

Integration of ICT in Education: Pedagogical Issues

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Abstract

The progress of any country depends upon the quality of education offered and its practices. Indian education was well known for its Gurukul system of education in the Vedic age. Education in India has undergone various phases and stages of development starting in the Vedic age to the post-independent period. At all stages of development there was a concern for bringing in quality education reflecting on the practical aspects in education.

The great Indian thinkers had emphasized on developing the inner potential of individuals by reflecting on unique potential of individuals. Getting educated is solely dependent upon the individual teacher's role to set conditions and generate environments for learning. The recent curriculum framework 2005 as proposed by NCERT (National Council of Educational Research and Training), India focuses on the issues of;

- ▶ Connecting knowledge to life outside
- ▶ Shifting from rote learning to constructing knowledge
- ▶ Providing a wide range experiences for the overall development of a child
- ▶ Bringing flexibility in the examinations

The recent developments in technology have changed the world outside the classroom; it is more eye-catching and interesting for a student than the classroom setting. As a result, students find classroom instructions as dull and devoid of life and do not interest them for learning. The information technology has made learner WWW-afflicted. This is because technological developments have brought developments in two ways: First, by enhancing human capabilities by helping people to participate actively in social,

economic, and political life in a society at large. Second, by giving advantage to technological innovation as a means for human development due to economic progress and increased productivity. The power of information is such that almost all decisions made in different sectors like science, technology, economics, and business development will be based on information that has been generated electronically. Information has become a key asset of the organization for its progress. Therefore, access to information is a key factor in the generation of wealth and there is a strong link between a nation's level of development and its level of technological development. Educators and policymakers believe that information and communication technologies are of supreme importance to the future of education and, in turn, for the country at large. As ICT is becoming an integral element for educational reforms and innovations at secondary schools, this situation calls for an enhancement of pre-service education on ICT for prospective teachers.

There is a growing importance for ICT within the school curriculum. Not only it is used to support teaching and learning within other curriculum subjects, but it is also a subject in its own right as a separate discipline. The major objective is that developing skills, knowledge, and understanding in the use of ICT prepares pupils to use such technologies in their everyday lives. ICT tools enable pupils to access, share, analyze, and present information gained from a variety of sources and in many different ways. The use of ICT provides opportunities for pupils to work both collaboratively and independently. As such, the role of ICT within the curriculum is not only to enhance the learning experiences of pupils but also to help them develop the skills essential to participate effectively in the world of affairs. It generates avenues for working in groups developing team spirit, cohesion, and social values.

Here, a teacher plays a pivotal role in the process of teaching learning. Hence, knowledge of ICT and skills to use ICT in teaching/learning has gained enormous importance for today's teachers. Teachers are expected to know to successfully integrate ICT into his/her subject areas to make learning more meaningful. This knowledge development during pre-service training has gained much importance with the notion that exposure to ICT during this time is helpful in increasing student teachers' willingness to integrate

technology with classroom teaching. This paper focuses on issues relating to ICT in education as a core component in pre-service teacher education and the different models to be adopted for its integration.

Review of studies conducted in the area of attitude, anxiety, and efficacy of teachers and development of computer skills

Pre-service teachers need to plan to use computers in their classrooms. Vision is needed to motivate and direct their teaching and learning with the help of technology and using related instructional methods. There are various strategies used to make teachers understand and implement the integration of ICT in various curricula. They should serve as a basis for understanding computer operations and programming along with assisting pre-service teachers to learn computer concepts in developing a vision, value, and use of computers in learning. Many studies have been conducted on teachers' attitude and their use of ICT skills. It has been found that teachers' attitudes play an important role in the teaching learning process.

It has generally been found that pre-service teachers have demonstrated their ability for integrating technology into their teaching, but do not have clarity about how far technology can be beneficial for students. They will probably avoid teaching with technology once the requirement for the demonstration lesson is over. Hence, a negative attitude about teaching with and about technology in a subject matter area could work against well-planned instruction in teacher preparation programs. While, on the other hand, those teacher candidates who believe in the potential and utility of technology in the classroom and continue facing many challenges become the models for student teachers to emulate. Many studies have been conducted with regard to the attitude of teachers towards use and interations of technology have revealed the importance of attitudes for learning to use technologies (Cox, Rhodes & Hall, 1988; Davidson & Ritchie, 1994; Hannaford, 1988; Kay, 1990). These findings were further supported by Bandalos & Benson, 1990; Dupagne & Krendl, 1992; Francis-Pelton & Pelton, 1996; Loyd & Gressard, 1984a; Mowrer-Popiel, Pollard, & Pollard, 1994; Office of Technology Assessment, 1995.) Several studies have found that individuals' attitudes toward computers may improve as a result of well-planned instruction (Kluever, Lam,

Hoffman, Green & Swearingen, 1994; Madsen & Sebastiani, 1987; Woodrow, 1992). Like other individual characteristics that are hypothesized to play a role in the continued growth of technology proficiency, attitudes and beliefs can't be easily taught and must be developed by an individual over a period of time.

Another factor that is noted to have a profound effect on the student teacher's learning technology and its integration is computer anxiety. Computer anxiety, as defined by Rohmer and Simonson (1981), is "the mixture of fear, apprehension, and hope that people feel while planning to interact or while actually interacting with a computer" (p. 151). Research has shown that there is often a negative relationship between the amount of prior computing experience and the level of computer anxiety exhibited by individuals. Reed and Overbought (1993) and Hackney (1994) found significantly reduced levels of computer anxiety following instruction whereas Chu and Spires (1991) observed a significant reduction in computer anxiety for only the most anxious quartile of subjects. McKiernan et al. (1994) reported that some students experienced reduced levels of computer anxiety at the end of a computer training class while other students experienced continuing anxiety. The level of anxiety could be reduced with increased experience in using and working with computers and thereby succeeding in reaching goals.

Over and above the attitude of teachers, self-efficacy is also an important aspect to consider. Researchers have indicated that although teachers may have positive attitudes toward technology (Duane & Kernel, 1992; Office of Technology Assessment, 1995), they may still not consider themselves qualified to teach with it or comfortable using it. If teachers are to integrate technology into their teaching, they must feel self-efficacious about using it (Decorum & Kingie, 1993; Remer et. al., 1993; Office of Technology Assessment, 1995). Bandera (1986) defined perceived self-efficacy as "people's judgments of their capabilities to organize and execute courses of action required to attain designated types of performances. It is concerned not with the skills one has but with the judgments of what one can do with whatever skills one possesses" (p. 391). According to Bandura (1982), people acquire information about efficacy from four sources: performance attainments, vicarious experiences of observing the performances of others,

verbal persuasion, and physiological states from which people partly judge their capability, strength, and vulnerability (p. 126). This information would help an individual assess his/her performance and then generate self-appraisals of his/her ability. When the concept of computer-efficacy is applied to the domain of learning to use computers in teaching, hands-on computer experience becomes an important component in effective instruction at the pre-service level.

Research has shown a high correlation between efficacy judgments and subsequent performance (Bandura & Adams, 1977; Bandura, Adams & Beyer, 1977; Schunk, 1981). This particular link between self-efficacy and subsequent actions is significant in developing an idea for a teacher who continues to learn to teach with technology apart from instruction in teacher preparation (Ashton, 1985). Self-efficacy was originally conceived as having a high domain-specific component rather than one with high generalizability (Lennings, 1994), and this has led to recent research interest in the area of computer self-efficacy (Delcourt & Kinzie, 1993; Ertmer, Evenbeck, Cennamo, & Lehman, 1994). Computer self-efficacy represents the essential elements of self-efficacy as applied to the domain of computer learning. Several studies have found the positive effects of instruction on computer self-efficacy (Ertmer, Evenbeck, Cennamo & Lehman, 1994; Gist, Schwoerer & Rosen, 1989; Russon, Josefowitz & Edmonds, 1994; Torkzdeh & Koufteros, 1994).

There is little doubt that today's prospective teachers will be expected to teach with technology in the classrooms of tomorrow. However, the resources available to teachers in terms of hardware, software, networking, and professional development vary greatly at the school level. Hence, it is imperative that teachers become directors of their own learning with regard to using information technologies in the classroom. Through learning to teach with technology, teacher preparation programs have a unique place at the beginning of this challenging process. The development of a pedagogically-based framework of constructs that are related to learning to use computers and an approach for its application in teacher preparation shows promise for meeting these challenges as discussed above.

Another challenge for pre-service education is finding classrooms where pre-service teachers could observe teacher educators using technology appropriately and to understand where and how to include technology in their lessons. The computer has moved from an object to be studied to a teaching and learning tool for teachers and students. Hence, teacher preparation programs could no longer rely on an introductory course. We can't just bolt on the technology in teacher education curriculum; we need to take proactive steps for its integration in teaching learning. Teacher education and technological competence should involve all aspects of the preparation of teachers, i.e., introductory competencies, use of technology in methods classes, school placements, and student teaching. Pre-service teachers need to develop a vision from the very beginning of their careers for using computers in their classrooms. For this, student teachers must understand computer operations and programming--leading them to develop a vision of the value and use of computers in learning.

Therefore, it is crucial that teacher preparation programs should develop the cognitive, social, and physical environments that will help teachers feel efficacious and in control of learning to teach with technology, a domain that is often overwhelming even for experienced teachers.

Another challenge of preparing teachers to teach with technology is that as a result of knowledge generation, our knowledge about computer technology is constantly changing. In addition to this factor, there are various other dimensions like attitude, motivation, computer anxiety, and computer self-efficacy which play an important role in developing skills and competencies among prospective teachers.

Pedagogy is primarily associated with formal school education. There are significant differences between the two concepts of pedagogy and "webogogy", especially in terms of independence/dependence of the learners, resources for learning, motivation, and the role of the teacher. The context of learning is significant because learning is contextually and situationally specific. The teacher's role in web-based teaching has already been identified as being very different from the teacher's role in formal education, with terms like facilitator referring to the person who is on-line and interacting with students in various ways. It may be the same person who produces the course materials. Also, the on-

line teacher will need to arrange a range of activities in which he or she will engage students, and a range of roles that he or she will fulfill. In web-based teaching, the teacher would be engaged in preparation and organization of instructional materials based on the same kind of assumptions about learners that are held by textbook authors.

The Internet provides a wide range of scope for integrating varied learning experiences and making learning holistic. All of the resources developed by an individual teacher could be shared in a web forum for further refining the lesson plans.

The various skills and competencies to be developed on the part of student teachers would be:

- Surfing the Internet and locating useful information from the Internet for the development of lesson plans.
- Developing lessons plans incorporating student use of technology in the learning process.
- Evaluating and selecting appropriate software for a particular subject and per student needs.
- Generating printed documents like student assignments, newsletters, communication, etc. utilizing a variety of applications software like word processing and desktop publishing.
- Managing student data ; using data management tools for efficiently managing learning.
- Using technology to gather, organize, and report information about student performance like Excel and Access for database management.
- Developing tools to evaluate technology-based student projects including multi-media, word processing, database, spreadsheet, PowerPoint, desktop publishing, and Internet/telecommunications.

- Using the Internet to support professional development including locating professional organizations, communicating with other teachers electronically, and participating in on-line professional development workshops and seminars.
- Developing assignments and project work for students; giving them broader and deeper knowledge in a field of study; developing critical thinking and infusing creativity among students.

Computer Education at The Secondary Level

Recognizing the growing importance of ICT in the education area, policy makers in the school education sector have taken proper care to integrate computer education at the school level. The Curriculum Guide and Syllabus for Information Technology in Schools developed by NCERT, India, has the following objectives for the secondary school level:

1. Selecting appropriate IT devices for a given task; making his/her own informed choice of browser and search engines; trouble-shooting for peripherals.
- 2. Identifying specific strengths and weaknesses of technology resources; demonstrating legal and ethical behavior regarding the use of technology and information.**
3. Communicating to a variety of audiences using IT tools; using a variety of technology tools for data collection and analysis; using tools to present and publish information with interactive multi media features; using tools to make models and simulations; manipulating images.
4. Using on-line information resources for collaboration and communication; collaborating with others to build content-related knowledge bases.
5. Developing strategies to find relevant and appropriate electronic information sources.
6. Investigating technology-based options for lifelong learning; using productivity tools, communication tools and research skills.

IT competency standards at the end of Class X to be developed in students are:

- Ability in and understanding of fundamental computer operations and concepts.
- Using a variety of programs to accomplish learning tasks.
- Exhibiting skills in the use of communication networks.
- Exhibiting skills in the selection and use of technology to gather, process, and analyze data and preparation of reports.

The expectations from the school sector in terms of established student objectives and expected skills to be developed demonstrate the need to develop necessary knowledge and skills among teachers with positive attitudes and the right inclination.

Techno-Pedagogy a Skill

The aim of teacher education is to develop skills and appropriate knowledge among teacher trainees for using and integrating the correct technology in an appropriate manner. Every teacher should know how to use technology, pedagogy and subject area content effectively in their daily classroom teaching. It is clear that merely introducing technology to the educational process is not enough. One must ensure technological integration since technology by itself will not lead to change. Rather, it is the way in which teachers integrate technology that has the potential to bring change in the education process. Hence, attitude and self-efficacy towards technology play an important role. For teachers to become fluent in the usage of educational technology means going beyond mere competence with the latest tools to developing an understanding of the complex web of relationships among users, technologies, practices, and tools. Teachers must understand their role in technologically-oriented classrooms. Thus, knowledge about technology is important in itself, but not as a separate and unrelated body of knowledge divorced from the context of teaching--it is not only about what technology can do, but perhaps what technology can do for them as teachers.

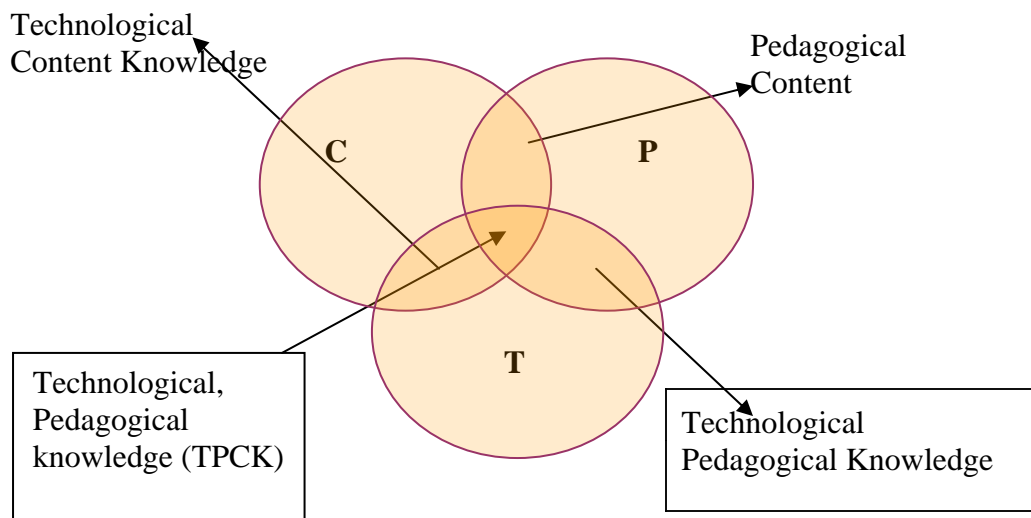
In techno-pedagogy, there are three areas of knowledge, namely: content, pedagogy, and technology.

Content (C) is the subject matter that is to be taught.

Technology (T) encompasses modern technologies such as computer, Internet, digital video and commonplace technologies including overhead projectors, blackboards, and books.

Pedagogy (P) describes the collected practices, processes, strategies, procedures, and methods of teaching and learning. It also includes knowledge about the aims of instruction, assessment, and student learning.

Speaking truthfully, technology integration entails the understanding and negotiating of the relationships among the aforementioned three components. Good teaching is not simply adding technology to the existing teaching and content domain. Rather, the introduction of technology causes the representation of new concepts and requires developing sensitivity to the dynamic, transactional relationship between all three components suggested by the TPCK framework. (Koehler, M. J. and Mishap, P. 2005)



Depending upon the nature of content, scope of content, and level of students, appropriate technology integration must be sought. Technology as an aid enhances the process of learning and helps in achieving higher level objectives.

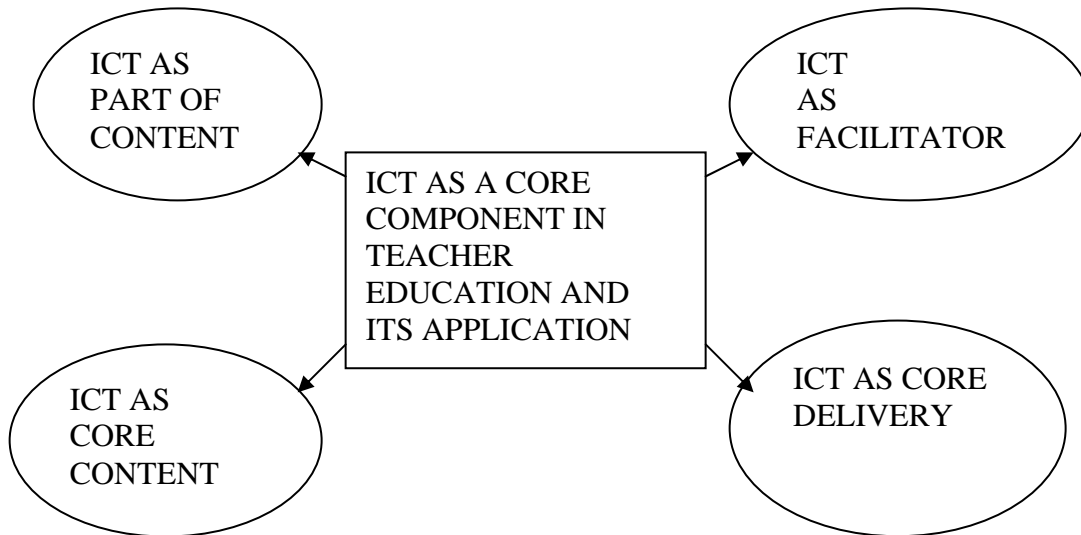
Approaches to ICT integration in Teacher Education

Use of ICT within teacher training programs around the world is being approached in a number of different ways with varying degrees of success. These approaches were subsequently described, refined and merged into following approaches:

1. *ICT skills development approach*: Here importance is given to providing training in use of ICT in general. Student teachers are expected to be skilled users of ICT for their daily activities. Knowledge about various software, hardware and their use in educational process is provided.
2. *ICT pedagogy approach*: Emphasis is on integrating ICT skills in a respective subject. Drawing on the principles of constructivism, pre-service teachers design lessons and activities that center on the use of ICT tools that will foster the attainment of learning outcomes. This approach is useful to the extent that the skills enhance ICT literacy skills and the underlying pedagogy allows students to further develop and maintain these skills in the context of designing classroom-based resources.
3. *Subject-specific approach*: Here ICT is embedded into one's own subject area. By this method, teachers/subject experts are not only exposing students to new and innovative ways of learning but are providing them with a practical understanding of what learning and teaching with ICT looks and feels like. In this way, ICT is not an 'add on' but an integral tool that is accessed by teachers and students across a wide range of the curricula.
4. *Practice driven approach*: Here emphasis is on providing exposure to the use of ICT in practical aspects of teacher training. Focus is on developing lessons and assignments. Using ICT and implementing it in their work experience at various levels provides students an opportunity to assess the facilities available at their school and effectively use their own skills.

Thus, ICT in teacher training can take many forms. Teachers can be trained to learn how to use ICT tools. ICT can be used as a core or a complementary means to the teacher

training process (Collis & Jung, 2003). The various ways in which ICT teacher training efforts could be classified into four categories are shown below in Figure 1.



From the above suggested approaches, regarding ICT as a core component at the pre-service level, integration of all approaches would help in developing proper attributes among prospective teachers. There should be joint efforts of educators and prospective teachers in implementing and sharpening ICT skills. Whatever approach is followed in educational institutions to develop knowledge about ICT, it has inherent limitations. Coupled with other reasons, we are not making student teachers fully confident in using ICT in their daily classroom activities. As reported by Larose F. in their study, the level of computer literacy of the teaching staff is satisfactory but there is little transfer of these competencies to teaching practices (Larose F., et al. 1999). **Efforts are required on the part of teachers to make use of the available facilities for the best use in teaching /learning.**

ICT in Education Course Scenario at the Pre-Service Level

The syllabi for ICT in education courses offered by some of the universities in India were analyzed in terms of the objective of the course, weight given to theory and practice, and other syllabus components. **The Curriculum Guide and Syllabus for Information Technology in Schools developed by NCERT, India, has the following expectations**

about basic competencies of teachers to achieve the objectives of ICT education at the secondary level:

- **Understanding the role of technology in change and the implications of technology-mediated changes for education.**
- Creating interest in learning among students through unique utilities like animation, simulation, the Internet, etc.
- Demonstrating a sound understanding of basic IT concepts and operations.
- Planning and designing effective learning environments with necessary technology support.
- Making the best use of technology-enhanced lessons to enrich student learning.
- Adopting assessment strategies to evaluate (a) student competencies in IT skills and (b) student learning in the new environment.
- Using technology to enhance our own creativity and professional practices.
- Demonstrating understanding of social, ethical, legal, and human issues surrounding the use of technology in schools.
- Fashioning a climate of values that encourage questioning, exploration, problem-solving, decision-making, and group co-operation.
- Striving for education to emerge from its disciplinary narrowness.
- Identifying useful learning material from various sources.

The teacher has to take an active part in developing his own checklist for evaluation of learning materials and use it in the context of (a) the learner profile, (b) the learning environment, and (c) the technical strength of the computer laboratory of the school. Moreover, the tasks of the teacher are:

1. Design one's own checklist.
2. Review software to be procured or on the World Wide Web
3. Report his/her assessment of courseware to the principal so a purchase decision can be made.

ICT is introduced in secondary teacher training courses at various levels as a compulsory subject or a special field subject. Sometimes, it is also introduced as one of the subjects to be studied under a course titled 'Educational Technology'. Various objectives/rationales for introducing the course are as follows:

1. Understanding the scope and importance of ICT in contemporary society.
2. Developing effective perspectives and attitude towards emerging technologies.
3. Developing skills in handling, maintaining and protecting different types of hardware and equipment in the institutions of learning.
4. Acquiring a theoretical basis of ICT and to develop an awareness about recent developments in the area of ICT.
5. Acquiring adequate knowledge about the fundamentals of computers and operating systems.
6. Acquiring the necessary skills of handling software packages for the purpose of education in the institutions of learning.
7. Acquiring knowledge about new Internet technologies and their place in the field of education.

Regarding the weight given to the subject, different approaches are followed. Overall the weight given to theory and practice is 60/40 (60% for theory and 40% for practice).

Broadly the content areas regarding theory/practice include:

- a. Introduction to Computers
- b. Introduction to Operating Systems
- c. Application of Computers in Teaching
- d. Functions of Computers – Knowledge of M.S. Office and other related packages and Computer languages
- e. Application of computers in Education
- f. New Trends and Techniques in Computer education (EDUSAT etc.)
- g. Knowledge of Internet, World Wide Web, etc.

In the majority of teacher education institutions, the syllabi exhibit less weight to practical than theoretical aspects. Since the nature of ICT subjects is more practical and application-oriented, there needs to be more practical than theoretical input. This aspect seems to be neglected in designing and framing curricular objectives.

The present approach for ICT integration is dismal as an “add on” approach for ICT course is adopted :

- ICT basics are taught to teacher trainers focusing on technical issues, but little emphasis is given to the pedagogical aspects
- Educational technology courses are taught in a rather traditional way and show little evidence of using new technology to support instructional innovations
- Students don't know how to use new technology in their classroom instruction when they go to schools
- Technology input is not integrated in the curriculum courses, especially method courses.

These are certain basic problems associated with the integration aspects of technology. These are major hurdles in the integration of ICT in the teaching/learning process. This scenario shows that the objectives of introducing ICT at the pre-service level are developing technological know-how and awareness regarding various other technologies and software packages. Further, the time spent for practical sessions is less, as more time is spent for theory sessions. The total approach of introducing ICT at the pre-service level is not very serious. It is very clear that student teachers will not get much scope in order to integrate ICT in curriculum or the teaching/learning process. In teacher training programs at the secondary level, the ICT education scenario is struggling with the following problems:

- Only at the awareness development level are objectives being achieved, but higher order thinking skills regarding the use of ICT tend not to be occurring.
- Technology, pedagogy and content area integration is a rare feature. All components are dealt with separately which creates confusion for students.

- There is a serious discrepancy among syllabi of teacher training institutions and secondary schools. Syllabi at various institutions are not on a par with school level curriculum.
- Time duration of the courses related to ICT education is too short to develop knowledge and necessary skills among students to achieve higher order thinking skills.
- There is a lack of availability of proper infrastructural facilities at most of the institutions.
- There is a mismatch between available hardware and software to develop required learning resources.
- Support from technical staff for maintenance is dismal.

The objective at the pre-service level is not to prepare technocrats, but to develop techno-pedagogues. Teachers should be in a position to integrate technology into teaching / learning as well as develop the art and skill of “webogogy” (i.e., to make use of Internet technology, exploring it, accessing information from it to use in teaching learning, etc.). So, objectives must be set at the attainment of application and skill levels rather than just at the knowledge and understanding levels. The professional development of teachers needs to be given importance. There must be congruence between the school curriculum and teacher training curriculum at the secondary level. Otherwise, teachers are not ready to utilize their knowledge to effectively design teaching/learning processes, project work, and assignments. In addition to offering ICT as a compulsory and special course, integrated approaches need to be studied along with methods courses. This will help student teachers to develop the concept of ‘techno pedagogy’ to a greater extent.

Thus, management of change in teacher education is a complex and demanding task involving comprehension, concern, caution, and contemplation. Planners and administrators of teacher education have to provide academic leadership to prepare reflective teachers who can manage the educational system efficiently at various stages of education at the pre-primary, primary, elementary, secondary, and higher secondary levels. Effective change in schools is possible only when there are corresponding changes in the management of teacher education programs.

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