaching, Learning and Effective Management', in UNESCO Bangkok, ed. *Report of the 7th UNESCO-APEID International Conference on Education*. Bangkok: UNESCO Bangkok.

[2]Resta, P. (Ed.). 2002. *Information and Communication Technologies in Teacher Education: A Planning Guide*. UNESCO, Paris.

[3]Cream, Wright, Cream (Ed). 2000. *Issues in Education and Technology: Policy Guidelines and Strategies*, London: Commonwealth Secretariat, 2000

[4]UNESCO. 2002. *Information and Communication Technology in Education: A Curriculum for Schools and Programme of Teacher Development* (Eds J. Anderson and T. van Weert). UNESCO, Paris.

[5]Majumdar, S. 2004. *Integrating ICT in Teaching & Learning: A Functional Approach* Presented at the UNESCO-APEID writing workshop for a Guideline and Competency Based Standards for Teachers' Pedagogy-Technology Integration, Hua Hin, Thailand. March 28-31.

[6] Alessi, S. M., and Trollip, S. R. 1985. *Computer-Based Instruction : Methods and Development,* Englewood Cliffs, NJ : Prentice-Hall.

[7]Wheeler, S. 2000. *The Role of the Teacher in the Use of ICT*. Keynote Address, National Czeeh Teachers Conference, University of Western Bohemia, Czeeh Republic.

[8]UNESCO, Bangkok. 2003. *Final report, Building Capacity of Teachers/ Facilitators in Technology-Pedagogy Integration for Improved Teaching and Learning,* Bangkok, Thailand. June 18-20.

[9]Delors, J. 1996. *Learning: The Treasure Within* (Report of the International Commission on Education for the Twenty-first Century). UNESCO, Paris.

[10]Zhu, Z. 2003. *Teacher Training in Technology-Pedagogy Integration: A Concept Paper from China.* Presentation to Experts Meeting on Teachers/Facilitators Training in Technology-Pedagogy Integration, Bangkok, Thailand. June 18-20.

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

[12]Vgotsky. L. 1978. *Mind in society: The development of higher mental processes*. Cambridge: Harvard University Press.

[13]Jonassen, D., Peck, K., and Wilson, B. 1999. *Learning with Technology.* Prentice Hall, Upper Saddle River, New Jersey.