

Emerging Trends in ICT for Education & Training

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1.0 Introduction

During the past few years, the world has witnessed a phenomenal growth in communication technology, computer network and information technology. Development of new broadband communication services and convergence of telecommunication with computers have created numerous possibilities to use a variety of new technology tools for teaching and learning system. The integration of computers and communications offers unprecedented opportunities to the education systems with its capacity to integrate, enhance and interact with each other over a wide geographic distance in a meaningful way to achieve the learning objectives. The growth of these communication and computer systems, their ease of use, the power and diversity of information transfer allow 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 order of the day in the ICT supported environment. ICT opens up opportunities for learning because it enables learners to access, extend, transform and share ideas and information in multi-modal communication styles and format. It helps the learner to share learning resources and spaces, promote learner centered and collaborative learning principles and enhance critical thinking, creative thinking and problem solving skills.

Not only mastering ICT skills, but also utilizing ICT to improve teaching and learning is of utmost importance for teachers in performing their role of creators of pedagogical environments. While literature provides some evidence of the effectiveness of using ICT in technical considerations, little is known about which learning strategies and pedagogical framework should be used for education and training. How to construct these electronic teaching and learning environments so that they are based on specific epistemologies or knowledge bases? What will be the new vision and guiding principles of teacher development for pedagogy-technology integration? As we become increasingly supported by ICT, teaching and learning will not be the same as before. We will have to make use of the rich and exciting opportunities offered by the new technologies in education to reach our new goal and vision. To appreciate the integration of ICT in teaching and learning, we need to understand the major paradigm shifts in education in recent years.

2.0 Paradigm Shifts

Education around the world is experiencing major paradigm shifts in educational practices of teaching and learning under the umbrella of ICT enabled learning environment. 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 perhaps more fitting for the present times. The major hallmark of this learning transition is from teacher centered to learner focus paradigm.

During the last three decades, the changes in educational environment have been phenomenal. The model, focus, role of the learner and technology has been changed drastically from traditional instruction to virtual learning environment as depicted below.

Changes in Teaching-Learning Environment			
MODEL	FOCUS	ROLE OF LEARNER	TECHNOLOGY
TRADITIONAL	TEACHERS	PASSIVE	CHALK & TALK
INFORMATION	LEARNERS	ACTIVE	PERSONAL COMPUTER
KNOWLEDGE	GROUP	ADAPTIVE	PC+ NETWORK

Shifting the emphasis from teaching to learning can create a more interactive and engaging learning environment for teachers and learners. This new environment also involves a change in roles of both teachers and learners. The role of the teachers will change from knowledge transmitter to that of facilitator, knowledge navigator and sometime as co-learner. The new role of teachers demands a new way of thinking and understanding of the new vision of learning process. Learners will have more responsibilities of their own learning as they seek out, find, synthesize, and share their knowledge with others [2]. ICT provides powerful tools to support the shift from teacher centred to learner centred paradigm and new roles of teacher, learner, curricula and new media. The major shifts have been described in a tabular form below.

Changes in Teachers' Roles	
From	To
Transmitter of Knowledge	Guide & Facilitator of Knowledge
Controller of Learning	Creator of Learning Environment
Always Expert	Collaborator & Co-learner
Learning to use ICT	Using ICT to Enhance Learning
Didactive/ Expository	Interactive/Experiential/Exploratory

Changes in Learners' Roles

From	To
Passive Learner	Active Learner
Reproducer of Knowledge	Producer of Knowledge
Dependent Learner	Autonomous Learner
Solitary Learner	Collaborative Learner
Solely Learning Content	Learning to Learn/Think/Create & Communicate

Changes in Curricula & Delivery

From	To
Memorizing Facts	Inquiry Based
Artificial Teaching Exercises	Authentic Learning
Rigid Delivery (Fixed Time & Space)	Open & Flexible Delivery (Any Time & Anywhere)
Single Path Progression	Multi Path Progression

Changes in Media Applications

From	To
Single Sense Stimulation	Multi Sensory Stimulation
Single Media Application	Multimedia Application
Delivery of Information	Exchange of Information
Monologue Communication	Dialogue & Collaborative
Analogue Resources	Digital Resources

All these changes taking place in learning and teaching demand a new learning environment to effectively harness the power of ICT to improve learning. ICT has the potential to transform the nature of education: where, when, how and the way learning takes place. It will facilitate the emergence of responsible knowledge society emphasizing life long learning with meaningful and enjoyable learning experiences.

3.0 Creating New Cultures

The integration of ICT into the very idea of teaching and learning always places pedagogy over technology. It is not the only concern to master ICT skills, but rather it involves using ICT to improve teaching and learning. The major emphasis of ICT infusion in pedagogy should be such that it tends to improve learning, motivate and engage learners, promote collaboration, foster enquiry and exploration, and create a new learner centered learning culture. It permits

the move from reproductive model of teaching and learning to an independent, autonomous learning model that promotes initiation, creativity and critical thinking with independent research. Learners are expected to collect, select, analyze, organize, extend, transform and present knowledge using ICT in authentic and active learning paradigm. Teachers are expected to create a new flexible and open learning environment with interactive, experiential and multimedia based delivery system. ICT should help teachers and learners to communicate and collaborate without boundaries, make learners autonomous and allow teachers to bring the whole world into classroom activities. It is ultimately important to understand the roles of ICT in promoting educational changes. A basic principle is that the use of ICT changes the distribution and ownership of information resources in the space of teaching and learning and thus changes the relationship among educational participants [3]. While designing any innovative teaching and learning environment using ICT, the teacher should always keep the learning at the center of all activities, pedagogy should be at the heart and integration of pedagogy-technology should be the central focus.

4.0 Pedagogical Practices using ICT

Mere learning ICT skills is not suffice, but using ICT to improve the teaching and learning is the key for pedagogy-technology integration. But the question is how we can combine these two.

Consider a scenario of a young teacher who has just started to use ICT for his daily classroom activities of teaching and learning. To start with he or she needs to prepare lesson plans and compile lesson materials for the classroom lecture. To prepare such materials one has to go through the act of drafting phase, editing phase, revising phase and finally publishing the lesson plans and course contents. Word processor can be a great help to accomplish this task in a professional and productive way to avoid repetition, duplication of manual work and concentrate on quality of the course materials.

The teachers also need to make lists of the name of the students for monitoring and recording their academic performance and to analyze and perform a statistical analysis to take some corrective measure if any, in the lesson plan, delivery of instruction. Spreadsheets can be a good choice for creating class lists, recording their performance and executing statistical analysis upon them.

While delivering the class lectures, any innovative teacher needs to draw diagrams, show pictures, animate some objects to explain critical concepts, even play some video clipping of real time operation. All these multimedia applications can assure very productive, interesting, motivating, interactive and quality delivery of classroom instruction. Presentation software like power point can be a good choice for teachers for performing such tasks.

In spite of the best efforts of teachers there will be a number of learners who will not be satisfied with the pace of instruction of the teachers. There may be a fast learner, average learner and slow learner. In a classroom environment it is impossible to satisfy all categories of learners with their specific learning styles. It is in these situations, teachers become helpless in a conventional teaching and learning environment. One way to solve such situations is to create interactive multimedia based instructional materials where learner is given control to review the topic at their own pace and in accordance to their individual interests, needs and cognitive processes. As such, multimedia courseware can be of great help to teachers to meet the challenges of such situation. With availability of user friendly authoring tools, it is now possible to develop multimedia courseware by any young teachers to support drill and practice to master basic skills, simulate complicated situations, produce individualized instruction with multimedia elements with built-in evaluation questions and scores. Such multimedia courseware can produce profound changes in the learning outcomes when it is being used along with face-to-face instruction.

Learners always look for flexibility in time, space, place, content selection and delivery of instructions. It was quite impossible to satisfy such requirements in earlier times due to the non-availability of proper tools. It is now feasible and possible to implement open & flexible learning strategies using ICT as tools. Flexible access to content and learning resources via network across conventional class rooms, homes and community centers is the defining characteristic of what has come to be known also as distributed learning. Learning any time, anywhere with synchronous and asynchronous communication across space, time and pace is the key to web based instruction. With the availability of online tools, it is now possible to create content websites, online education to support and assist face to face instruction in an innovative way. Communication with e-mail, searching for information, locating a proper website is now the key to success. Developing online and offline learning resources using various learning management system software/tools will become one of the key competencies of modern day teachers. Searching, locating and categorizing knowledge and information via internet has open a new vistas in implementation of flexible learning strategies.

As such starting from the productivity software to specialized educational software, there are numerous examples of various applications of the ICT tools in the teaching and learning system. Therefore, preparation of teachers to face the challenges of an ICT enriched teaching and learning environment is crucial. First teachers need to be equipped with the fundamentals of ICT tools and sufficient understanding on the integration of these tools in teaching and learning and secondly efforts must be oriented towards changing mind set and developing positive attitudes towards ICT application in teaching and learning. Understanding the changing role of teachers from instructor to facilitators, teacher lead instruction to learner-centered instruction is the key for successful implementation of pedagogy-technology integration for teacher development.

In designing learning materials using ICT productivity tools certain pedagogical principles need to be considered carefully. Mere ICT tools by themselves do not make good pedagogy. The moot question is how should the learning environment be designed using ICT as tools? What pedagogical principles would take the advantages of the best practices and unique environment afforded by this new ICT tools. These were the central questions which needed to be addressed. The use of ICT should satisfy the diverse needs of all kinds of learners characterized by all kinds of socio-cultural conditions including the diversity of multiple intelligences. Teachers should continue to learn through their lives new ways of using technology for the growth of their learners as well as the very systems of education. The critical question in education is- in what ways ICT can enhance learning and teaching practices. Broadly ICT tools help to open up opportunities for learning by enabling four major key processes in transforming teaching and learning as follows:

Access ideas and information from diverse sources through searching, locating, selecting, and authenticating material in a wide range of multimedia forms;

Extend ideas and information through processing, manipulating, analyzing & publishing material in different multimedia forms;

Transform ideas and information into new or different forms through synthesizing, modeling, simulating and creating material in many multimedia styles and formats; and

Share ideas and information across local, national and international networks by interacting electronically with others in actual and/or delayed time.

Access, extend, transform and share represent key processes by which students learn and become independent learners and self-starters. Through the processes learners express their creativity and imagination. These processes can be applied in all areas of learning and in all levels of education. There are three broad categories of educational software namely, **Generic tools for learning, Content-based resources and Interactive instructional courseware**. Starting from productivity tools to simulation & modeling, there are various generic tools that help learners to access, extend, transform and share information. Content-based resources help learners to access a vast source of educational resources that effectively can be integrated with the curriculum objectives. Interactive instructional coursewares are basically self-paced learning materials. These programs are helpful to learners to control their learning at their own place and convenience.

The integration of ICT with teaching and learning has produced some of the significant positive gains in learners' knowledge, skills and attitudes by providing the following key advantages:

- Explore and represent information dynamically and in many forms
- Become socially aware and more confident
- Increase motivation
- Communicate effectively about complex processes
- Develop better understanding and broader view of processes and systems
- Greater problem solving and critical thinking skills.

5.0 A Few Emerging Topics In ICT Integration

5.1 Multimedia

The pedagogical strength of instructional multimedia is that it uses the natural information processing abilities that we already possess as humans. Our ear and eyes, in conjunction with our brain, form a formidable system for transforming meaningless sense data into information. The old saying that "a picture is worth a thousand words" often understates the case especially with regard to moving images, as our eyes are highly adapted by evolution to detecting and interpreting movement. The major challenge in designing instruction through multimedia is, therefore, the choice of media and their application for optimising human learning with respect to the learning objectives. Multimedia courseware development process [4] is the systematic approach to the analysis, design, development, implementation and evaluation of learning materials. Instructional design aims for a learner-centered rather than the traditional teacher-centered approach to instruction, so that effective learning can take place. There appears to be an increasing realization by teaching faculty that in particular situation, multimedia courseware can offer a pedagogical improvement on traditional teaching methods by providing the learners with following advantages:

- Exercise more effectively & efficient control over their own learning
- Secure real time assessment & feedback
- Secure more information on their own learning
- Obtain situational appropriate learning assistance
- Obtain more individualized learning assistance

5.2 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.

5.3 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.

5.4 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 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, finally, 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 simulation, 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].

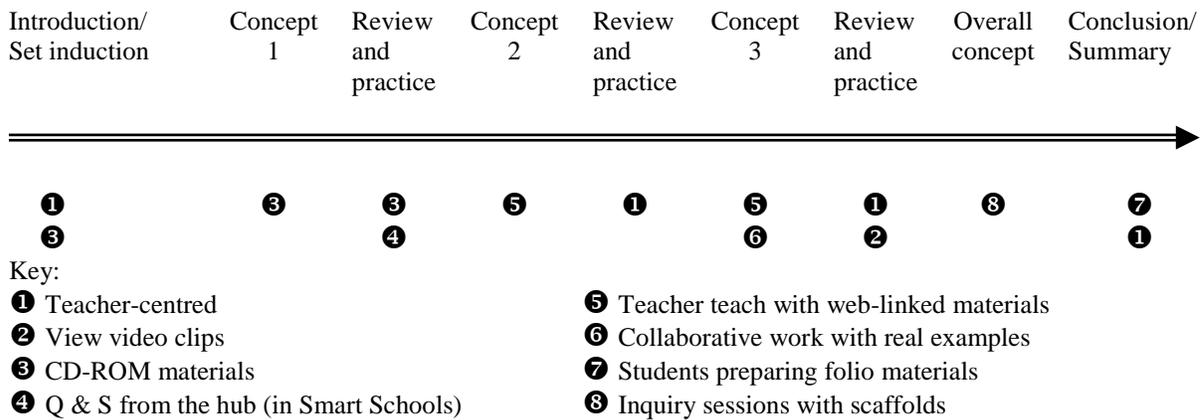


Figure1: Pedagogy with ICT integration

Figure1: illustrates a higher degree of embedding ICT in teaching learning process. Such an ICT-enabled environment creates a good integrated teaching and learning with ICT that fulfils good pedagogic principles as described above.

It has been observed [2,10] 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 purposefully seeking and contributing collaborative knowledge within a meaningful context. ICT offers various tools to implement above theories to create rich and engaging learning environments.

6.0 Stages of Web Development Continuum in Teaching & Learning System

A framework [11] of use of the Web has been suggested as continuum approaches. These levels represent continuum from basic occasional use to advanced continual use. They are: (1) informational, (2) supplementary, (3) complimentary (4) hybrid and (5) total.

Level 1: Information Web Use

The informational level of Web use is the most common and easiest to manage. Informational Web use consists solely of providing relatively stable information to the student. Typically, this information is administrative in nature and may not convey course content directly. Students may access this information from time to time during the course for reference purposes, but they would not be expected to review it on a frequent basis.

Level 2: Supplementary Web Use

The supplemental level of Web use is becoming more common, is more useful than the informational level and is only slightly more difficult to manage than the information level. The key difference between Level Two and Level One is that the supplemental level actually provides course content information for the learner. As the name suggests, however, this information is not critical to the course; it is intended as an addendum to the core content. Level Two consists of the instructor placing course notes and other handouts on the Web.

Level 3: Complimentary Web Use

Essential refers to the fact that the student cannot be a productive member of the class without regular Web access. The essential level of Web use is still fairly uncommon today. At this level, the student obtains most, if not all, of the course content information from the Web. At this level, one might think, for lack of a better example, of the Web replacing textbook in the course

Level 4: Hybrid Web Use

The communal level of Web-based instruction is only just beginning to receive widespread use. At this level, classes meet face-to-face and online. Course content may be provided in an online environment or in a traditional classroom. Ideally, students generate much of the course contents themselves. This level goes beyond basic HTML and requires the use of other online tools, such as Internet chat, bulletin boards and perhaps one- and two-way desktop video.

Level 5: Total Web Use

At this level all of the course content and course interactions occur online., this level should be seen as a sophisticated, constructivist virtual learning community. While it may include some degree of traditional content presentation, student practice, feedback and assessment practices found in traditional distance instruction, it is often comprised of learner-centered, constructivist pedagogues. At this level, both instructor and students must have a high level of technical expertise and sophisticated learning strategies.

7.0 Conclusion

As we become increasingly supported by ICT, teaching and learning will not be the same as before. We will have to make use of the rich and exciting opportunities offered by the new technologies in education to reach our training goal and mission. One of the objectives of the present paper is to provide better understanding and appreciation of the role of ICT in teaching and learning system. Several view points of integrating ICT in teaching and learning system has been discussed. Learning is not a transfer of knowledge, rather an active

construction. This paradigm shifts give the learners a completely new role that was not earlier described in the transmission model of teaching. Technology and teacher professional development in its use are best introduced in the context of broader educational reform which embraces a shift away from teacher-centred, lecture oriented towards learner centred, interactive and constructive learning environment. Multimedia and ICT can play the role of catalyst for such educational reforms. Multimedia courseware can promote effective instruction that is more engaging; learner centred, interdisciplinary and more closely related to real life events and processes and adaptive to individual learning styles and needs. It also encourages higher order thinking skills and help to construct knowledge socially. Thus teacher professional development in the use of interactive technology should embody and model the forms of pedagogy that teacher can use themselves in their classroom.

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