SUMMARY, FINDINGS AND IMPLICATION
5.1. GENESIS OF THE PROBLEM

Information and communication technologies (ICT) have the potential to enhance access, quality and effectiveness in education in general and to enable the development of more and better teachers. ICTs are one of the major contemporary factors shaping the global economy and producing rapid changes in society. They can transform the nature of education – where and how learning takes place and the roles of students and teachers in the learning process.

In order to function in the new world economy, students and their teachers have to learn to navigate large amounts of information, to analyse and make decisions, and to master new knowledge and to accomplish complex tasks collaboratively. Overloaded with information, one key outcome of any learning experience should be for learners to critically challenge the materials collected in order to decide whether it can be considered useful input in any educational activity. This is the basis for the construction of knowledge. The use of ICTs as part of the learning process can be subdivided into three different forms: as object, aspect, or medium. As object, one refers to learning about ICTs as specific courses such as ‘computer education’. This aim is computer literacy. As aspect, one refers to applications of ICTs in education similar to what obtains in industry. The use of ICT in education, such as computer aided design and computer aided manufacturing, are its examples. ICTs are considered as a medium whenever they are used to support teaching and learning.

ICT has great potential for enhancing teaching and learning outcomes. The realization of this potential depends much on how the teachers use technology. This would in turn depend on the kind of training that the teacher has undergone. 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 effectively use the new tools for teaching and learning. Hence for ICT to
be integrated in school teaching learning practices, the foremost effort should be integrating ICT into teacher education programme where the content is transacted by the teacher educators through mentoring, modeling and others.

“Teacher quality is the factor that matters most for student learning” – Darling Hammond and Berry(1998). Therefore, professional development for teachers becomes the key issue in using technology to improve the quality of learning in the classroom. Effective ICT use in education increases teachers’ training and professional development needs. The provision of ICT and an educationally sound ICT training programme for teachers can only have the required impact if the public administration fully supports this major transformation. Respective governments need to look carefully into the necessary prerequisites and consequences of ICT integration at the level of curriculum development. As teacher education programmes are getting ready to offer comprehensive ICT teacher training based on educational principles and targeting subject teachers, ICT should be infused into the curriculum.

5.2. NEED AND SIGNIFICANCE OF THE STUDY

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 integrate technology 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 integration. 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. The student teachers should be provided with opportunities to develop pedagogically appropriate projects that can be used during internship. Hands-on experience can potentially enhance the ICT
integration ability in teaching learning process. When students see ICT used much more 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 of how to use them 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 a less focus on pre-service teachers training on ICT integration. The few studies which have been done on pre-service teachers training 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. 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 define 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 integrate ICT in teaching and learning. This study aims at preparing an ICT Infused Instructional Design (IIID) which guides on the content to be integrated in the
methodology course for teaching mathematics at secondary level, strategies to be followed by the teacher educator to transact the ICT infused course and the activities for pre service teachers to training themselves in integrating ICT in their teaching and learning. As this design is prepared using the recommendations by various policies as a blue print, it reduces the gap between the curriculum and recommendations. As the curricular activities are planned in the lights of recommendation and the curricular 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.

5.3. STATEMENT OF THE PROBLEM

The present study aimed at infusing ICT components into methodology of mathematics syllabus in B.Ed Course offered by Tamil Nadu Teacher Education University. Here methodology of teaching mathematics is considered as a means of infusion. This study also described the instructional strategies to be followed by the teacher educator for transacting the ICT infused content and the activities for the student teachers that develops ICT competency and techno pedagogical competency in teaching mathematics at secondary level.

The ICT infused syllabus, instructional strategies and activities are altogether is known 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. Hence the study is entitled as;

“Effectiveness of ICT Infused Instructional Design (IIID) in methodology of teaching mathematics at secondary level“
5.4. OPERATIONAL DEFINITIONS

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

**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.

**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.

**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.

**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.

**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.

**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.

**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.

**5.5. 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 (IIID) in methodology of teaching mathematics
- **Dependent Variables:** Knowledge on ICT, Attitude towards ICT, ICT skills, Confidence in using ICT and Techno pedagogical competency in teaching mathematics
- **Moderate Variables:** Elective course – Computers in Education

**5.6. OBJECTIVES OF THE STUDY**

In order to study the effectiveness of ICT Infused Instructional Design (IIID) in methodology of teaching mathematics on the above mentioned dependent variables, the following objectives were defined.

- To develop an ICT Infused Instructional Design (IIID) in Methodology of Teaching Mathematics at secondary level.
- To study the differences among the groups exposed to IIID-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 IIID-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 IIID-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 (IIID) 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.

5.7. HYPOTHESES

In order to study the above objectives, the following hypotheses and sub-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.
There is no significant difference among groups exposed to IIID-MTM, bridge course and enhancement programmes in the knowledge on ICT after the intervention

There is no significant difference among groups exposed to IIID-MTM, bridge course and enhancement programmes in the attitude towards ICT after the intervention

There is no significant difference among groups exposed to IIID-MTM, bridge course and enhancement programmes in the confidence in using ICT after the intervention

There is no significant difference among groups exposed to IIID-MTM, bridge course and enhancement programmes in the ICT skills after the intervention

There is no significant difference among groups exposed to IIID-MTM, bridge course and enhancement programmes in the techno pedagogical competency in teaching mathematics after the 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.

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

There is no significant difference among groups exposed to IIID-MTM, bridge course and enhancement programmes in the mean gain in knowledge on basic computer operation and issues

There is no significant difference among groups exposed to IIID-MTM, bridge course and enhancement programmes in the mean gain in knowledge on use of application software

There is no significant difference among groups exposed to IIID-MTM, bridge course and enhancement programmes in the mean gain in knowledge on use of internet resources
There is no significant difference among groups exposed to IIID-MTM, bridge course and enhancement programmes in the mean gain in knowledge on use of ICT peripherals

There is no significant difference among groups exposed to IIID-MTM, bridge course and enhancement programmes in the mean gain in knowledge on use of ICT in teaching learning process

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

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

There is no significant difference among groups exposed to IIID-MTM, bridge course and enhancement programmes in knowledge on ICT after intervention when knowledge on ICT before intervention is taken as covariate

There is no significant difference among groups exposed to IIID-MTM, bridge course and enhancement programmes in knowledge on basic computer operation and issues after intervention when knowledge on basic computer operation and issues before intervention is taken as covariate

There is no significant difference among groups exposed to IIID-MTM, bridge course and enhancement programmes in knowledge on use of application software after intervention when knowledge on use of application software before intervention is taken as covariate
There is no significant difference among groups exposed to IIID-MTM, bridge course and enhancement programmes in knowledge on use of internet resources after intervention when knowledge on basic use of internet resources before intervention is taken as covariate.

There is no significant difference among groups exposed to IIID-MTM, bridge course and enhancement programmes in knowledge on use of ICT peripheral after intervention when knowledge on use of ICT peripherals before intervention is taken as covariate.

There is no significant difference among groups exposed to IIID-MTM, bridge course and enhancement programmes in knowledge on use of ICT in teaching learning process after intervention when knowledge on ICT in teaching learning process before intervention is taken as covariate.

There is no significant difference among groups exposed to IIID-MTM, bridge course and enhancement programmes in confidence in using ICT after intervention when confidence in using ICT after intervention is taken as covariate.

There is no significant difference among groups exposed to IIID-MTM, bridge course and enhancement programmes in attitude towards ICT after intervention when attitude towards ICT after intervention is taken as covariate.

There is no significant difference among groups exposed to IIID-MTM, bridge course and enhancement programmes in ICT skills when knowledge on ICT, confidence in using ICT and attitude towards ICT before intervention are taken as covariates.

There is no significant difference among groups exposed to IIID-MTM, bridge course and enhancement programmes in ICT technical skills.
There is no significant difference among groups exposed to IIID-MTM, bridge course and enhancement programmes in ICT social and ethical skills

There is no significant difference groups exposed to IIID-MTM, bridge course and enhancement programmes in ICT pedagogical skills

There is no significant difference among groups exposed to IIID-MTM, bridge course and enhancement programmes in ICT professional skills

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

There is no significant difference among pre service teachers undergoing computers in education course and other elective courses with respect to knowledge on ICT.

There is no significant difference among pre service teachers undergoing computers in education course and other elective courses with respect to confidence in using ICT.

There is no significant difference among pre service teachers undergoing computers in education course and other elective courses with respect to attitude towards ICT.

There is no significant difference among pre service teachers undergoing computers in education course and other elective courses with respect to ICT skills.
There is no significant difference among pre service teachers undergoing computers in education course and other elective courses with respect to 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

Knowledge on ICT, confidence in using ICT and attitude towards ICT are not significant predictors of ICT skills

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

5.8. 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?

5.9. DESIGN OF THE STUDY

The present study is a quasi-experimental in nature wherein a pre test-post test three group design is employed. Quasi- experimental design is different from true experimental design in a way that the samples are not selected randomly from a specified population nor they are randomly assigned as done in a true experimental design. Since it was not possible to randomly assign subjects to groups in the present study, it was intended to use a quasi-experimental design. The design begins with the identification of naturally assembled three groups .The three curriculum models for ICT integration in pre-service teacher education as recommended by UNESCO was implemented
in this study. First group was assigned with infused model second with the integrated model and third with the complementary model. The design of the present study is given in Figure 5.1.

**Figure 5.1: Design of the Present Study**

![Diagram showing the design of the present study]

5.10. SAMPLE

The population of the study is the pre-service teachers undergoing the methodology course in teaching of mathematics at secondary level in Tamil Nadu.

There are 27 B.Ed colleges in and around Madurai. 15 colleges were shortlisted based on the availability of infrastructure out of which three colleges were randomly selected for the study. The colleges finally selected for the study are:

- Group 1 - C.S.I College of Education for implementation of Infused model
- Group 2 - Thiagaraja College of Preceptors for implementing the integrated model in the form of seminar/workshop/hands-on training
• Group 3 - Penial College of Education for implementing the complementary model i.e., bridge course

All the students from mathematics stream of above three colleges were considered as the sample for this study. Group 1 had 22 student teachers, Group 2 had 25 and Group 3 had 11 student teachers.

5.11. INSTRUMENTS USED IN THE STUDY

The tools used in the study are ICT confidence scale, ICT attitude scale, ICT knowledge scale, Observation schedule for ICT skills and technological pedagogical competency in teaching mathematics. All these tools were developed by the investigator.

i) ICT Confidence Scale

ICT confidence scale was developed by the investigator to identify the measure pre service teachers’ level of confidence in using ICT for teaching and learning. Handling ICT tools and resources, managing the use of ICT to learn and teach, and solving the issues rising during the use of ICT were considered to be contributing to confidence to use ICT in teaching and learning. Items were constructed in such a way that it measures the identified dimensions and thus establishing the face validity.

Construct and sampling validity were established by subjecting the items prepared to the scrutiny of subject experts and experienced teacher educators. To establish discriminating power of the item, paired t test was applied between the upper scores and lower scores. All the 10 items were found to be significant at 0.05 level. Thus content validity was established. Thus the final tool has 10 items. To establish reliability, Cronbach’s alpha was also found. The reliability coefficient was found to be 0.799.

The tool was translated to Tamil for the convenience of the subjects and the translated tool was subjected to expert validation for scrutiny. Item analysis was done by extreme group method and all the items were found to be
significant at 0.05 level. To establish reliability, Cronbach’s alpha was also found. The reliability coefficient was found to be 0.787.

ii) ICT Attitude Scale

ICT attitude scale was developed by the investigator to analyse the attitude of pre service teachers towards the use of ICT in teaching and. Technical aspect of handling ICT, pedagogical usability of ICT, social and ethical aspects related to ICT and professional use of ICT were considered to be contributing to attitude towards ICT. Items were constructed in such a way that it measures the identified dimensions and thus establishing the face validity. Construct and sampling validity were established by subjecting the items prepared to the scrutiny of subject experts and experienced teacher educators.

To establish discriminating power of the item, paired t test was applied between the upper scores and lower scores. Out of 20 items 17 were found to be significant at 0.05 level. When the three items were analysed, it was related to time factor, ethical and social factor. Due to the importance and necessity of that item, these items were also considered for the final tool. Thus content validity was established. The final tool has 10 favorable and 10 unfavorable statements. To establish reliability, Cronbach’s alpha was also found. The reliability coefficient was found to be 0.821 and thus the tool was found to be highly reliable.

The tool was translated to Tamil for the convenience of the subjects and the translated tool was subjected to expert validation for scrutiny. Thus construct and sampling validity were established. Item analysis was done by extreme group method and out of 20 items 17 were found to be significant at 0.05 level. The three items were also considered based on the essentiality and important of those items. Thus content validity of the translated tool was established. To establish reliability, Cronbach’s alpha was also found. The reliability coefficient was found to be 0.842 and thus the tool was found to be highly reliable.
iii) ICT Knowledge Scale

ICT knowledge scale was developed by the investigator to analyse knowledge of pre service teachers on ICT at the entry level and the exit level. The dimensions of knowledge based ICT competency are basic computer operations and issues, application software, internet Resources, ICT peripheral, and ICT in teaching learning process. Items were constructed in such a way that it measures the identified dimensions and thus establishing the face validity.

Construct and sampling validity were established by subjecting the items prepared to the scrutiny of subject experts and experienced teacher educators. To establish discriminating power of the item, paired t test was applied between the upper scores and lower scores. All the 45 items were found to be significant at 0.05 level. Thus content validity was established. The final tool has 45 items where 9 is to measure basic computer operations and issues, 10 for application software, 12 for internet, 4 for ICT peripheral and 10 for ICT in teaching learning process. To establish reliability, Cronbach’s alpha was also found. The reliability coefficient was found to be 0.938 and thus the tool was found to be highly reliable. This tool consists of technical terms. As the subjects were found to known the technical terms only in English, the tool was not translated to Tamil.

iv) Observation Schedule for ICT Skills

This observation schedule was developed by the investigator in order to gather information of the skill practiced by the pre service teachers in integrating ICT in their teaching and learning throughout the treatment. It is also used as a rating scale by the pre-service teachers to self report on their skills. The four domains suggested by UNESCO were considered as the dimensions namely technology, pedagogy, social and ethical, and networking and collaboration. National ICT Competency Standards (NICS) for Teacher developed by Commission on Information and Communication Technology mostly suits the Indian context. So the domains, standards and the indicators
given by NICS were mapped with that of UNESCO standards and were found to match exactly. All the 76 indicators were converted to items for observation.

Through the scrutiny of the subject expects and experienced teacher educators, the construct and sampling validity was established. The item analysis was carried out based on the guidelines of Ebel and Frisbie (1991). To establish discriminating power of the item, paired t test was applied between the upper scores and lower scores. All the 76 items were found to be significant at 0.05 level. Thus content validity was established. The final tool has 76 items where 39 is to measure skill towards technology operations and issues, 17 for social and ethical, 12 for pedagogical and 9 for professional. To establish reliability, Cronbach’s alpha was also found. The reliability coefficient was found to be 0.938 and the inter rater reliability was found to be 0.90. This shows that the tool is highly reliable to be used as a observation schedule as well as a self reporting tool. As the teacher educators were found to known the technical terms only in English, the tool was not translated to Tamil.

v) Observation Schedule for techno pedagogical competency in teaching mathematics

Techno pedagogical competency refers to the pre-service teachers’ competency in infusing ICT in teaching of mathematics. This tool was developed to observe the techno pedagogical skills of the student teachers practiced during their internship. This tool address the technology as the pedagogical skill required for teaching mathematics. It is a five point Linkert rating. The two major dimensions are lesson design and lesson implementation. The sub skills required for each of this dimension were considered to frame the items in the observation schedule. Due focus was given to the skills required for teaching of mathematics. The main skills to be observed during teaching practice and the indicators of the main skills were areas. The items cover a wide range of competence in teaching of mathematics like listing objectives in the lesson plan, resource selection, preparation and validation, planning instructional activities and learning activities, planning
assessment techniques, transactional skills, class room management and ICT infusion competency. Totally there were 20 areas in which the competence need to be assessed and the indicators of each area were listed in the guidelines. Expert validation was done and the tool was validated.

5.12. RESEARCH PROCESS

The study was carried out in five phases. The activities done in each phase is described here.

5.12.1. Phase I: Analyse

1. The international and national recommendations related to ICT integration in pre service education, the existing ICT curriculum in teacher education and the researchers related to ICT integration were analysed and the ICT components that needs to be infused in the curriculum was identified.

2. The existing curriculum offered by Tamil Nadu Teacher Education University (TNTEU) was analysed in the lights of the national and international recommendations and the gaps were identified.

3. The instructional activities currently practiced in teacher education institutions in Madurai affiliated to TNTEU were analysed in the lights of the national and international recommendations as well as the TNTEU curriculum and the gaps were identified.

5.12.2. Phase II: Design

1. The design of the study was formulated to be a quasi experimental study in nature following non equivalent control group design.

2. Samples were selected for the study

3. Available tools were analysed and as no tools was appropriate to be used for this study, it was decided to develop the tools required for this study.

4. The interventions were designed as follows:

   Bridge course is the nature of intervention for the group in which complementary model is planned to be implemented. The intervention was
planned to a stand-alone bridge course at the starting of the academic year for 15 hours. i.e., 3 hours per day for 5 working days. The mode of the bridge course was seminars, exposures and demonstration followed by hands-on practice in laptops.

- Workshops (Demonstration with hands on practice) - Computer – Basic operation, Microsoft office, ICT tools for teaching of mathematics, Internet
- Seminar: Recent trends in Teacher Education – Role of ICT, ICT in teaching and learning of mathematics, Use of internet in teaching of mathematics, Application of MS office in Education, Use of Interactive white board in Education
- Exposure: Teaching mathematics using power point

Enhancement programmes is the nature of intervention for the group in which integrated model was planned to be implemented. The content coverage was maintained equivalent to the content coverage planned for the complementary model group. The enhancement programmes were conducted by the investigator, computer faculty and senior staffs. The students were given exposure to a class where teacher teaches using interactive board in the model school attached with the college. Altogether the intervention for this group was planned to be 15 hours across the academic year.

A framework for infusing ICT across the course ‘Methodology of teaching mathematics’ offered by TNTEU was designed by following the given steps.

- The objectives were listed in line with the standards expected to be developed among the pre service teachers. Objectives mainly focused on improving the understanding about ICT and its use in education, developing the skill of using ICT tools, developing the ability to integrate ICT in teaching and learning meaningfully, developing competence in working collaboratively, improve confidence in using ICT and developing positive attitude towards ICT and its use in education.
• Methodology was designed as a threefold model where every learning starts with the modeling of the teacher educator followed by guided learning and hands on experience by the pre service teachers and then the pre service teachers being evaluated by the teacher educator.

• Plug points to integrate ICT components into the methodology course for teaching mathematics offered by TNTEU were identified and it was found that all units and practicum component has scope for ICT infusion.

• The pedagogical approaches and learning activities. Strategies and activities like discussion, project, field trip, demonstration, brain storming, panel discussion, interviewing, peer tutoring, hands on practice, self learning, peer sharing, experimentation, exploration, debate, multimedia presentation etc were identified

• IIID framework was designed such that each unit and its subtopics are mapped to the teaching strategies for transacting the content and the activities to be conducted for the pre service teachers. This gives a picture for a teacher educator to implement the ICT Infused Instructional Design.

• Assessment strategies were designed such that the tools developed for this study, log book maintained by the students based on their experience during the intervention and the anecdotal records maintained by the teacher educator based on their observation in day today life will contribute in analyzing the effectiveness of the treatments.

5.12.3. Phase III: Develop

1. The tools required for this study were developed and validated.

2. The resources required for implementing ICT infused instructional design in methodology of teaching mathematics were developed and validated by the subject experts and experienced teacher educators.

3. Pilot study was done by using the developed resources in Christian College of Education, Perambalur. Try out of the students activities were also done to study the feasibility, time required and difficulties faced. The IIID - MTM was finalized based on the experience.
4. The resources required for the bridge course and enhanced programmes were also customized from the resources developed for IIID-MTM.

5. The way in which the observation schedule needs to be used for recording the student’s performance in terms of skill was developed by mapping the indicators to the activities.

5.12.4. Phase IV: Implement

1. The instructions regarding the observation schedule and maintenance of anecdotal record was shared with the teacher educators.

2. The ICT knowledge scale, ICT confidence scale and ICT attitude scale were administered as pre test at the starting of the academic year.

3. The students were instructed to maintain a log book to record their experiences regarding the learning and practice of ICT, their own feelings about the interventions and their feedback towards the activities.

4. The treatments were implemented in all the three groups as planned. The bridge course was conducted for 15 hours i.e., 3 hours per day as soon as the orientation was done by the college administration group 3. After the bridge course there no ICT intervention during academic year. Use of ICT was not modeled by the investigator while handling the methodology course. The investigator handled the methodology course throughout the academic year with the support of the course teacher. The enhancement programmes were conducted for 15 hours distributed across the course by using all the ICT facilities available in the college. The methodology course was handled by the teacher educator of that college itself due to the time constrain for the investigator to manage teaching between all three colleges. It was made sure that the teacher educator is implementing the course as planned by the investigator. Frequent visits were made and also discussed over phone about the intervention. The course teacher used three power points that were downloaded from the internet and not customized to teach three subtopics namely Blooms taxonomy, inductive and deductive model, and analytic and synthetic model using laptop and LCD.
projector. All type of resources like interactive board, software, hardware and applications were available in the educational technology lab. Students of this group were encouraged to use the facilities available in the college and a time slot was provided to use educational technology lab to prepare teaching materials using ICT. IIID-MTM was implemented as planned in the IIID framework using the respective resources. The methodology course were conducted for 180 hours.

5. A choice was given for the students to select ‘computer in education’ course as their elective paper. ICT skills were observed based performance in the designed activities and techno pedagogical competency in teaching mathematics was observed during internship.

6. Post test was administered using the tools ICT knowledge scale, ICT attitude scale and ICT confidence scale and oral feedbacks and their reactions were collected from the groups.

5.12.5. Phase V: Evaluate

Keeping in view the objectives and the design of the study different statistical techniques were employed to analyse the data. Descriptive statistics was employed to understand the nature of the variables. Inferential statistics like one way ANOVA, ANCOVA, independent sample t-test, paired t-test and regression analysis were employed. Data analysis was done using SPSS Version 20.

5.13. MAJOR FINDINGS OF THE STUDY

The major findings of the study has been are listed objective wise

1. The student teachers exposed to IIID-MTM have scored higher on techno pedagogical competency in teaching mathematics, all domains of knowledge on ICT, attitude towards ICT, confidence in using ICT and in all domains of ICT skills after the intervention.

2. The groups that underwent IIID-MTM and bridge course didn’t differ before the intervention in knowledge, attitude and confidence, but they
were found to differ after the intervention. The groups that underwent IIID-MTM and integrated model didn’t differ in confidence before intervention, but differed after intervention

3. IIID-MTM is effective in developing knowledge on ICT, confidence in using ICT, attitude towards ICT, ICT skills and TPC-TM.

4. The mean gain score of the group exposed to IIID-MTM has scored higher than that of other treatments in ICT knowledge, attitude and confidence. The IIID-MTM group has gained more knowledge in all domains of ICT knowledge, attitude towards ICT and confidence in using ICT. This reemphasize that IIID-MTM is effective in developing ICT knowledge, attitude and confidence. But complementary model is found to reduce the confidence in using ICT and knowledge on use of ICT peripherals due to inadequate hands on experience on using ICT.

5. The adjusted mean scores of the group exposed to IIID-MTM was found to be higher than the other two groups in all domains of knowledge on ICT, confidence in using ICT and attitude towards ICT when their respective pre test scores were taken as a covariate. These pre scores were found to predict the post scores.

6. The adjusted mean of group exposed to IIID-MTM was found to be higher than the other two groups in ICT skills when knowledge, confidence and attitude were considered as covariate. Only knowledge on ICT before intervention was found to predict ICT skill when control is applied on knowledge, attitude and skill.

7. The adjusted mean of group exposed to IIID-MTM was found to be higher than the other two groups in TPC-TM when knowledge, confidence and attitude were considered as covariate. Only attitude towards ICT before intervention was found to predict ICT skill when control is applied on knowledge, attitude and skill.

8. There is no impact of the elective course ‘computer in education’ in developing the knowledge on ICT, attitude towards ICT, confidence in using ICT, ICT skills and TPC-TM.
9. Knowledge on ICT and attitude towards ICT predicts ICT skills, but knowledge on ICT was found to be contributing higher towards ICT skills than the attitude. Though attitude towards ICT and ICT skills were found to be predictors of TPC-TM, attitude was found to be contributing more than the skill.

10. ICT Infused Instruction design in methodology of teaching mathematics is effective in developing pre-service teachers’ knowledge on ICT, confidence in using ICT, attitude towards ICT, ICT skills and techno pedagogical competency in teaching mathematics when compared to other two treatments. i.e., integrated and complementary model.

5.14. RECOMMENDATIONS AND IMPLICATIONS OF THE STUDY

The findings of this study become meaningful only when it has an educational implication. Few implications of this study are put forth.

1. ICT infused instructional design (IIID) is found to be effective in developing knowledge on ICT, confidence in using ICT, attitude towards ICT, ICT skills and techno pedagogical competency. Hence TNTEU may take efforts to revise the pre-service teacher education curriculum for infusing the ICT components. Similarly NCTE and UGC can adapt this model for implementing in other university.

2. The bridge course that is considered as a standalone from the pedagogy course is less effective as there is less hands on experience on integration of ICT and pedagogy. Hence the pre-service teacher education curriculum should be enhanced with more activities that provide hand on experience in ICT and pedagogy integration.

3. Since the complementary model is found to reduce the confidence in using ICT and knowledge in ICT peripherals as adequate hands on practice was not provided, this model should be discouraged by teacher education institution for ICT training.
4. IIID was found to be effective than the integrated and complementary model. Hence the teacher education institutions can adapt this model for preparing pre-service teachers to integrate ICT in their teaching.

5. Since the effectiveness of IIID was observed, it may be used by the teacher educators to inculcate ICT competency and techno pedagogical competency in pre-service teachers.

6. Self study using tutorials and online courses was found to assist pre-service teachers to learn themselves. Similarly teacher educators can equip themselves to integrate ICT in their teaching and learning by using ICT for their self learning.

7. Though the students had the attitude to use power point, Tamil typing was found to be a stopper. Hence curriculum designers need to give due consideration for including such tools as part of the ICT infusion.

8. IIID was found to create a motivation among the pre-service teachers, teacher educators, teachers and the students. So teacher education institutions can make ICT use in teaching as mandatory during internship. NCTE can make the use of ICT infused lesson during internship as a mandatory practicum component.

9. As the ICT Infused Instruction Design in methodology of teaching mathematics was found to be effective, universities can attempt to develop such ICT infused curriculum for methodology courses.

10. As knowledge on ICT, ICT skills, attitude towards ICT and confidence has its impact on the pre-service teachers techno pedagogical competency policy makers can bring in a method of certifying the teachers on ICT competency.

11. As IIID is designed to fill the gap between the recommendations at national and international level, instructional strategies and learning activities, it can be used by the educationist to have a curriculum that meets the standards.

12. As the elective course ‘Computers in Education’ was found to be ineffective, it needs to be revised and improved by the curriculum designers of TNTEU.
13. The need for the teacher educator to be trained on ICT integration is realised from this study. So action plans for training the teacher educators’ needs to be formulated by the policy makers, universities and institutions.

14. Practicum components can be resigned to provide opportunities for the student teachers to practice ICT pedagogy integration.

5.15. SUGGESTIONS FOR FURTHER RESEARCH

The present study had its limitations and delimitations. It is therefore, desired that similar studies may be conducted after overcoming the limitations. Further, the experimental studies like this need to be repeated in different setting to establish the validity and reliability of the study. The following insights on further research that could be conducted are put forth.

1. Infusing ICT into curriculum prepares pre service teachers for better ICT integration. So mega researches on such designs should be conducted to well establish the impact of ICT infused model which will contribute to acceptance of this model worldwide.

2. A case study can be done to reason out the causes that contributes to development of ICT competency while applying the infused model

3. A qualitative research can be done to study in-depth of the process of ICT skills development among the pre service teachers.

4. A comparative study could be done by analyzing the effect of ICT infused design before and after internship.

5. A case study of the pre service teachers can be done to study all the aspects of changes that takes place while implementing ICT infused design

6. A study to find an appropriate training model to train teacher educators on ICT integration can be studied.

7. A post impact study of this research can be done.

8. A study to find the appropriate method of training for a learner having particular type of learning style can be studied