CONCEPTUAL FRAMEWORK
CHAPTER I

CONCEPTUAL FRAMEWORK

1.1. INTRODUCTION

The achievement of universal participation in education will be fundamentally dependent upon the quality of education (EFA, 2005). In 1990, the World Declaration on ‘Education for All’ noted that poor quality of education needed to be improved and recommended that education be made both universally available and more relevant. The declaration also identifies quality as a prerequisite for achieving the fundamental goal of equity. While the notion of quality was not fully developed, it was recognized that expanding access alone would be insufficient for education to contribute fully to the development of an individual and society. Emphasis was accordingly placed on assuring an increase in children’s cognitive development by improving quality of their education.

Later, the Dakar Framework for Action (2000) declared that access to quality education is the right to every child. It affirmed that quality was ‘at the heart of education’ – a fundamental determinant of enrolment, retention and achievement. So, various organization attempts to bring quality change in education by bringing innovations in education. The role of Information Communication Technology (ICT) is thought to be one of the major factors contributing towards quality in education. In this context, use of ICT in teaching and learning is seen as more potentially effective in improving standards of classroom instruction than the traditional modes.

Government of India supports federally sponsored schemes like Sarva Siksha Abhiyan (SSA) and Rashtriya Madhyamik Shiksha Abhiyan (RMSA) with the objectives of providing school education to every child and improving the quality of school education in the country. A substantially higher amount has been allocated to these novel schemes, which also aim at fostering ICT-based education in schools. Teachers are the medium, through whom these novel schemes are taken to the ground root level. So to achieve this, teachers
need to be trained in implementing ICT-based education. A classroom can be enhanced with the role of ICT, only by the way the teachers integrate ICT in the classroom. It is evident from the researches that teachers’ capacity to integrate ICT in classroom depends on teacher’s competency in using ICT in classroom. Capacity building of teachers is achieved through pre-service teacher training as well as in-service teacher training. As teachers in service are overloaded with a lot of responsibilities, the training that happens during in service is fruitful only when the external factors like increments, awards, promotions etc are considered. But pre-service is a training period that does not demand such external factors. UNESCO (2005) has recommended infusing ICT into the curriculum as it can enhance the technological pedagogical and content knowledge. Mishra & Koehler (2006) recommends the same through their technological pedagogical and content knowledge (TPACK) model. Hence it is essential to plan pre-service training in such a way that it prepares the teachers to integrate ICT in teaching and learning that indirectly impacts the quality of education in achieving education for all.

1.2. EMERGENCE OF KNOWLEDGE SOCIETY

Every society has its own knowledge assets. Knowledge has always been a factor of production, and a driver of economic and social development. Earlier economies depended on knowledge about how to farm, how to build and how to manufacture. But now it depends upon the capacity to manipulate, store and transmit large quantities of information cheaply which is increasing at a staggering rate over recent years. Intellectual property is valued high more than a physical property. The hearts and minds of people contribute more to the essential growth and prosperity rather than traditional labour. Workers at all levels in knowledge society, need to be lifelong learners, adapting continuously to changed opportunities, work practices, business models and forms of economic and social organisation. It is believed that ICT will be a key factor in future positive change. The new information and communication technologies have created new conditions for the emergence of knowledge societies and also
reshape the global economy. For preparing the future generation there is a need
to build up the store of knowledge and keep abreast of rapid technological
development. School which is seen to prepare the future generation needs to be
in line with the change in the society. As knowledge societies encompass much
broader social, ethical and political dimensions, schools need to orient the
students towards development of knowledge that adheres to the knowledge
society.

Hence it becomes the responsibility of the school to connect the forms of
knowledge that societies already possess and the new forms of development,
acquisition and spread of knowledge values. Among the school related factors,
teachers play a vital role in preparing the students to face the current society.
As the society demands the change where ICT has a role to play, teachers are
forced to be the practitioner of using ICT in developing the students’ knowledge.
Thus the emergence of knowledge society demands the teachers to be enriched
with ICT competency.

1.3. EDUCATION IN DIGITAL SOCIETY

Rapid change in technology and global communication has become part
of life in this 21\textsuperscript{st} century. In this century, almost every aspect of people’s lives
is characterized by change. This change has its hand on education system as
well. As Charles Darwin says “It is not the strongest of the species that survive,
nor the most intelligent, but the ones most responsive to change”, the education
system must respond to change in the way that helps to shape the future.
Consequently, the use of ICT in schools through the improved provision of
infrastructure, availability of equipments and connectivity cannot be seen as
just an example of change in school system. But it is the evidence of societal,
global and technological changes that is established in the society. Education
system has a turned over in this digital age.

Teaching is becoming one of the most challenging professions in our
society where knowledge is expanding rapidly and much of it is available to
students as well as teachers at the same time (Perraton, Robinson, & Creed,
Pedagogical changes are welcomed to engage the latest digital technologies. The method of instruction is more blended in nature where there is a blend between face-to-face and online instruction (Krishnan, 2012). Most of the content has moved from text based to multimedia based content. Globally, educational systems are under great pressure to adopt innovative methodologies and to integrate new ICT in the teaching and learning process, to prepare students with the knowledge and skills they need in the 21st century.

The emphasis on teacher-centered, lecture-based instructions is apparently changing to student-centered interactive learning environments. Technology has condensed time and space, making it possible for student and teachers to engage in academic, economic, and social activities across the globe in real-time. The wheels of change are certainly in motion and technology is driving a shift in the way institutions deliver educational services and facilitate learning. Thus ICT is influencing what is being taught and what is learnt.

As new concepts of learning have evolved, teachers are expected to facilitate learning and make it meaningful to individual learners rather than just to provide knowledge and skills. Recent developments of innovative technologies have provided new possibilities to teaching profession but at the same time have placed more demands on teachers to learn how to use these technologies in their teaching (Robinson & Latchem, 2003).

Further it is imperative that educators are aware of and able to skillfully manage at the classroom level the impacts that result from social, cultural, political and economic trends and educational policies. Roblyer (2004) states that ‘One of the things that make teaching so challenging is that it goes on in an environment that mirrors - and sometimes magnifies - some of society's most profound and problematic issues.’ Adding ICT to this mix makes the situation even more complex. Yet to integrate ICT successfully into their teaching, educators must recognize and be prepared to work in this environment with all of its subtleties and complexities.
1.4. TEACHERS AND STUDENTS OF DIGITAL SOCIETY

Students live in a rapidly changing technological world surrounded with a variety of technologies. ICT including hardware and personal digital devices, software, and systems that manage, store, process, create, produce and communicate information, has become an important part of students’ life. As society changes, the skills that student should possess to lead a successful life also changes. Student of digital society no longer feel the basic skills in reading, writing and arithmetic to be sufficient. These basic skills now extend to reading critically, writing persuasively, thinking and reasoning logically, and solving complex problems. Skill of finding, evaluating, applying and managing information to understand it with a greater flexibility is now the students’ thirst. Students of digital society demands to equip them with skills and perspectives that could help them to anticipate change and plan accordingly, as this will equip them to thrive in a world characterized by rapid continuous change. Students of digital society strive to enrich themselves with the 21st century skills. These 21st century skills, allows students to prepare for careers, requiring them to acquire new knowledge, learn new technologies, rapidly process information, make decisions and communicate in a global and diverse society.

Jones and Fox (2009) in ‘The Pew Report’ characterizes the new generation of learners as digital natives. However teachers are often seen as digital disconnects, that is, professionals who resist the inclusion of technology for learning and teaching. Students expect the same kind of skills from teachers as they are expected to lead them in acquiring the 21st century skills. There is a profound gap between the knowledge and skills most teachers have and what is required in today’s world and ICT infused in workplaces. ICT that has become so pervasive in daily lives is still outside the comfort zone for most of the teachers. Teachers are still bound with the 20th century skills where they need to address the 21st century learners. The challenge is to overcome traditional ways, and change pedagogical practices in ways that reflects the changing social, political and economic landscape in which 21st century students will
learn. As a digital native, student expects the learning environment to be highly customized to satisfy their needs. This expectation is extended to the teachers as well. Not only the societal changes that demands the teachers to be competent in using ICT but also the nature of the student in this digital society demands for it. However, teachers try to become digital immigrants through the resource and exposure available for them. They try to update themselves with the changing technologies to address the learners and their expectations.

1.5. POLICY PERSPECTIVES OF ICT IN TEACHER EDUCATION

Education policymakers widely accept that improved access to ICT in education can help individuals to compete in a global economy by creating a skilled work force and facilitating social mobility. They emphasize that ICT in education has a multiplier effect throughout the education system, by enhancing learning and providing students with new sets of skills; by reaching students with poor or no access; by facilitating and improving the training of teachers; and by minimising costs associated with the delivery of instruction.

The main aspects that are recommended by various policies are:

- Professional education should be effective to initiate the student teachers towards the needed revolution in teaching and lay foundation for their future professional growth.
- As using ICT is a need for the school at present times, teacher education programmes should be rigorous, thorough and intensive to provide training for student teachers to use ICT.
- ICT should be integrated throughout the curriculum.
- The attitude of the student teacher will be influenced more by the methods used with them, than by what they are formally taught about the methods they use in schools.
- Teacher educators are expected to have openness towards the innovations in education and to get familiarised with them to model it to the student teachers.
- Technology can greatly aid the process of mathematical exploration, and clever use of such aids can help engage students. So modern technologies should be used to visualize mathematics.
- Practicum component of teacher education should provide opportunity to practice the use of ICT which is a demand in real school system.
- Digital content should follow the standards prescribed by the government and more of freeware should be used for the purpose of education.
- Educationist should play the vital role in designing the ICT use in schools rather than the technologist

The policies and recommendations at the national and international level formed the strong base for the need of an ICT infused teacher education curriculum, defines the ICT components that needs to be infused in the curriculum and also describes the guidelines to be followed while preparing the same.

1.6. PROFESSIONAL DEVELOPMENT OF PRE-SERVICE TEACHERS ON USE OF ICT IN TEACHING AND LEARNING

Teachers are the central forces in tapping the learning opportunities created by information communication technology (ICT). New development in ICT has had a huge impact on the role of teachers in information intensive society. Many teachers lack the knowledge and skills to effectively use ICT as a tool in facilitating learning and in increasing ICT – pervasive learning environments.

For pedagogy ICT integration, changes may be introduced in both teaching learning methods and in content. There is a definite deficit in teachers’ knowledge and skills needed for using ICT as an effective teaching tool. According to ‘ICT in Education’ policy by UNESCO the following points can be gleaned:

- Institutions and local communities need strong leadership and management committed to using ICT for pedagogical/ educational
purposes, and supportive of teachers in professional development towards the better use of ICT.

- There is a need to enable the ICT training of future teachers, by transforming existing teacher-centered, information-intensive curricula.

Teachers’ capacity to use computers in classrooms effectively has not kept pace with the increasing levels of access to constantly changing equipment (Sandholtz, 2001). A comprehensive study ‘Teachers and Technology: Making the connection’ cites lack of teacher preparation as a major obstacle to the effective use of technology in classrooms. Indian teachers identified the lack of professional development as a major stumbling block to effective educational use of ICTs and expressed the view that the lack of funds available made hardware acquisition a higher priority than professional development.

The quality of education in school depends on the teachers who are responsible for providing the learning experience. One of the necessary conditions for successful learning with ICTs is learning and development—ensuring teachers have the necessary capabilities to effectively engage with and use ICTs as a tool of learning. The mode of training for teachers in which our Government or private sectors provide is only in the technical area. But it is mere want when it comes for integrating ICTs in teaching learning process. The training should focus on the skills and needs of teacher to integrate ICTs in teaching learning process. The present scenario of training which exists in practice leads to use ICTs for clerical purpose more than integrating it in methodology. This lack in training exists since the authorities who design the training are not sure of the needs and competencies required for the teacher to effectively integrate ICTs in teaching learning process. In building the capacities of teachers and other facilitators, it is vital that an increased awareness of the impact of new ICT on education and on teachers is developed, in addition to learning how to encourage positive perceptions of technology as an aid rather than as a substitute or a thread.

Professional development about/with ICTs is not primarily a matter of technology but rather it is improving the profession by aligning technology
with a school or district’s long range vision of learning, school improvement, leadership and accountability. The main characteristic of professional development is its relation to standards and norms, and the development of more precise expectations, with related accountability measures, for the integration of technology into teaching. There is a growing sense that “good” professional development can be related with international standards like ISTE etc., Professional development can be devoted to four major aspects: the development of a clear sense of purpose and a shared vision, the building of a collaborative culture, the learning of new leadership roles for the governance of schools and reflective practice and critical inquiry.

Professional development with respect to content, may be concentrated on removing teachers’ anxiety toward computers and creating a gateway to greater networking capacities. Professional development with respect to process, may be a single or multifaceted programme (short courses workshops offered after school, weekends or during summer), programmes broadcasted on TV, available on videos, site-based and hands-on provided to all at one sort (teachers, administrators etc..) tailored to individual needs of teachers and other staff members, programmes offered using a train-the-trainer model or service-based models, programmes fostered through incentives provided for obtaining personal computers at home or valuing voluntary participation, programmes conducted only face-to-face or online or programmes centered around an annual-event bringing teachers, administrators, provincial policy makers and teacher educators together. Professional development with respect to context, may be offered before the school, labs, classrooms are networked or applied by teachers immediately after their classroom is networked, just-in-time as connectivity issues get resolved or just-in-case as more networked computers become available or conducted in solo mode or in partnership with other schools, or institution, including universities.

A teacher being a pivot in the process of teaching learning, knowledge of ICT and skills to use ICT in teaching learning has gained immense importance for today’s teacher. A teacher is expected to know successful integration of
ICT into his/her subject area to make learning 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 for classroom teaching. Various competencies must be developed throughout the educational system for ICT integration to be successful. Teacher professional development should have five foci:

- skills with particular applications;
- integration into existing curricula;
- curricular changes related to the use of IT (including changes in instructional design);
- changes in teacher role and
- underpinning educational theories.

Ideally, these should be addressed in pre-service teacher training and built on and enhanced during in-service. In some countries, like Singapore, Malaysia, and the United Kingdom, teaching accreditation requirements include training in ICT use. ICT teacher training can take many forms. Teachers can be trained to learn HOW to use ICT or teachers can be trained VIA ICT. ICT can be used as a core or a complementary means to the teacher training process (Collis & Jung, 2003). Approaches to the professional development of teachers must be dependent on context and culture. It is important to note that some very strong models of teacher education provide simultaneous professional development for more than one group. For example, pre-service preparation can be aligned with in-service teacher education. A practicing teacher may work with a pre-service teacher education student on an innovative educational project. This not only increases the research potential of the in-service teacher, but the pre-service teacher also experiences role modeling and, as a result, may have an easier transition into teaching.

Professional learning communities allow teachers to support the professional development of colleagues and receive support themselves. ICTs have increased the access to and reach of such professional associations.
Mentorship can be fostered across geographic distances and supported by synchronous and asynchronous interaction. Professional development may also be enhanced by public or private partnerships with the community. Such partnerships may be particularly appropriate for professional development related to ICTs, with financial and technical support contributed by ICT companies, such as the Intel Teach to the Future Programme, Microsoft Sikshsa, or by local communities.

The professional development of teacher educators is also essential. Unless teacher educators model effective use of technology in their own classes, it will not be possible to prepare a new generation of teachers who will effectively use the new tools for learning. With ICTs, students often become teachers, using the processes of peer tutoring or reciprocal mentoring. Indeed, a teacher may facilitate learning by reversing the teaching-learning roles, with students acting as expert learners who model the learning process. ICTs provide extensive opportunities for this to occur in ways that can increase the self-esteem, motivation, and engagement of students. Teachers need encouragement to adopt such strategies rather than to feel ashamed to be taught by young learners.

Members of the community also may become teachers, or at least invited experts. ICTs extend the range of such opportunities and provide access to extensive relevant supporting materials. The teacher’s role changes to manager and facilitator in many of these situations as the teacher helps the expert communicate with the learners and scaffolds the learning process. The teacher also acquires professional development by learning from the expert. Teachers may find it impossible to incorporate ICTs into their work without support and encouragement from colleagues, parents, and leaders. To bring this about, these community members may also need professional development, along with the teachers. The most obvious technique for professional development for teachers is to provide courses in basic ICTs knowledge and skills, delivered by experts. However, this approach has had limited success without follow-on training and support, as compared to effective use of ICTs by trained teachers.
Hence ICT infusion in the form of activities and teaching strategies are recommended for better professional development in using ICT for teaching.

1.7. ICT TRAINING APPROACHES FOR PRE-SERVICE TEACHER EDUCATION

Use of ICT within teacher-training programmes around the world is being approached in a number of ways with varying degrees of success. In the review, Steketee (2005) classified ICT integration under four approaches:

- **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 in their day-to-day activities. Knowledge about various software and hardware and their uses in educational process is provided. In simple words it refers to inclusion of a core computer education unit in to the teacher education programmes.

- **ICT pedagogy approach**: This approach emphasizes on integrating ICT skills in respective subjects, drawing on the principle of constructivism, pre-service teachers design lessons and activities that centre 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 pedagogy allows student to further develop and maintain these skills in the context of designing classroom-based resources. Students who have undergone this type of training have reported significant changes in their understandings associated with effective implementation strategies, as well as their self-efficacy as to their ICT competencies.

- **Subject- specified approach**: Here ICT is embedded into one’s own subject area. By this method teachers not only expose students to new and innovative ways of learning, but also provide 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.
• **Practice-driven approach**: Here the emphasis is on providing exposure to use of ICT in practical aspects of teacher-training also. Emphasizing on developing lessons, assignments etc. using ICT and implementing these in their practical work experience at various levels, the students are provided with an opportunity to assess the facilities available at workplace and effectively use their own skills to manipulate these facilities. Based on the concept that the pre-service teacher is a learner, manager, designer and researcher, he is expected to research their practicum school’s ICT facilities, design ICT activities with their tutor-teacher, manage those activities in the classroom, and evaluate their effectiveness in terms of student learning.

Another way approaching ICT integration given by Collis and Jung (2003) is:

- ICT use as part of teaching methods
- ICT as core technology for delivering teacher training
- ICT used to facilitate professional development and networking
- ICT use as main content focus of teacher training

The pre-service teacher training curriculum should focus on developing literacy with ICT. The curriculum models for integration of ICT as proposed by Literacy with ICT Across the Curriculum (2004) is represented in Figure 1.1.

**Figure 1.1 Curriculum Models for ICT integration in Pre-service Education**

A supplementary relationship separates ICT and curriculum in space, time, and personnel i.e., separate computer labs, computer classes, and
computer teachers. This model deals with ICT skill development rather than integrating ICT with pedagogy. The focus in this model is on technology training like MS office, internet etc., which is isolated from the pedagogical aspects. A complementary relationship begins to connect ICT with curriculum in various ways. This model is also a standalone mode but a link is maintained between technology and pedagogy in terms of its application. The applications of technology in education are explained without a practical exposure in it. For example, while teaching Ms word, the knowledge on the use of MS word for preparing question paper, notes etc., are explained. An integrated relationship allows the classroom teacher to bring ICT into the classroom so it is available at teachable moments. This model extends from complementary model by providing the practical exposures on its applications. An infused relationship allows the transparent application of ICT, wherever and whenever appropriate, to enhance critical and creative thinking. The infused approach is the one recommended for better utilization of ICT in education by several researches. For example, in complementary model training on power point is provided separately and activity to prepare a presentation to teach a concept is provided separately. But in infused model, an activity is provided to teach a concept where the emphasis is more on teaching concept. For presenting this concept, power point is made use and in the course of preparing the presentation, power point is learnt by the student. In this model ICT and pedagogy are inseparable and the line of separating both is unseen. Majumdar (n.d) states the four stages by UNESCO for integration of ICT into teaching learning. They are emerging, applying, infusing and transforming as shown in Figure 1.2.

**Figure 1.2: Model of stages of teaching and learning with and through ICT**
The introduction and use of ICT in education proceeds in broad stages that may be conceived as a continuum or series of steps, namely: Emerging, Applying, Infusing and Transforming. Each of the successive stages in the continuum gets richer in both technology and pedagogy in terms of quality and complexity. In emerging stage, the focus is on the technical functions and uses of ICT and on the need for some knowledge and representation of the impact of ICT systems as a whole. This stage often involves teachers own personal use of ICT. Pedagogically speaking, student teachers at this stage are still firmly grounded in traditional, teacher-centered practice. At applying stage, teachers involve themselves in integrating ICT to acquire specific subject skills and knowledge. They begin to change their teaching methodology in the classroom, and using ICT to support their training and professional development.

At infusing stage, teachers integrate ICT in all aspects of professional life, to improve learning and management of learning processes. ICT enable them to become active and creative teachers, able to propose and manage the learning of students, integrating a range of preferred learning styles and uses of ICT in achieving similar goals. The teachers use ICT to manage not only the learning of their students but also their own learning. At transforming stage, teachers involved in integrating or embedding ICT across the curriculum, and in employing a range of computer-based technologies in laboratories, classrooms, and administrative offices. The emphasis changes from teacher-centered to learner-centered.

Figure 1.3: Mapping ICT stages onto learning and teaching

<table>
<thead>
<tr>
<th>Learning about ICT</th>
<th>Emerging</th>
<th>Applying</th>
<th>Infusing</th>
<th>Transforming</th>
</tr>
</thead>
<tbody>
<tr>
<td>Learning how to use ICT in subject teaching</td>
<td>Becoming aware of ICT</td>
<td>Understanding how and when to use ICT</td>
<td>Learning how to use ICT in subject teaching</td>
<td>Specializing in the use of ICT</td>
</tr>
<tr>
<td>Teaching with and through ICT</td>
<td>Applying productivity tools</td>
<td>Facilitating learning using multi-modal instructions</td>
<td>Enhancing traditional teaching</td>
<td>Creating and managing innovative and open learning environments</td>
</tr>
</tbody>
</table>
Figure 1.3 shows the mapping from learning about ICT to teaching with or through ICT. For this mapping to be successfully implemented, ICT should be infused into entire teacher education programme. Throughout their teacher education experience, students should learn about and with ICT and has to incorporate it into their own teaching. Restricting technology experiences to a single course or to a single area of teacher education, such as methods courses, will not prepare students to be technology using teachers. Pre-service teachers should learn about a wide range of educational technologies across their professional preparation, from introductory and foundations courses to practicum experiences, to continued professional development. Experiences provided should focus upon both ongoing computer or technical literacy and professional literacy i.e., using ICTs to foster educational growth within students. Teacher education programmes must acknowledge that all disciplines in the world are being transformed by technology, changing both what the discipline is about and the way work is being carried out. Hence the training must prepare teachers capable of recognizing and responding to the new ways students communicate and access information. Teacher education programme must include elements supporting students in learning such as:

- About technology (i.e., technical advancements, sociology of impact of technology on students’ current and future lives, the non-neutrality of technology)
- With technology (i.e., using ICTs for their own learning, having use of ICTs modeled in teacher educator’ pedagogy)
- About the ways to seamlessly incorporate the use of ICTs to support rather than overtake their own professional curricular and pedagogical judgments and practices

Governments and teacher training institutions seem to recognize the importance of integrating ICT in teacher training. In many cases, the national vision for ICT use in education has been integrated into teacher training. Teachers tend to integrate ICT in their teaching if they experience ICT skills as a learner (Collis & Jung, 2003). Teachers learn best, and are most likely to
embrace new approaches, when they can experiment and reflect in a safe setting, and have opportunities to discuss ideas and collaborate with their peers and instructors as they put new ideas into practice.

The pre-service training should focus in creating the literacy with ICTs among the pre-service teachers. Literacy with ICT means choosing and using ICT, responsibly and ethically, to support critical and creative thinking about information and about communication. ICT literate students choose and use ICT, responsibly and ethically, to support their critical and creative thinking about textual, numerical, visual and aural information as citizens of the global community. They develop this literacy through a process of inquiry across the curriculum as they plan and question, gather and make sense, produce to show understanding, communicate or reflect on their learning. Ideally, an integrated approach is to be followed for developing ICT skills in teaching. Under the changing scenario, there is a need to redefine the role of a teacher-educator. The main objective of pre-service training to infuse ICT is to produce teachers qualified and competent to employ the tools of the technology to supplement their traditional teaching methods and thereby achieve enhanced student learning, can use the tools of the technology to keep themselves abreast of the latest developments in the subjects they teach and can contribute to their own professional advancement

1.8. ICT INFUSED INSTRUCTIONAL DESIGN

Mere learning ICT skills is not suffice, but using ICT to improve the teaching and learning is the key for pedagogy-technology integration. The evidence suggests that pre-service teachers do not feel prepared to effectively use technology in their classrooms (Drent & Meelissen, 2008; Kay, 2006). These studies indicate the importance of pre-service teachers’ understanding with regards to technology. It suggests that pre-service teacher education should not only focus on how to use technology, but also how technology can be used for teaching and learning. Many researchers have suggested that technology skills should be integrated throughout the teacher education
curriculum in order to provide pre-service teachers with the skills and experiences needed to apply technology to their specific content areas (Niess, 2005). 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. With this respect, pre-service teacher education programmes can provide a wide range of approaches throughout their curriculum information delivery of technology integration content (e.g., lectures, podcasts), hands-on technology skill building activities (e.g., workshops), practice with technology integration in the field (e.g., field experiences), and technology integration reflections (e.g., electronic portfolios).

Based on the assumption that technology should be connected to specific content areas, Koehler and Mishra (2009) introduced the concept of Technological Pedagogical Content Knowledge (TPACK) and explained that TPACK encompasses an integrative knowledge base of technological knowledge and skills, as well as knowledge of learners, subject matter content, and pedagogy necessary for teachers to be competent to teach with technology in the classroom. TPACK is a framework that emphasizes the importance of preparing pre-service teachers to make sensible choices in their uses of technology when teaching specific content to a specific target group. According to this framework, technology integration does not require one single pedagogical orientation; it includes a spectrum of approaches to teaching and learning. Teachers select specific technological applications in line with their selections of other curricular variables and processes that fit into their existing educational beliefs (Tondeur, Hermans, van Braak, & Valcke, 2008). In this respect, many researchers believe that technology skills should be integrated throughout the teacher education curriculum, thus providing pre-service teachers with experience in applying technology to specific content areas and pedagogical approaches (Brush et al., 2003; Kay, 2006). The need to better align pre-service teachers’ preparation in the integration of technology with pedagogical issues and curriculum integration has been noted by many
researchers recently (e.g., Agyei & Voogt, 2011; Ottenbreit-Leftwich et al., 2010; Sang et al., 2010). In one review of quantitative studies of previous pre-service teacher technology training, Kay (2006) concluded that “The jury is still out on which strategies work best”.

In the infusing stage, teachers are fully intergrading ICT in all aspects of their professional life to improve their own learning and the learning of their students. Teachers use ICT to manage their own learning and that of their students. They use ICT to assist all students assess their own learning in completing specific personal projects. It is natural for teachers to collaborate with other colleagues in sharing experiences to solve problems. ICT becomes a stimulus for exciting new teaching opportunities. The infusion of ICT across the curriculum provides opportunities for all students to develop their skills to become competent, discriminating, productive, creative and ethical users of ICT. Infusion of ICT components can be infused throughout the teacher education curriculum else into the methodology course to prepare the pre-service teachers to reach the infusing stage. The purpose of the current study was to develop an ICT Infused Instructional Design in methodology of teaching mathematics (IIID-MTM) and to find its effectiveness on the certain depend variables identified through the review of literature and related research studies. This IIID-MTM aims at preparing the pre-service teachers to reach the infusing stage as per UNESCO’s stages.

1.9. FACTORS RELATED TO ICT INTEGRATION IN TEACHING AND LEARNING

In 2003 the British Educational Communications and Technology Agency (BECTA) commissioned two literature reviews and a teacher survey to identify the factors which hinder or promote the effective use of ICT by teachers (BECTA, 2003a, 2003b). The BECTA (2003a) report collates evidence from a range of sources on the actual and perceived barriers to teacher uptake of ICT. It draws on the literature associated with teachers' use of ICT, and also on a small scale teacher survey. It is published in conjunction with a companion
report (BECTA, 2003b) looking at the factors that enable teachers to make successful use of ICT. Key findings of the BECTA (2003a) report include:

- Confidence, time and access to quality resources are major factors in determining teachers' engagement with ICT
- Recurring technical faults, and the expectation of faults occurring during teaching sessions, are likely to reduce teacher confidence and cause teachers to avoid using the technology in future lessons
- Resistance to change is a factor that prevents the full integration of ICT in the classroom. In particular, teachers who do not realise the advantages of using technology in their teaching are less likely to make use of ICT
- There are close relationships between many of the identified barriers to ICT use, and any factors influencing one barrier are likely also to influence several other barriers. For example teacher confidence is directly affected by levels of personal access to ICT, levels of technical support and the quality of training available

Based on review of literature and from the wide researches that has taken place in the field of ICT integration in teaching learning process, teachers’ confidence in using ICT, ICT competency and techno pedagogical competency were identified to be contributing more ICT integration by teachers.

1.9.1. Confidence in Using ICT

In addition to the new interpersonal and pedagogic skills which teachers require to use ICT in their classrooms, other contextual factors which can act as barriers to using ICT include: lack of confidence, experience, motivation, and training; access to resources and timetabled use of dedicated ICT suites; collaboration, debate and interactivity within which much technology-based activity is said to be situated (Hadley and Sheingold 1993, Schofield 1995, Becker 2000, Dawes 2001). A significant determinant of teachers’ levels of engagement in ICT is their level of confidence in using the technology.
1.9.2. ICT Competency

There are general competencies and abilities to infuse ICT in teaching and learning and for management of learning. The focus of professional development will be on developing the confidence and competence of teachers, building upon their previous knowledge to apply the learnt ICT competency in teaching and learning process. Examples of general teacher competencies include the following:

- Understanding why, when, where, and how ICT tools will contribute to learning objectives; and choosing from among a wide range of ICT tools those that are most appropriate to stimulate students’ learning
- Managing whole school and classroom-based environments, and teamwork to achieve learning objectives
- Infusing multimedia presentations into whole class, group or individual teaching, and learning to increase access to learning programmes
- Analyzing multimedia learning environments
- Supporting students to find, analyze and synthesize information from disparate Internet and school-based learning environments
- Utilizing a range of communication tools to collaborate with colleagues, with students, and other learning communities beyond the school
- Using ICT more proficiently, regularly taking part in professional development, and participating in teaching experiments and developments

A teacher should be equipped with these competencies to address the present needs of the school. As UNESCO (2005) has termed ICT competency as a one component that consists of three domains namely knowledge on ICT, attitude towards ICT and ICT skills, all these three domains remains a separate factor that influences the use of ICT in teaching learning process. As stated by UNESCO (2005), the ICT competencies are organized into four groups.

- **Pedagogy** is focused on teachers’ instructional practices and knowledge of the curriculum and requires that they develop applications within
their disciplines that make effective use of ICTs to support and extend teaching and learning.

- **Collaboration and Networking** acknowledges that the communicative potential of ICTs to extend learning beyond the classroom walls and the implications for teachers development of new knowledge and skills.
- Technology brings with it new rights and responsibilities, including equitable access to technology resources, care for individual health, and respect for intellectual property included within the **Social Issues** aspect of ICT competence.
- Finally, **Technical Issues** is an aspect of the Lifelong Learning theme through which teachers update skills with hardware and software as new generations of technology emerge.

**Pedagogy:**

The most important aspect of infusing technology in the curriculum is pedagogy. When implementing the pedagogical competencies for infusing technology, the local context and the individual approach of the teacher linked with that of their subject discipline must be paramount. Teachers move through stages as they adopt ICTs. Initially, the teacher adopting technology applies it simply as a substitute for current teaching practice where technology is not used (e.g., teacher lecture becomes electronic presentation supporting lecture, students writing papers by hand become students writing papers using a word processor, course syllabus on paper becomes course syllabus online). The adaptation of ICTs by teachers should (and does) challenge and support changes in teaching practice, building upon individual pedagogic expertise. As teachers’ pedagogical practices with new technologies continue to develop, and organizational support and access to ICTs grow, it becomes possible to move beyond the adaptation of ICT applications that fit with existing practice. Transformation of the educational process will start to emerge and may move toward more student centered learning environments. A teacher who continually develops their pedagogical use of ICTs to support learning,
teaching, and curriculum development, including assessment of learners and the evaluation of teaching, then they will:

- demonstrate understanding of the opportunities and implications of the uses of ICTs for learning and teaching in the curriculum context;
- plan, implement, and manage learning and teaching in open and flexible learning environments
- assess and evaluate learning and teaching in open and flexible learning environments.

**Collaboration and Networking:**

ICTs provide powerful new tools to support communication between learning groups and beyond classrooms. The teacher’s role expands to that of a facilitator of collaboration and networking with local and global communities. The expansion of the learning community beyond the classroom also requires respect for diversity, including inter-cultural education, and equitable access to electronic learning resources. There is growing evidence that communities learn through collaborative activities that reflect diverse cultures in authentic projects that serve society. Both local and global understandings can be enhanced using ICTs. The development of teachers’ competencies in networking and collaboration are therefore essential to ICTs in education. Through collaboration and networking, professional teachers promote democratic learning within the classroom and draw upon expertise both locally and globally. In this process, they will:

- demonstrate a critical understanding of the added value of learning networks and collaboration within and between communities and countries;
- participate effectively in open and flexible learning environments as a learner and as a teacher;
- create or develop learning networks that bring added value to the education profession and society (locally and globally); and
- widen access and provide learning opportunities to all diverse members of the community, including those with special needs.
Social and Health Issues:

The power to access information and communication technologies brings increased responsibilities for everyone. Legal and moral codes need to be extended to respect the intellectual property of freely accessible information. Copyright applies to web resources, too, regardless of the ability of the user to purchase the rights. This respect can be modeled in classroom practice with students from an early stage. The challenges faced by society, locally and globally, by adoption of technology should become part of the curriculum in a way that involves learners and helps them to develop an effective voice in the debates. Health issues of ICTs also need to be addressed. For example, prolonged engagement with ICTs (including screens and keyboards) requires appropriate support for the body, especially the hands and back. Similarly, hazards of electricity and other power sources require care and the modeling of safe practice. The technology standards for students and teachers from the International Society for Technology in Education (ISTE) offer guidelines for social issues, under the topic of social, ethical, legal, and human guidelines relating to the responsible use of technology. Teachers need to understand social and health issues surrounding ICTs and apply that understanding in their practice. Specifically, they need to:

- understand and apply the legal and moral codes of practice, including copyright and respect for intellectual property;
- reflect upon and lead discussion of the impact of new technology on society, locally and globally; and
- plan and promote healthy use of ICTs, including seating, light, sound, and related energy sources (including electricity and radio signals).

Technical Issues

Technical issues regarding integration of ICTs into the curriculum include the technical competencies and provision of both technical infrastructure and technical support for technology use throughout the curriculum. Technical competencies of the individual are perhaps the most obvious but perhaps the least important in the long-term because use of
technology should ultimately become transparent. When technology is robust and used competently, it moves from the foreground to the background and remains essential. This is similar to the process of gaining any new skill set, such as riding a bicycle. Each new skill must be consciously attended to and practiced until it becomes an automatic response.

Competent bike riders do not focus on balance and the pedals of the bike, they focus on navigation and safety. However, we do recognize that in many contexts, the lack of technology competence, infrastructure, and technical support can create barriers to access and reliability resulting in diminished support for the curriculum. Additional technical support or training is therefore advised, depending on local circumstances. Simply providing the technology for learners and teachers is not enough. The type and level of access is also important. ICTs will improve learning very little if teachers and students have only rare and occasional access to the tools for learning. Reasonable access to ICTs has been shown to be important for the acquisition of competence with hardware and software, especially for teachers. For example, provision of portable computers is an important strategy for ICTs teacher education. Teachers with portable computers can use them for both teaching in school and for other professional activities elsewhere. Teachers, provided with reliable technology infrastructure and technical assistance, demonstrate continual growth in their skill with ICTs and knowledge of their current and emerging applications within education and local and global society. Specifically they are able to use and select from a range of ICT resources to enhance personal and professional effectiveness; and willingly update skills and knowledge in the light of new developments.

1.9.3. Techno pedagogical Competency in Teaching Mathematics

ICT is an increasingly important tool in mathematics teachers’ activity that has several dimensions. It may be regarded as: (i) an auxiliary educational means to support pupils’ learning; (ii) a mathematics teacher’s tool of personal productivity, to prepare material for classes, carry out managerial tasks, and
search for information and materials, and (iii) a medium for interacting and collaborating with other teachers and educational partners. Teachers need to know how to use ICT; evaluate its potential, strengths, and weaknesses; and develop an awareness of its social and ethical implications.

In pre-service mathematics teacher education, participants must become acquainted with applications such as word processing, database management systems, image processing software, spreadsheets, statistics software, presentation software (like PowerPoint), electronic mail, educational software concerning the learning of specific topics, and the Internet in terms of information search and production. ICT can be used to reinforce teacher-centered practices as well as to facilitate educational change. In fact, even today, many people regard the teacher’s role as one of providing pupils with information, controlling the discourse and managing the class. But curriculum documents increasingly advocate the teachers’ role as one of creating stimulating learning situations, challenging pupils to think, supporting their work, and encouraging diversification of learning routes. Therefore, pre-service teachers must develop not only various technical competencies but also a sound educational perspective regarding the use of ICT in the mathematics classroom.

Thus, ICT poses specific challenges to the mathematics teachers’ professional knowledge. Such knowledge may be regarded as a blend of declarative, procedural, and strategic knowledge that is used in situations of practice (Shulman, 1986). This knowledge has tacit and personal dimensions and develops through experience and personal reflection (Elbaz, 1983; Schön, 1983). Among its structuring elements are the conceptions that frame the way a range of objects, processes, and problems are handled (Ponte, 1994; Thompson, 1984). Professional knowledge concerns not just the teaching practice in the classroom but also other professional roles such as tutoring students, participating in school activities and projects, interacting with members of the community, and working in professional groups. For these roles, mathematics teachers need to (i) have knowledge of educational theories and issues; (ii) are competent in their teaching domain, and (iii) have a strong preparation in
mathematics education, the specialized field that concerns their activity. This involves developing perspectives about curriculum, student learning, classroom instruction, and student evaluation (Boero, Dapueto, and Parenti, 1996).

However, it is not enough for pre-service mathematics teachers to have knowledge of mathematics, educational theories, and mathematics education. Teacher’s simultaneous use of Technology, Pedagogy, and Content Knowledge brings into play what is known as a TPCK model by Koehler and Mishra (2009), and originally based on Shulman’s framework of PCK. This framework underlines that Technology, Content or subject matter, and Pedagogy are not isolated components. Successful integration is possible when the teacher assimilates his or her Knowledge of Pedagogy, Knowledge of Content, and Knowledge of Technology. This framework clearly explains that the professional development of teachers in technological skills alone cannot help the teacher to infuse ICT in teaching of mathematics.

Technological pedagogical knowledge (TPK) is knowledge of the existence, components, and capabilities of various technologies as they are used in teaching and learning settings, and conversely, knowing how teaching might change as the result of using particular technologies. This might include an understanding that a range of tools exists for a particular task, the ability to choose a tool based on its fitness, strategies for using the tool’s affordances, and knowledge of pedagogical strategies and the ability to apply those strategies for use of technologies. This includes knowledge of tools for maintaining class records, attendance, and grading, and knowledge of generic technology-based ideas such as Web Quests, discussion boards, and chat rooms (Mishra and Koehler, 2006). TPK also refers to the affordances and constraints of technology as an enabler of different teaching approaches. For example, online collaboration tools may facilitate social learning for geographically separated learners. An important part of TPK is developing creative flexibility with available tools in order to repurpose them for specific pedagogical purposes.
While teaching mathematics, the method of teaching is dependent on the type of content being taught. The materials required to be used as teaching aid also depends on the content, method and the objectives planned to achieve. This can be achieved through pedagogical competencies. When ICT needs to be infused along with pedagogy, there need to be discrimination about the type of ICT tool to be used to teach a particular type of content. Hence teachers need to have a combined competency of technology and pedagogy which is termed here as techno pedagogical competencies. This competency helps in infusing ICT in teaching of mathematics in a meaningful way.

1.10. TAMIL NADU TEACHER EDUCATION UNIVERSITY (TNTEU) CURRICULUM

The curriculum suggested by NCTE for one year B.Ed course recommends for a unit in pedagogy of mathematics on learning resources in mathematics which includes the ICT based learning resources. In general courses, it recommends for a skill development course on ICT which is an optional course. Though these guidelines are given by NCTE for teacher education curriculum, most of the university curriculum do not align with the recommendations of NCTE.

University of Delhi provides computer education and educational technology as elective paper which is optional for students to choose for study. Methodology in science teaching has few parts of ICT integrated in the course whereas methodology of mathematics teaching does not have any component of ICT. Consistency is not found in integrating ICT into the B.Ed curriculum. Andhra University offers the educational technology and computer education as a core paper with practical component included in it. But the link is not between these ICT components and pedagogy. Methodology courses do not have any ICT component to facilitate students to use ICT in teaching the particular subject. Most of the universities in India are in the same condition as University of Delhi or Andhra University where ICT is integrated into curriculum in a skill development approach. Few other universities and
colleges make their own collaboration with Intel or Microsoft to transact their ICT based trainings and courses as a standalone course into the B.Ed curriculum. Though student teachers gain knowledge on ICT, the integration of the acquired knowledge into teaching is lacking in this type of programmes.

But University of Kerala has emerged with a reformation by including ICT to various parts of the curriculum which is effective from 2013-14 academic year. It has integrated ICT throughout the curriculum and also strategies for teacher educators to use ICT in their teaching. TPACK is introduced into the curriculum. When compared to other university curriculum in South India, Kerala University has a better integration of ICT in teacher education curriculum. This is achieved as they have a state policy on ICT in education and they maintain like between the philosophies followed in school system and the curriculum designed for teacher education.

The ICT related content in TNTEU curriculum is more theoretical in nature. The components included in the curriculum do not satisfy the recommendation 8.21 of the national policy on ICT for school education where the emphasis is given on practicing the use of ICT. The practical aspect is included only in one elective course ‘Computers in education’. Though it is offered by university, many institutions do not offer it to the students due to lack of infrastructure and human resources. So introducing ICT components as an elective course does not provide equal opportunity for all pre-service teachers as per the recommendation. Even when institution is ready to offer this elective course, the number of students who can opt the course is restricted again resulting in less opportunity for all. There is list of recommendations by UNESCO for the pre-service teacher education institution in the document “ICT Competency standards for teachers- Implementation Guidelines” on content inclusion and strategies to be followed for better ICT integration. It also permits for localization having the objectives and standards in mind. While analyzing the TNTEU curriculum in the lights of ICT standards by UNESCO, there is a vast gap between the recommendation and the curriculum.
While analyzing the syllabus for methodology in teaching mathematics offered by TNTEU, it was found only three ICT related topics namely improvised aids, computer assisted instruction and e-learning are found. The practicum component insists to prepare a multimedia package. Moreover, ICT is not infused in the methodology courses. The recommendation to infuse subject specific ICT components fails in the TNTEU curriculum. This concludes that there is gap between TNTEU’s existing curriculum and the national policies as well as international recommendations. The curriculum is not sufficiently guiding the instructional activities to be implemented to achieve the objectives of the curriculum. Thus the course in methodology of teaching mathematics is found to be insufficient to develop the ICT use among pre-service teachers based on the curriculum and need analysis.

1.11. NEED AND SIGNIFICANCE OF THE STUDY

Technology could be integrated with the larger goals and processes of educational programme rather than viewed in isolation or as an add-on. In this context, technological use that turns teachers and children into mere customers and technology operators need to be reviewed and discouraged (NCF, 2005). Disjoined from the other components related to teaching learning using ICT, it fails to convince a teacher of her role of engineering the teaching learning situation and to make it a more meaningful experience for herself and her pupil (NCF, 2005). The real need of teachers in the use of ICT in education is the discrimination, analysis and filtering of information rather than solely on the technologies as such.

Lederman and Neiss (2000) report that technology courses which are part of teacher preparation programmes often emphasis pre-service teachers learning about technology rather than the integration of technology into classroom teaching. A large body of literature supports the idea that technology training is the major factor that could help teachers develop positive attitudes toward technology and integrating technology into curriculum (U.S. department of Education, 2005; Reynolds & Morgan, 2001; Yildirim &Kiraz,
Technology training that simply focuses on teaching basic skills is unlikely to ensure the successful infusion of technology into the classroom. To effectively infuse technology into the curriculum, teachers need to participate in intense curriculum based technology training that move them beyond the attainment of basic computer skills to activities that teach them how to seamlessly infuse ICT into the curriculum. Successful integration did not require teachers to be proficient in a larger variety of technology applications but instead, teachers needed to feel comfortable and confident in instructional methods of ICT infusion. Teachers needed proficiency in a few ICT applications but knowledge of instructional methods of integration was a greater indicator of success, suggesting a need for more focus on instructional methods of integrating technology.

Pre-service teachers should be provided with opportunities to develop pedagogically appropriate projects for using it during internship. Observing the practical application used in the classes by the teacher educator and working with ICT in hands-on activities were viewed as a powerful way to assist ICT integration in teaching learning process. When students see ICT being used frequently in their education classes, they attempt to create more opportunities to use ICT in their teaching preparation. This approach is recommended because it is argued that students need to learn to use ICT while performing authentic learning tasks. This approach will help the teachers to acquire some working knowledge of the ICT tools and considerable knowledge on their use in a variety of instructional approaches in their classrooms. The review of the literature related to professional development of teachers in ICT integration reveals that the researches has focused on three main areas namely- identifying the barriers in ICT integration, Need for professional development for ICT integration and training packages for in-service teachers. There has been less focus on pre-service teachers training on ICT integration. The few studies on pre-service teachers training that have been reviewed also have attempted to make a separate ICT curriculum where the pedagogy has not been focused. In reality, the ICT training models that are followed by several pre service
institution aims only in developing the ICT skills and the ICT pedagogy integration has lost its focus. Most of the institution provides training as a separate stand alone course or as some enhancement programmes which follows the complementary and integrated model recommended by UNESCO. When these trainings are analysed in the lights of the recommendations by various national and international policies, there exists a gap between the recommendations in the policies and the existing pre-service teacher education curriculum. It is also seen there is a gap between the curricular activities and the curriculum as such resulting in a wide gap between the recommendations and curricular activities. This give rise to the need of curriculum that satisfies the recommendation for integrating ICT in teaching and learning as well as described the curricular activities to prepare pre-service teachers to integrate ICT in their teaching and learning.

Based on the overall review, there is an urgent need for a transformation of the existing approach in preparing pre-service teachers to infuse ICT in teaching and learning. This study aims at preparing an ICT Infused Instructional Design (IIID) in methodology of teaching mathematics which guides on the content to be integrated in the methodology of teaching mathematics course in the B.Ed curriculum, strategies to be followed by the teacher educator to transact the ICT infused course and the activities for pre-service teachers to develop the techno pedagogical competency which helps them in infusing ICT in teaching of mathematics. As this design is prepared based on the recommendations by various policies and reports as a blueprint, it reduces the gap between the curriculum and recommendations. As the curricular activities are planned in the lights of recommendation and the curriculum as a base with the objective of preparing the pre-service teachers for ICT infusion, this design reduces the gap between the curricular activities and curriculum as well as the recommendations. Since this study aims to analyse the process of growth among pre-service teachers when ICT is infused in the existing curriculum, it fulfills the requirement for professional development of pre-service teachers.
1.12. STATEMENT OF THE PROBLEM

The present study aims at infusing ICT components into methodology of mathematics syllabus in B.Ed Course offered by Tamil Nadu Teacher Education University (TNTEU). Here methodology of teaching mathematics is considered as a means of infusion. This study also describes the instructional strategies to be followed by the teacher educator for transacting the ICT infused content and the activities for the student teachers that develop ICT competency and techno pedagogical competency in teaching mathematics at secondary level. The ICT infused syllabus, instructional strategies and activities are altogether is termed as ICT Infused Instructional Design (IIID) in methodology of teaching mathematics. This study researches upon of the effectiveness of IIID in methodology of teaching mathematics on ICT competency that comprises of knowledge on ICT, attitude towards ICT and ICT skill, confidence in using ICT and techno pedagogical competency in teaching mathematics. On the whole it aims to suggest ways and means of infusing ICT in the existing pre-service teacher education curriculum so that it can help to prepare pre-service teachers for integrating ICT in school education. Hence the study is entitled as; “Effectiveness of ICT Infused Instructional Design (IIID) in methodology of teaching mathematics at secondary level”

1.13. OPERATIONAL DEFINITIONS

The terms used in this study are operationally defined as follows.

1.13.1. Information and Communication Technology (ICT)

According to UNESCO (2005), the term “information and communication technologies” (ICT) refers to forms of technology that are used to transmit, process, store, create, display, share or exchange information by electronic means. This broad definition of ICT includes such technologies as radio, television, video, DVD, telephone (both fixed line and mobile phones), satellite systems, and computer and network hardware and software, as well as
the equipment and services associated with these technologies, such as videoconferencing, e-mail and blogs. This same definition is taken to define ICT in this study.

1.13.2. ICT Infused Instructional Design in methodology of teaching mathematics (IIID-MTM)

In this study, ICT Infused Instructional Design refers to a threefold combination of methodology in teaching mathematics course infused with ICT components, instructional strategies to transact the content and the activities for students to practice the use of ICT in teaching and learning.

1.13.3. Confidence in using ICT

In this study, confidence refer to the confidence to handle ICT tools, manage the use of ICT in teaching learning process and solve the issues related to ICT- pedagogy integration.

1.13.4. ICT Competency

A competency is a set of attributes covering knowledge, skill and attitude for enabling one to effectively perform the activities of a given occupation or a function to the standard expected in employment. The four main groups of competencies are content and pedagogy, technical issues, social issues, collaborating and networking (UNESCO, 2005). In this context, the dimensions of the ICT competency are knowledge on ICT, attitude towards ICT and ICT skills.

1.13.4.1. Knowledge on ICT

In this study, knowledge on ICT refers to familiarity, awareness or understanding of facts, information, description about ICT concepts, tools and use of ICT for teaching and learning. The major dimension of knowledge on ICT considered for this study are Basic computer operations and issues,
Application software, Internet Resources, ICT peripheral and ICT in teaching learning process.

1.13.4.2. Attitude towards ICT

Attitude has been defined as an inclination to act or to be in a state of ‘readiness’ to act (Gagne, 1985). In this study, attitude towards ICT refers to positive or negative evaluation of the capabilities of ICT use in teaching learning process, skill of using ICT and social aspects related to use of ICT in education.

1.13.4.3. ICT Skills

In this study, ICT skills refer to ability to work with ICT tools, applications, software, to integrate ICT in teaching learning process, to address the social and ethical issues related with the use of ICT especially for education purpose and use ICT for their professional development which involves sharing their expertise, communication with the larger group, research and contribution towards society.

1.13.5. Techno Pedagogical Competency in teaching mathematics (TPC-TM)

Techno pedagogical competency refers to the pedagogical competency in teaching mathematics in combination with the competencies required for an effective integration of ICT into pedagogy of teaching mathematics.

1.14. VARIABLES OF THE STUDY

In the present study which explores the effectiveness of ICT Infused Instructional Design (IIID) in methodology of teaching mathematics, the independent, dependent and moderate variables are as follows:

Independent variable: ICT Infused Instructional Design in methodology of teaching mathematics at secondary level (IIID-MTM)
Dependent Variables:
- Knowledge on ICT
- Attitude towards ICT
- ICT skills
- Confidence in using ICT and
- Techno pedagogical competency in teaching mathematics (TPC-TM)

Moderate Variables:
- Elective course – Computers in Education

1.15. OBJECTIVES OF THE STUDY

In order to study the effectiveness of IID-MTM on the above mentioned dependent variables, the following objectives were defined.

- To develop an ICT Infused Instructional Design (IID) in Methodology of Teaching Mathematics at secondary level.
- To study the differences among the groups exposed to IID-MTM, bridge course and enhancement programmes before intervention with respect to knowledge on ICT, attitude towards ICT and confidence in using ICT.
- To study the difference among the groups exposed to IID-MTM, bridge course and enhancement programmes after intervention with respect to knowledge on ICT, attitude towards ICT, confidence in using ICT, ICT skills and techno pedagogical competency in teaching mathematics.
- To study the differences in mean gain among the groups exposed to IID-MTM, bridge course and enhancement programmes with respect to knowledge on ICT, attitude towards ICT and confidence in using ICT.
- To study the effectiveness of ICT Infused Instructional Design (IID) in methodology of teaching mathematics on knowledge on ICT, attitude towards ICT, confidence in using ICT, ICT skills and techno pedagogical competency in teaching mathematics by taking the pre test scores as covariates
• To study the influence of the elective course ‘Computer in Education’ on developing knowledge on ICT, attitude towards ICT, confidence in using ICT and ICT skills and techno pedagogical competency in teaching mathematics.

• To identify the predictors of ICT skills and techno pedagogical competency in teaching mathematics.

1.16. HYPOTHESES

In order to study the above objectives, the following major hypotheses were formulated:

1. There is no significant difference among the groups exposed to IIID-MTM, bridge course and enhancement programmes in knowledge on ICT, attitude towards ICT, confidence in using ICT, ICT skills and techno pedagogical competency in teaching mathematics after intervention.

2. There is no significant difference among the groups exposed to IIID-MTM, bridge course and enhancement programmes in the mean gain in knowledge on ICT, attitude towards ICT and confidence in using ICT.

3. There is no significant difference among the groups exposed to IIID-MTM, bridge course and enhancement programmes in knowledge on ICT, attitude towards ICT, confidence in using ICT, ICT skills and techno pedagogical competency in teaching mathematics after intervention when pre test score are taken as covariates.

4. There is no significant difference among pre service teachers undergoing computers in education course and other elective courses with respect to knowledge on ICT, attitude towards ICT, confidence in using ICT, ICT skills and techno pedagogical competency in teaching mathematics.

5. Knowledge on ICT, attitude towards ICT and confidence in using ICT are not significant predictors of techno pedagogical competency in teaching mathematics and ICT skills.
1.17. RESEARCH QUESTION

Besides the above formulated hypotheses, a research question was framed to analyse the observations made by the investigator during the intervention:

1. How did the pre-service teachers perform in integrating ICT in teaching and learning when they were exposed to IIID-MTM, bridge course and enhancement programmes during their pre service teacher education course?

1.18. DELIMITATIONS

- The study is delimited to one year B. Ed model teacher education programme
- The study is confined only to the colleges of education affiliated to Tamil Nadu Teacher Education University and selected universities.
- Study is delimited to selected ICT components and they are infused only in methodology of teaching mathematics course of B.Ed programme.
- Study is delimited to selected variables like knowledge, skill, attitude, confidence and techno pedagogical competency in teaching mathematics.

This chapter highlighted the need for ICT infused curriculum, highlighted with the conceptual background and further proceeds with stating the objectives, hypotheses, research questions and delimitation of the study. The review of the policies and reports, research process, research design, tools used in this study and its development, interventions and its development, analysis of the data, interpretation of the analysis and major findings of the study are in the proceeding chapters.