Chapter I

INTRODUCTION AND CONCEPTUAL FRAMEWORK
CHAPTER I

INTRODUCTION AND CONCEPTUAL FRAMEWORK

INTRODUCTION

The concept of teacher education is undergoing a rapid change throughout the world. It has widened its scope from mere training of a person to become a functional teacher as conceived earlier. It involves the acquisition of that type of knowledge or information, skill and ability which helps a teacher to discharge his/her professional duties and responsibilities effectively and efficiently. It means shaping and reshaping the attitudes, habits and personality of a teacher. As the educational scenario goes through a vast change in the newly emerging society, the teachers need to be well-equipped with knowledge which would create curiosity in the students to learn new things.

Teacher education is defined as “All formal and informal activities and experiences that helps to qualify a person to assume the responsibility as a member of the educational profession or to discharge his/her responsibility most effectively” (Good, 1945, p. 409).

A sound programme of professional education of teachers is essential for qualitative improvement of education. Investment in teacher education can yield very rich dividends because the financial resources required are small when measured against the resulting improvements in the education of millions (Report of the Education Commission, 1964-66, p. 87).
The Encyclopaedia of Educational Research defines teacher education as “the total education experiences which contribute to the preparation of a person” (1960, p. 1462). But the term is completely employed to designate the programme for the courses and other experiences offered by an educational institute for the announced purposes of preparing persons for teaching and other educational service and for contributing to their growth in competency for such service.

TEACHER EDUCATION

Teacher education is that knowledge, skill and competencies which are relevant to the profession of a teacher. Since teaching is an art and trained teacher alone can play a vital role in education as well as in the society, the Secondary Education Commission (1952-53) rightly states, “We are, however, convinced that the most important factor contemplated in educational reconstruction is the teacher, his personal qualities, his educational qualifications, his professional training and the place that he occupies in the school as well as in the community”.

Teacher education emphasises the development of specific knowledge, attitude, skills and behaviour patterns which an individual requires to perform a job adequately. So this education should develop those skills which are needed for a prospective teacher to become an excellent professional teacher. The purpose of training is to bring excellence in the specific job for which the individual is being trained.
Teacher education is not teaching the teacher to teach, but it is to learn to teach and teach to learn. Teacher education is a process aiming at the formation of positive attitudes towards teaching profession. So, a sound programme for professional education of teachers is essential for the quality improvement in education (Aggarwal, 1985).

NEED FOR TEACHER EDUCATION

Training is essential for every teacher. A trained teacher can do more than untrained teachers. The profession demands that the present day teacher grows to the expectations and required demands of the present day society. Many skills are needed to communicate the information effectively such as the skill of questioning, illustrating, demonstrating, explaining and the skill of logically sequencing the subject matter. Teaching is not only confined to impart knowledge of subject matter to others. In a wider perspective, teaching aims at an all-round development of personality. Skills or attitudes can be developed through systematic training. A systematised knowledge is required in order to achieve these skills and attitudes which require training (Kakkad, 1988).

FUNCTIONS OF TEACHER EDUCATION

(i) Better understanding of the student: - Teacher training is a must as it enables the potential teacher to understand the student better. The knowledge of educational psychology helps him a lot in dealing with children scientifically.
(ii) Building confidence:- Teacher training builds confidence in the potential teachers. A trained teacher can essentially face the class with confidence.

(iii) Methodology of teaching:- Through training, the future teacher becomes familiar with the methodology of teaching. He also gets essential knowledge of methods required for a particular subject.

(iv) Building a favourable attitude:- A sort of brainwash is also done through training. It helps in building favourable attitudes towards the teaching profession. During the course of training, many doubts of the teacher trainees' stand removed. It results in creation of love and respect for the teaching profession.

(v) Familiarising with the latest in education:- Teacher training programme familiarises the future teachers with what is latest in education.

ROLE OF NCTE IN TEACHER EDUCATION

The National Council for Teacher Education, in its previous status since 1973, was an advisory body for the Central and State Governments on all matters pertaining to teacher education, with its secretariat in the Department of Teacher Education of the National Council of Educational Research and Training (NCERT). The National Policy on Education (NPE), 1986 and the Programme of Action hereunder, envisaged a National Council for Teacher Education with statutory status and necessary resources as a first step for overhauling the system of teacher education. The National Council on

The National Council for Teacher Education (NCTE) was set up as a statutory body by an Act of Parliament, 1993 to achieve planned and co-ordinated development of teacher education throughout the country and to ensure the maintenance of norms and standards in teacher education. It covers the whole of teacher education starting from pre-primary upto senior secondary and non-formal and adult education. It has also brought out a number of publications on competency-based and commitment-oriented teacher education for quality school education through in-service, pre-service and distance education systems (Rao, 2004).

FUNCTIONS OF NCTE

NCTE has taken several initiatives from time to time for improving the professional quality of teachers and has been concerned with the challenge of making teacher education relevant to the changing context of education and societal needs. In order to perform the assigned functions of the quality improvement, co-ordinated development and innovations in teacher education, there are four regional committees with headquarters at Delhi to carry out the work of NCTE. As per NCTE Act, each regional committee possesses an authority to recognise institutions offering course of training in teacher education and also give permission for a new course or training by recognised institution. The important functions of NCTE are to co-ordinate and monitor
teacher education and its development in the country. They will examine and
review periodically the implementation of the norms, guidelines and standards
laid down by the council and to suitably advise the recognised institutions.

For making many innovations in education, NCTE will undertake and
support researches, surveys and studies relating to manpower planning,
effectiveness of various models in teacher education and the status of
infrastructure facilities in teacher education. In order to gear the educational
system to international scenario, it reviews the existing curriculum,
instructional process, evaluation techniques, creating awareness for
developing professional quality in teachers, instituting teacher education
awards, identifying innovations and disseminating their results. Also, NCTE
takes all necessary steps to prevent commercialisation of teacher education
(Rao, 2004).

RECOMMENDATIONS OF NCTE TO TEACHER TRAINING INSTITUTES

NCTE has made various suggestions for teacher training institutions for
improving the quality of teacher education. The teacher trainees should make
best use of library, multi-purpose laboratory and other available resources of
the institutions. The teacher trainees should be provided training in the
preparation and development of effective low-cost teaching learning materials
and how to make their best use in the classrooms. For making the teacher
education programme innovative, the institutions should document and
disseminate useful and relevant information to other teacher training
institutions. For capacity building of the teacher trainees they should be
exposed to various seminars and workshops on various issues. The trainees should use the latest available information technology for strengthening their teacher training programme. For capacity building, inter-institution and inter-state visits should be organised for teacher trainees (Rao, 2004).

SECONDARY TEACHER EDUCATION

Secondary education occupies a very crucial place in education, not only because the children become more mature and develop additional psychological characteristics but also because of its special educational functions. The curriculum for this stage becomes enriched and stands in the mid-way of elementary and senior secondary schools. Further, it is an independent stage of education for the majority of students who prefer to enter into life. The teachers are expected to play somewhat different roles and prepare students for two-fold responsibilities to cater the needs of students for life and prepare them for senior secondary schools. But the major consideration which demands the attention of teacher educators is to maintain the continuity of integrated approach in curriculum development and its transactional strategies and prepare students for subject-centred approach in future. Since teachers at secondary stages have to deal with adolescents they must understand their problems and offer solutions to them including their social transformation maintaining their uniqueness. This requires a teacher education programme rich in content to realise the following objectives:
i. To maintain the continuity of elementary education and to prepare students for the study of diversified courses and appropriate selection of subjects at the senior secondary stage.

ii. To empower the prospective teachers to adopt disciplinary approach in teaching and to develop among students interest in such studies.

iii. To train them in the use of Information and Communication Technology (ICT), its advantages, disadvantages and ways of safeguarding from unethical practices.

iv. To curtail the educational and cultural gap between the rich and the poor and the schools meant for them by adopting suitable educational approaches.

v. To develop among the prospective teachers love for Indian culture and its contribution to the world and to inculcate a sense of national pride and identity.

vi. To enable them to develop the teaching competencies and performance skills for the subjects they have to teach, using appropriate aids including ICT, organise supplementary educational activities and elicit community co-operation.

vii. To empower student teachers not only to understand the nature of subjects but also the unity and integrity of knowledge.

viii. To prepare them for the development of personality, inculcation of values, fostering the spirit of citizenship and patriotic feeling.
ix. To create among them the awareness of environmental protection and need to maintain an ecological balance.

x. To enable students to acquire, construct, process and utilise knowledge as per the requirement of circumstances.

xi. To help them to grasp the main thrust of the curriculum and develop appropriate transactional and evaluation strategies for the same.

xii. To enable them to integrate yogic, healthy, kinaesthetic, aesthetic and inclusive education with other educational activities.

xiii. To enable the prospective teachers to orient and sensitise the students with care and caution about Life Skill Education, HIV/AIDS preventive education and reproductive health.

xiv. To develop among them the capacity for undertaking action research for improving the quality of education, for the solution of its problems and to evolve the culture specific and community oriented pedagogy.

xv. To help them evolve happy and healthy school and community relationship and promote interest in life-long learning.

xvi. To acquaint them with Indian nation's distinctive character of 'unity in diversity' and adopt curriculum development practices to strengthen them (Dash, 2004).
The curriculum for the secondary teacher education course has to be developed keeping in view the concerns articulated here under:

i. Objectives of secondary education/teacher education, updated curricular content with emphasis on competencies and values,

ii. Appreciation of the regional conditions and the main stream of nation’s life,

iii. Necessity to improve the standard and quality of school education and

iv. Utilisation of the locally available resources (Reddy, 2006).

The curriculum of secondary teacher education needs to maintain continuity with elementary school curriculum in certain respects. However, it has to become an independent entity in itself as the teachers at this stage are required to deal with mature students who have been exposed to many-sided social and life experiences. The students at this stage acquire new psychological characteristics for addressing appropriate teaching strategies that are to be deployed.

The curriculum of teacher education at this stage may include cultural heritage of India, its unity and diversity, its relevance, Indian philosophy, emerging Indian society, social problems, modernisation, westernisation, evil effects of violence and terrorism, challenges of value inculcation, HIV/AIDS preventive education, educational experiments, psychology of teaching and learning, mental health, deviant behaviour, sub-normal and abnormal children,
pedagogical analysis of certain areas of social sciences and sciences, concentration of attention, environmental awareness, teaching competencies in school subjects, development of scientific temper, development of linguistic and mathematical skills, viewing learning as a life long activity, working with community, general health, reproductive health, hygiene, yogic and physical education, art of meditation, Information and Communication Technology, counselling and guidance, school management, action research, working with community status, history, problems and issues of secondary education, teachers and their social role, communal harmony and social cohesion, disaster management, development of patriotic feeling and citizenship. These theoretical components should focus on the realisation of the goals of the curriculum and the transaction of its contents.

The pedagogy of teacher education at this stage should consist of practice teaching, development of reading materials for students of various stages in social science, physical sciences, language and mathematics and internship of substantial duration in a school under the supervision of a teacher educator. The student teachers will be required not only to acquire proficiency in the planning of lessons and their delivery but also learn the practical management of the class to arrange and organise school assemblies, prayers, promoting habits of cleanliness among the students and the school premises and proper seating arrangements for students. Practice of teaching should be a rigorous task which will include voice culture and its modulation. Emphasis will be laid on enhancing communication skills and use of ICT and
on improvising and using teaching aids. They would be encouraged to prepare teaching aids by themselves. Every teacher in the school has to maintain certain records. The prospective teachers will learn this art and participate in the evaluation of students. They would also try to prepare various types of tests as part of their curriculum (Gopalakrishnan, 2010).

UNDERSTANDING TECHNOLOGY

Technology can be defined as the tools created by human knowledge of how to combine resources to produce desired products to solve problems, fulfil needs or satisfy wants. This definition implies two uses of the word. The first use describes an individual tool or technique and the second use encompasses all tools, techniques, and knowledge. If one chooses to use the first sense of the term there can be an internet technology that specifically refers to the tool, namely, the internet. Likewise there is a "computer technology," a "word-processing technology," and "microscope technology" (collectively called technologies). Using the second sense of the term, there can be educational technology, which describes the sum of the tools, techniques, and collective knowledge applicable to education. This definition includes both analogue technologies (chalkboard, pencil, and microscope) and digital technologies (the computer, blogging, and internet). Our view does not distinguish between older technologies (the chalkboard, the overhead projector, the hand-held calculator, and the pencil) and newer technologies (interactive white board, MP3 player and bloggs) (Koehler& Mishra, 2008).
TECHNOLOGY INTEGRATION IN TEACHER EDUCATION

Teacher education and teacher professional development are facing important quantitative and qualitative challenges. It is estimated that 15–35 million new teachers are needed to achieve UNESCO's goal of 'Education for All' (UNESCO, 2002). Asian-Pacific region teacher education faces many challenges due to widespread changes in educational and curriculum reforms. Paradigms and approaches, derived from promising conceptual and technical tools and capable of renewing instruction and activity systems, are needed to prepare teachers for 21st century teaching and learning. The value of technology in teaching and learning has been a subject of some contention in the education community for some time. Teachers' use of technologies has an important role in education in the 21st century. Technology can provide powerful environments eliciting modern views of learning but may not change teachers' beliefs and practice. It depends on how teachers interpret the uses of tools and how they use them to transform the learning processes (Riel, 1998).

INTEGRATING INFORMATION AND COMMUNICATION TECHNOLOGY: THE CHALLENGE AND THE FUTURE OF TEACHER TRAINING

With the increasing disparity between technology's relatively discreet presence in classrooms and its ever increasing popularity in the society at large, it has become imperative for universities, and especially faculties and departments involved in teacher training, to bridge this technological gap. With the advent of the knowledge era, teacher education needs to prepare teachers to face the changing technological contexts and to model pedagogies and tools for better forms of learning. Despite much enthusiasm about the
roles of technology in education, its role in transforming teacher learning, in ways aligned with advances in the learning sciences and contemporary socio-cultural perspectives few changes have occurred.

The adoption of ICT is an overarching trend that is producing rapid changes in all sectors of society and creating new demands for schools. More than ever before, schools are expected to educate citizens who are capable of problem solving, teamwork, critical thinking and working with knowledge. Advances in the learning sciences are instrumental in re-defining and expanding on what it means to learn for understanding. This is a time of opportunity for transforming teacher education and professional development activity systems for teachers in ways that lead to increased emancipation of the learner, be it at the elementary, secondary, or tertiary level, rather than new forms of control and the narrowing of experience in the classroom (Luke, 2000).

The advent of internet-based technology in the classroom acts as an impetus for the re-conceptualisation of learning; the idea that ICT has the potential to transform teaching and learning is broadly held (UNESCO, 2002). Teacher educators need to keep abreast of contextual changes: Pre-service and in-service teachers have to be knowledgeable about technological changes and to exercise deliberative and creative thinking in regard to the growing repertoire of pedagogies and tools for learning.

In school, word processing, drill and practice software, and computer assisted instruction are common. These uses of technology may be important initial steps; but they fall short of the tremendous potential of technology for
re-conceptualising and transforming classroom based teaching and learning. To prepare students and teachers for the current era, there is a need for teacher educators to expand their activity beyond traditional views of teaching and learning. Borrowing from activity theory, they are challenged to understand how the digital technologies (new tools) can create powerful learning environments (objects-outcomes) in which students and teachers (communities) can become engaged learners (roles), take responsibility for their own learning (rules), and co-construct their knowledge (routines-outcomes). Teacher educators themselves are well positioned to model pedagogy and to design e-learning for teacher change.

Preparing future teachers who know how to integrate effective use of ICT in their curriculum remains a challenging goal for teacher preparation programmes. Studies have shown that many pre-service teachers are not prepared to use technology and integrate it into the curriculum. In order to increase the technology proficiency of new teachers in classrooms, training institutions should increase the level of technology integration in their own academic programmes.

Teaching with new and emerging ICT is a complex task. Recent frameworks have identified that teaching with technology is much more than simply using computers for instruction. Effective technology integration in learning activities demands an understanding of how ICT tools relate to content area topics and pedagogy. In addition to Pedagogical Content Knowledge (PCK), student teachers need opportunities to begin developing
Technological Pedagogical Content Knowledge (TPCK) to understand what technology to use, when to use it and how to use it to support student learning.

In addition, recent revisions of National Educational Technology Standards for Students and Teachers have "raised the bar" for effective technology use from an emphasis on basic productivity skills to development of creativity and innovation, communication and collaboration, research and information fluency, digital citizenship, critical thinking, problem solving, and decision making with information and communication technology. It is no longer enough to simply teach word-processing, internet searches or presentation skills. Students need to acquire digital age literacy skills and learn how to responsibly use technology as a learning tool for acquiring content area information, solving problems, sharing knowledge, creating original works and innovative ideas, cultivating higher-order thinking, developing global awareness and communicating and collaborating on learning tasks with multiple audiences beyond the classroom walls.

TECHNO-PEDAGOGY

Literally, 'pedagogy' refers to the *art-science* of teaching and 'techno' refers to the *art-skill* in handcrafting, derived from the Latin 'texere' (to weave or fabricate). Here, 'techno' is a qualifier; it intersects or crosses the meaning of 'pedagogy'. Techno-pedagogy refers to weaving the techniques of the craft of teaching into the learning environment itself. It requires conscious recognition of the mediated learning environment in order to maximise the ease and clarity in the transmission of information. It may also be used to describe the medium
specific learning strategies inherent in each technological form, where the medium facilitates or contributes to the learning process. Techno-pedagogy, then, necessarily implies that there is not only one valid or legitimate method of instruction per discipline nor per medium (nor per learner). Creativity is an essential aspect of the successful learning environment. Additionally, generating multiple strategies for learning (per concept, per medium and/or per learner) within one mediated learning environment (or product) brings to fruition the idea of a post modern pedagogy, defined in terms of praxis. It is a metaphorical interweaving of fact and fiction, text and texture, imagination and myth, word and image, language and symbol. The educational media developer must always strive to reach as many factors involved in the contextual interplay as possible, simultaneously frustrated and awe-struck in awareness that such knowledge will never be complete (Koehler & Mishra, 2008).

ROLE OF TECHNO-PEDAGOGICAL SKILL IN TEACHER EDUCATION

Educational technologies existed long before the advent of computers. From the abacus to the VCR, from the slate to the calculator, from printed textbooks to CD ROMs, students and teachers have made use of numerous technologies to aid in the construction and presentation of educational materials.

Technologies seem to help student teachers overcome a great array of teaching challenges or difficulties encountered during their teaching. The greatest advantage of using technologies appears to be the variety of activities that can be undertaken in the classrooms. Technology appears to help student
teachers diversify both their teaching strategies and the activities they expect learners to accomplish.

Technology helps teacher trainees to be more professional as they allow them to have an increased access to a great variety of up-to-date resources to improve teaching/learning activities. Technologies help them present new concepts, theories or ideas and it helps to nurture student motivation, an important challenge, especially at the high school level.

Technology is a very useful means to increase communication with various people involved in their field practice (co-operating teacher, university supervisor, colleagues and peers, other professors, parents, etc.). Use of Information and Communication Technology increases collaboration and communication during the process of teaching-learning.

Technology integration helps student teachers in various ways to face pedagogical and other challenges encountered during their practice teaching programme. ICT allow student teachers to profit from a vast network which can help them maximise their academic performance and even increase their wellbeing in sometimes difficult situations that can occur in schools. Integrating technology in the classroom redefines established teacher-learner relationships and teaching-learning styles.

A FRAMEWORK FOR TEACHER’S KNOWLEDGE FOR TECHNOLOGY INTEGRATION

Educational technologies both enable and require new approaches to learning and assessment that transcend our hierarchical, industrial-based
educational models. Just because we can change education, does not mean that we will. And just because a change is required, it does not mean it will happen. Educational technology leadership is complex and contextual; it can be riddled with both consensus and conflict; it is hard work that requires courage.

Change in education is constant and complex educational technology transforms the ways in which teachers and learners can work, learn, and communicate in schools and on campus. Educational technology leadership is needed as schools and campuses both embrace and reject the changes that technology brings.

With the increasing disparity between technology’s relatively discreet presence in classrooms and its ever increasing popularity in the society at large, it has become imperative for universities, and especially faculties and departments involved in teacher training, to bridge this technological gap. Many studies (Karsenti and Larose, 2001) show, among other findings, that while new teachers have certain elements of knowledge about ICT they have few or no practical skills allowing them to integrate ICT into their professional practice. Haughey (2000) agrees with these findings and adds that until very recently, education was mostly concerned about “learning about technologies rather than working with technologies as part of learning experiences.” Teacher educators today are faced with the responsibility of preparing pre-service teachers to integrate technology into instruction to enhance learning. Studies have shown that many pre-service teachers are not
prepared to use technology and integrate it into the curriculum. Teachers have more resources available through technology than ever before, but have not received sufficient training in the effective use of technology to enhance learning.

The International Society for Technology in Education (ISTE) states that all candidates seeking certification or endorsements in teacher preparation should meet the following educational technology standards. Teachers demonstrate a sound understanding of technology operations and concepts. Teachers implement curriculum plans that include methods and strategies for applying technology to maximise student learning. It is the responsibility of faculty across the university and at co-operating schools to provide opportunities for teacher candidates to meet these standards (Handler & Strudler, 1997).

In order to prepare our pre-service teachers to integrate technology into instruction and effectively meet the needs of diverse students, a series of assignments are developed that integrates a number of best practice pedagogies.

Teaching is a complex cognitive skill occurring in an ill-structured, dynamic environment. There are clearly many knowledge systems that are fundamental to teaching, including knowledge of student thinking and learning, and knowledge of subject matter. Historically, knowledge bases of teacher education have focused on the content knowledge of the teacher (Shulman, 1986).
When teachers invite technology into their classrooms, they are inviting change in at least four areas at once (Koehler & Mishra, 2008).

i. content knowledge

ii. pedagogical knowledge

iii. pedagogical content knowledge, and

iv. techno-pedagogical knowledge

More recently, teacher education has shifted its focus primarily to pedagogy, emphasising general pedagogical classroom practices independent of subject matter and often at the expense of content knowledge. Shulman (1986) advanced thinking about teacher knowledge by introducing the idea of Pedagogical Content Knowledge (PCK). He claimed that the emphasis on teachers' subject knowledge and pedagogy were being treated as mutually exclusive domains in research concerned with these domains. The practical consequence of such exclusion was production of teacher education programmes in which a focus on either subject matter or pedagogy dominated. To address this dichotomy, he proposed considering the necessary relationship between the two by introducing the notion of PCK. PCK exists at the intersection of content and pedagogy. Thus, it goes beyond a simple consideration of content and pedagogy in isolation from one another. PCK represents the blending of content and pedagogy into an understanding of how particular aspects of subject matter are organised, adapted and represented for instruction. Shulman argued that having knowledge of subject matter and
general pedagogical strategies, though necessary, was not sufficient for capturing the knowledge of good teachers. To characterise the complex ways in which teachers think about how particular content should be taught, he argued for "pedagogical content knowledge" as the content knowledge that deals with the teaching process, including "the ways of representing and formulating the subject that make it comprehensible to others". At the heart of PCK is the manner in which subject matter is transformed for teaching. This occurs when the teacher interprets the subject matter and finds different ways to represent it and make it accessible to learners. The notion of PCK has been extended and critiqued by scholars after Shulman. In fact, Shulman's initial description of teacher knowledge included many more categories, such as curriculum knowledge and knowledge of educational contexts. Matters are further complicated by the fact that Shulman has himself proposed multiple lists, in different publications, that lack, in his own words, "great cross-article consistency". The emphasis on PCK is based on Shulman's acknowledgement that Pedagogical Content Knowledge is of special interest because it identifies the distinctive bodies of knowledge for teaching. It represents the blending of content and pedagogy into an understanding of how particular topics, problems, or issues are organised, represented, and adapted to the diverse interests and abilities of learners, and presented for instruction. Traditional classrooms use a variety of technologies, from textbooks to overhead projectors, from typewriters in English language classrooms to charts of the periodic table on the walls of laboratories. However, until recently, most technologies used in classrooms had been rendered "transparent" or in other
words, they had become commonplace and were not even regarded as technologies. In contrast, the more common usage of technology refers to digital computers and computer software, artefacts and mechanisms that are new and not yet a part of the mainstream. Thus, though Shulman’s approach still holds true, what has changed since the 1980s is that technologies have come to the forefront of educational discourse primarily because of the availability of a range of new, primarily digital, technologies and requirements for learning how to apply them to teaching. These new technologies incorporate hardware and software such as computers, educational games, internet and the myriad applications supported by it.

CONTENT KNOWLEDGE

Content Knowledge (CK) is knowledge about the actual subject matter that is to be learned or taught. The content to be covered in high school social studies or algebra is very different from the content to be covered in a graduate course on computer science or art history. Clearly, teachers must know and understand the subjects that they teach, including knowledge of central facts, concepts, theories, and procedures within a given field; knowledge of explanatory frameworks that organise and connect ideas; and knowledge of the rules of evidence and proof (Shulman, 1986). Teachers must also understand the nature of knowledge and inquiry in different fields. Teachers who do not have these understandings can misrepresent those subjects to their students.
PEDAGOGICAL KNOWLEDGE

Pedagogical Knowledge (PK) is deep knowledge about the processes and practices or methods of teaching and learning and how it encompasses, among other things, overall educational purposes, values, and aims. This is a generic form of knowledge that is involved in all issues of student learning, classroom management, lesson plan development and implementation, and student evaluation. It includes knowledge about techniques or methods to be used in the classroom; the nature of the target audience; and strategies for evaluating student understanding. A teacher with deep pedagogical knowledge understands how students construct knowledge, acquire skill and develop habits of mind and positive dispositions toward learning. As such, pedagogical knowledge requires an understanding of cognitive, social, and developmental theories of learning and how they apply to students in their classroom.

PEDAGOGICAL CONTENT KNOWLEDGE

The idea of Pedagogical Content Knowledge is consistent with, and similar to, Shulman’s idea of knowledge of pedagogy that is applicable to the teaching of specific content. This knowledge includes knowing what teaching approaches fit the content, and likewise, knowing how elements of the content can be arranged for better teaching. This knowledge is different from the knowledge of a disciplinary expert and also from the general pedagogical knowledge shared by teachers across disciplines. PCK is concerned with the representation and formulation of concepts, pedagogical techniques, and knowledge of what makes concepts difficult or easy to learn, knowledge of
students' prior knowledge, and theories of epistemology. It also involves knowledge of teaching strategies that incorporate appropriate conceptual representations in order to address learner difficulties and misconceptions and foster meaningful understanding. It also includes knowledge of what the students bring to the learning situation, knowledge that might be either facilitative or dysfunctional for the particular learning task at hand. This knowledge of students includes their strategies, prior conceptions, misconceptions that they are likely to have about a particular domain, and potential misapplications of prior knowledge.

TECHNOLOGY KNOWLEDGE

Technology Knowledge (TK) is knowledge about standard technologies, such as books, chalk and blackboard, and more advanced technologies, such as the internet and digital video. This involves the skill required to operate particular technologies. In the case of digital technologies, this includes knowledge of operating systems and computer hardware, and the ability to use standard sets of software tools such as word processors, spreadsheets, browsers, and e-mail. TK includes knowledge of how to install and remove peripheral devices, install and remove software programmes, and create archive documents. Most standard technology workshops and tutorials tend to focus on the acquisition of such skills. Since technology is continually changing, the nature of TK needs to shift with time as well. For instance, many of the examples given above (operating systems, word processors, browsers, etc.) will surely change, and may be even disappear, in the years to
come. The ability to learn and adapt to new technologies (irrespective of what the specific technologies are) will still be important.

TECHNOLOGICAL CONTENT KNOWLEDGE

Technological Content Knowledge (TCK) is knowledge about the manner in which technology and content are reciprocally related. Although technology constrains the kinds of representations possible, newer technologies often afford newer and more varied representations and greater flexibility in navigating across these representations. Teachers need to know not just the subject matter they teach but also the manner in which the subject matter can be changed by the application of technology. For example, consider Geometer’s Sketchpad as a tool for teaching geometry. It allows students to play with shapes and forms, making it easier to construct standard geometry proofs. In this regard, the software programme merely emulates what was done earlier when learning geometry. However, the computer programme does more than that. By allowing students to “play” with geometrical constructions, it also changes the nature of learning geometry itself; proofs by construction are a form of representation in mathematics that was not available prior to this technology. Similar arguments can be made for a range of other software products.

TECHNOLOGICAL PEDAGOGICAL KNOWLEDGE

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.

TECHNOLOGICAL PEDAGOGICAL CONTENT KNOWLEDGE

Technological Pedagogical Content Knowledge (TPCK) is an emergent
form of knowledge that goes beyond all three components (content, pedagogy,
and technology). This knowledge is different from knowledge of a disciplinary or
technology expert and also from the general pedagogical knowledge shared by
teachers across disciplines. TPCK is the basis of good teaching with technology
and requires an understanding of the representation of concepts using
technologies; pedagogical techniques that use technologies in constructive ways
to teach content; knowledge of what makes concepts difficult or easy to learn and
how technology can help address some of the problems that students face;
knowledge of students’ prior knowledge and theories of epistemology; and
knowledge of how technologies can be used to build on existing knowledge and
to develop new epistemologies or strengthen old ones. TPCK represents a class of
knowledge that is central to teachers’ work with technology. This knowledge
would not typically be held by technologically proficient subject matter experts,
or by technologists who know little of the subject or of pedagogy, or by teachers
who know little of that subject or about technology. Thus, technology integration in teaching and learning argues that developing good content requires a thoughtful interweaving of all three key sources of knowledge: technology, pedagogy, and content (figure 1.1). Quality teaching requires developing a nuanced understanding of the complex relationships between technology, content, and pedagogy, and using this understanding to develop appropriate, context-specific strategies and representations.

**FIGURE 1.1 TECHNO PEDAGOGICAL CONTENT KNOWLEDGE**
Reproduced from http://tpack.org/

Productive technology integration in teaching needs to consider all three issues not in isolation, but rather within the complex relationships in the system defined by the three key elements. The traditional view of the
decisions; the pedagogical goals and technologies to be used follow from a choice of what to teach.

However, things are rarely that clear cut, particularly when newer technologies are considered. The introduction of the internet can be seen as an example of a technology whose arrival forced educators to think about core pedagogical issues. So, in this context, it is the technology that drives the kinds of decisions that one makes about content and pedagogy.

APPLYING THE TPCK FRAMEWORK TO PEDAGOGY

How are teachers to acquire an understanding of the complex relationships among content, pedagogy, and technology? The standard approach suggests that teachers simply need to be trained to use technology. Underlying this approach is a view of technology that sees it as being a universally applicable skill; unlocking the power and potential of technology can be achieved by acquiring basic competency with hardware and software packages. This approach is best exemplified by the plethora of state and national technology standards that have been implemented recently and that emphasise enhancing teachers’ knowledge of current versions of hardware and software. The leap of faith, however, is that by demonstrating their proficiency with current software and hardware, teachers will be able to successfully incorporate technology into their classrooms. Lankshear (1997) described this emphasis as a form of applied technocratic rationality a view that technology is self-contained and has an independent integrity, and that to unlock its potential and power requires merely learning certain basic skills.
Most scholars working in this area agree that traditional methods of technology training for teachers - mainly workshops and courses are ill suited to produce the “deep understanding” that can assist teachers in becoming intelligent users of technology for pedagogy (Koehler & Mishra, 2008).

THE RAPID RATE OF TECHNOLOGY CHANGE

Training teachers to use specific software packages not only makes their knowledge too specific to be applied broadly, but it also becomes quickly outdated. Technology is changing so fast that any method that attempts to keep teachers up to date on the latest software, hardware, and terminology is doomed to create knowledge that is out of date every couple of years. More recent standards, such as those of the International Society for Technology (ISTE) and the National Council for Accreditation of Teacher Education (NCATE, 1997) have moved away from an emphasis on just basic skills and have enumerated a series of higher order goals that are essential for effective pedagogy with technology (Glenn, 2002; Handler & Strudler, 1997).

A review of the recent teacher education research regarding technology will show numerous examples of teacher education programmes that have implemented instructional technology in ways that encourage integration (Hewson & Hewson, 1988). Shulman (1987) argued, the goal of teacher education is not to indoctrinate or train teachers to behave in prescribed ways, but to educate teachers to reason soundly about their teaching as well as to perform skilfully. Sound reasoning requires both a process of thinking about what they are doing and an adequate base of facts, principles and experiences
from which to reason. Teachers must learn to use their knowledge base to provide the grounds for choices and action. Good teaching is not only effective behaviourally, but must also rest on a foundation of adequately grounded premises.

GUIDING PRE-SERVICE TEACHERS IN DEVELOPING TECHNOLOGICAL PEDAGOGICAL CONTENT KNOWLEDGE

Two hundred years ago, the predominant belief about preparing teachers for teaching was that knowing the content at a particular level was adequate preparation for teaching that content at that level. Teachers needed to know and understand the content determined by the grade they planned to teach. An elementary reading teacher needed to be able to read, write, and compute at the elementary level. At the secondary level, a geography teacher needed a secondary level geography understanding and a mathematics teacher needed a secondary level mathematical understanding. Teachers taught what they were taught, as they were taught. That was yesterday.

Today beliefs about what preparation teachers need for teaching have significantly changed. Teachers need to know the content they are to teach, but they must also have knowledge about teaching and learning that content—the pedagogy of teaching. Shulman (1986) challenged this framework for, preparing teachers indicating that effective teachers rely on a specialised knowledge that is more than simply knowing the subject matter and the pedagogy of teaching. He contended that effective teachers need an integrated knowledge base—one that relies on an integration of multiple domains of
knowledge (knowledge about subject matter, learners, pedagogy, curriculum, and schools) in order to translate the content in ways that students are able to grasp. Shulman described this vastly different teacher knowledge as Pedagogical Content Knowledge (PCK).

Yet, if teacher preparation methods courses continue as they have been, focused on the teaching strategies and classroom management, planning for instruction, and assessment of learning developed from the directions of the twentieth century, they will most certainly rob the children of tomorrow. With the addition of an integration of new and emerging twenty first century technologies as tools for learning, the preparation of teachers must evolve toward preparing pre-service teachers to teach in ways that help them to guide their students in learning with appropriate technologies Today, the twenty first century, teacher preparation methodology courses must assume the task of guiding pre-service teachers toward the abilities and ways of thinking or teaching today and tomorrow.

Technological Pedagogical Content Knowledge (TPCK) defines that body of knowledge that teachers now need for teaching with and about technology in their assigned subject areas and grade levels. TPCK is described as the interconnection and intersection of content, pedagogy (teaching and student learning), and technology. However, TPCK is more than a set of multiple domains of knowledge and skills that teachers need for teaching their students particular subjects at specific grade levels. TPCK is a way of thinking within these multiple domains of knowledge.
Shavelson, Li, and Ayala (2003) bring clarity to thinking about the thinking involved in TPCK: Declarative (knowing that, including definitions, terms, facts, and descriptions), procedural (knowing how that refers to sequences of steps to complete a task or subtask), schematic (knowing why by drawing on both declarative and procedural knowledge, such as principles and mental models), and strategic (knowing when and where to use domain specific knowledge and strategies, such as planning and problem solving together with monitoring progress towards a goal). Accumulating these notions suggests that TPCK is a way of thinking strategically while involved in planning, organising, critiquing, and abstracting for specific content, specific student needs, and specific classroom situations while concurrently considering the multitude of twenty first century technologies with the potential for supporting students' learning (Niess, 2008).

Incorporating TPCK as a way of thinking strategically into the curriculum of the pre-service methods courses exposes the "wickedness" of the pre-service teacher preparation problem because pre-service teachers have not traditionally experienced learning their subjects with these new and emerging technologies. They have not learned how to learn their content with these technologies as tools for learning. Putnam and Borko (2000, p. 4-15) indicate, "How a person learns a particular set of knowledge and skills, and the situation in which a person learns, become a fundamental part of what is learned." The challenge then becomes one of overcoming and enhancing pre-service teachers' experiences in learning the content that they learned.
without such technologies. How can pre-service teachers gain the experiences that require a change in their mindsets and beliefs about how students need to learn the subject matter content? In other words, how can a teacher preparation programme challenge future teachers to develop new ways of learning their subject with appropriate new and emerging technologies so they are prepared to teach the children of tomorrow?

New teachers must be prepared to redesign and create a curriculum and instruction to prepare their students with the skills of a twenty first century literate citizen. An expanded form of literacy that includes new communication and information skills, the ability to think critically and creatively in problem solving and decision making situations in response to and recognition of the interconnections among systems, a respect for diverse perspectives, and basically the knowledge and skills to successfully face rigorous higher education coursework career challenges and a globally competitive workforce.

Teacher preparation methods courses are typically directed toward helping future teachers gain effective teaching methods and strategies while carefully considering the students' background knowledge and experiences, the school environment, and the learning goals in the curriculum, that is, a way of thinking that results in guiding a diversity of students in the classroom toward learning the content that is taught. With conscious attention to the development of TPCK as a way of thinking, methods courses potentially establish environments for engaging pre-service teachers in integrating their
developing understandings of content, teaching, and learning along with a conscious consideration of the integration of technology in the learning environment. Integrating technology in teaching and learning also exposes broader issues and concerns that pre-service teachers must consider when designing lessons. Therefore, enhancing methods courses to consider developing TPCK's ways of thinking requires that the pre-service teachers are more likely engaged in changing their mindsets and behaviours established from their own personal learning experiences when learning to plan, organise, critique, and abstract for their specific content, specific student needs, and specific classroom situations. Such methods courses provide experiences that enhance the course goals in emphasising the preparation of pre-service teachers in:

(i) Understanding the diversity of students and their learning needs in a technology-mediated classroom,

(ii) Planning and designing learning environments and experiences that meet the diversity of student learning needs in a technology-mediated classroom,

(iii) Developing effective instructional strategies to adequately attend to the diversity of student learning needs in a technology-mediated classroom,

(iv) Identifying effective classroom management strategies to support the diversity of students in learning in a technology-mediated classroom,
Assessing the diversity of student learning in a technology-mediated classroom.

While these may seem to present individual topics, the topics are intertwined in the development of the strategic thinking that pre-service teachers need as they develop TPCK. Planning lessons relies on knowledge of effective instructional strategies that meet specific student learning needs and considers how to integrate technology that effectively guides students in learning. Structuring the curriculum and instruction of methods courses to prepare pre-service teachers to teach with technology in their lesson designs requires attention to the pedagogical reasoning that integrates their knowledge about the students, of the content, of the instructional strategies, managing the classroom, and assessing student learning along with a careful consideration of how technology impacts on how students interact with the subject matter. Equally important, these various topics need to be integrated with appropriate field experiences where the pre-service teachers are provided with opportunities to test their developing ways of thinking for teaching with technology (Niess, 2008).

EXPLORING STUDENT UNDERSTANDINGS IN A TECHNOLOGY-ENHANCED LEARNING EXPERIENCE

Prensky (2001) describes students of the twenty first century as, "digital natives", students with significantly different experiences with information technologies than their teachers. Methods courses structured to develop TPCK must not only attend to the typical diversity of students that the pre-service teachers will encounter; they must attend to the pre-service teachers' understandings of what this digital diversity adds to the mix of
students they will encounter. How these children learn and understand ideas in a technology-enhanced context is likely quite different from how the pre-service teachers learned and understood similar ideas as they were learning-without the use of technology. In other words, preparing pre-service teachers to develop TPCK strategic thinking strategies requires attention to more than the physical, cognitive, cultural, personal, and social developmental levels of the students they will be teaching. Pre-service teachers need opportunities that unveil how students think and learn in technology-enhanced learning environments. Recognition of this broader perception of diversity impacts their planning, teaching, and reflection on instruction (Niess, 2008).

DEVELOPING EFFECTIVE INSTRUCTIONAL STRATEGIES

As pre-service teachers design lessons that integrate various technologies, they have the opportunity to plan for student learning. However, simply hoping that the lesson will "go well" is definitely not a strategy for insuring effective learning. Methods courses must engage pre-service teachers in the identification and exploration of instructional strategies for supporting the learning needs of a diversity of students. Incorporating the proposals from the dynamic matrices used in developing their units provides study groups with experiences in meta-cognitive reflections on the effects of particular strategies for integrating technology in the lessons: What the strategies afford them to do with technology and how the strategies constrain the integration of technology for effective student learning (Niess, 2008).
GAINING EFFECTIVE CLASSROOM MANAGEMENT STRATEGIES

Integrating technology in instruction calls for a teacher's careful attention to classroom management strategies that have potential for guiding students toward a successful learning experience. With technology integrated in learning activities, effective classroom managers must consider (i) motivation and problem prevention as well as (ii) coping with problems effectively (Good & Brophy, 2003). Research findings suggest that teachers who approach classroom management as a process of establishing and maintaining effective learning environments tend to be more successful than teachers who place more emphasis on their roles as authority figures or disciplinarians (Niess, 2008).

EFFECTIVE PLANS FOR TEACHING WITH TECHNOLOGY

Pre-service teachers typically struggle to consider and verbalise the details needed when planning to teach with technology and for this reason need experiences in planning these technology-enhanced lessons. They must be challenged to consider effective classroom management techniques when integrating technology in the instruction and to incorporate these ideas in their plans. With the active, hands-on nature of many technology lessons, pre-service teachers need to think about and develop lesson plans for guiding students with hands-on uses of technologies in ways that continue to value the importance of the focus on the subject matter content. As they think through such a lesson, they are forced to consider important factors for establishing effective classroom management (Niess, 2008).
ASSESSING STUDENT LEARNING WITH TECHNOLOGY

Assessment of student learning is as important as planning lessons for student learning. However beautiful the strategies in the plans, pre-service teachers must determine the extent to which the students met the objectives of the lessons and units—the results. With the addition of learning both with and about the technology, pre-service teachers need to learn how to assess students' knowledge of the subject matter content in an environment where technology is integrated as a tool to think and learn with the technology as a productivity tool, a communication tool, a research tool, and a problem solving and decision making tool.

When technology is added to the educational environment, teachers must consider (i) how technology can be applied to enhance learning, (ii) how the use of technology changes what is learned, and (iii) how technology can be used to enrich the evidence of student learning. New methods, new tools, and new approaches that apply technology to learning must be accounted for when applying technology to the assessment of what is learned and how that learning is known and displayed. Considering the affordances and constraints for multiple assessment strategies when thinking about what students learned with technology is an important experience in learning about different assessment techniques. Classroom tests have been a traditional assessment of learning (Niess, 2008).
NEED TO INTEGRATE TECHNO-PEDAGOGICAL SKILLS IN TEACHER EDUCATION

The aim of teacher education is to develop skills and appropriate knowledge among teacher trainees for using and integrating the correct technology in an appropriate manner. Every teacher trainee should know how to use technology, pedagogy and subject area content effectively in their daily classroom teaching. It is clear that merely introducing technology to the educational process is not enough. One must ensure technological integration since technology by itself will not lead to change. Rather, it is the way in which teacher trainees integrate technology that has the potential to bring change in the education process. Teacher trainees have to make continual decisions about how to best utilise these tools in teaching, learning and assessment. Teaching is no longer just about covering the curriculum by dispensing information, knowledge and skills. The objectives of education have become more complicated. In classrooms of the twenty first century, teachers will need to employ a greater range of teaching approaches appropriately and according to the need of the situation.

THINKING

Thinking refers to the process of creating a structured series of connective transactions between items of perceived information. In the most general sense, thinking is a mental process in which something is turned over in the mind in order to make sense out of experience (Beyer, 1987). Thinking is the process of receiving of external stimuli through the senses followed by internal processing. Cognitive scientists have traditionally defined thinking as problem solving. From
this perspective, the thinking process begins with perception and recognition, followed by a search for connections between things. Then data are retrieved and transformed, and, finally, reasoned assessment of progress toward problem resolution occurs (Geertsen, 2003).

**HIGHER-LEVEL THINKING**

Dewey (1933) was one of the first educators to distinguish between levels of thinking. At the higher-level, he distinguished between searching and judging and called them reflective and critical thought. Dewey conceptualised reflective thought as a mental process that originated with a state of doubt and then expanded into a search for ways to ease that doubt. He later identified something similar to the scientific method as a problem solving strategy for reflective thought. In contrast, Dewey described as critical thinking the judgments that an individual made while solving some problem. Dewey's terms are widely used in the education literature; however, the way they are used often obscures his important distinction between critical and reflective thought as different forms of higher-level thinking. For example, Richard Paul equates critical thinking with higher-level thinking, whereas Wanda Teays equates reflective thought with higher-level thinking. Teays (1996), who describes critical thinking as the use of conscious reflection to elevate thoughts above those found in everyday thinking. This broad conception encompasses more than two dozen dimensions, including attitudes and dispositions, observation skills, analysis, testimony, decision making, techniques of persuasion, moral reasoning, factual reporting, syllogisms,
argumentation, predicate logic, prejudicial language, and a dozen other elements of thinking. Salmon (1989) has a narrower view of critical thinking, identifying it with inductive and deductive logical skills. Yeh (2001) defines critical thinking as argumentation. Borg and Borg (2001) equate critical thinking with the ability to make contextually appropriate choices based on one's own personal values. The experts seem to agree that higher-level thinking is more disciplined and systematic than everyday thought. Some degree of judging or searching is also present in this form of thought.

The emphasis on promoting thinking and creativity was spearheaded by the recognition that rapid changes brought about by globalisation and the onslaught of the technological and information revolution necessitate the development of a "new" type of citizen - one who can manage increasing amounts of information, who can sort through the information, choose information that is relevant and effectively use that information (Sibichen, 2010).

Thinking has been variously defined and many lists of thinking skills exist, including Bloom's Taxonomy (1956) which describes several categories: knowledge, comprehension, application, analysis, synthesis, and evaluation. Nickerson (1981) has suggested that no one taxonomy exists. However, there is agreement on some common components of thinking. These include basic micro skills such as compare and contrast, classification, causal explanation, and complex processes such as decision making, problem solving, as well as metacognitive strategies. In addition to cognitive skills, a good thinker possesses certain traits and dispositions such as perseverance in searching for
information, open-mindedness, curiosity, empathy, reflective capability, making judgement after considering many angles (Geertsen, 2003).

THINKING SKILLS

Thinking skills are one of the most important, yet inadequately implemented areas of the curriculum. Thinking skills are relatively specific cognitive operations that can be considered the "building blocks" of thinking. Certainly a part of helping students develop and improve their thinking skills is connected in some significant way with challenge and discovery. However, it is often the case that what works in a given situation may not work at all in another, different situation. The variables related to thinking skills are themselves quite formidable. Assisting students to improve their thinking skills is increasingly recognised as a primary goal of education. Researchers have defined a range of skills associated with thinking. Skills can be conceptualised on a continuum based on the level of complexity required or the difficulty of the problem to be addressed. The broad term "cognitive processes" refers to complex operations that usually require substantial time and effort and the integration of general and specific knowledge (Ennis, 1991).

THINKING PROCESS

A thinking process is a relatively complex sequence of thinking skills. They are:

i) Concept formation - Concept formation is organising information about an entity and associating that information with a label. A concept may be defined a perceived relationship between two or more facts.
ii) Principle formation - Principle formation is recognising a relationship between or among concepts.

iii) Comprehending - Comprehending is generating meaning or understanding by relating new information to prior knowledge.

iv) Problem solving - Problem solving is analysing a perplexing or difficult situation for the purpose of generating a solution.

v) Decision making - Decision making is the process of selecting from among available alternatives.

vi) Research - Research is the process of conducting inquiry for the purpose of confirming or validating one or more hypotheses.

vii) Composing - Composing is developing a product, which may be written, musical, mechanical, or artistic.

ix) Oral discourse - Oral discourse is talking with other people (Presseisen, 2000).

CHANGING IDEAS: COGNITIVE, BEHAVIOURAL, META-COGNITIVE AND SOCIO-COGNITIVE ASPECTS

One of the theories of thinking and learning which has had the greatest impact on educational practice and on teacher training during the last half century is the genetic epistemology of Piaget (Piaget, 1971). This theory about how children and young people move through a series of developmental stages, in which their understanding of objects, relationships and concepts is limited by their powers of thought, has had an enduring influence on the belief
systems of many teachers. In the 1960s and 1970s there was a strong interest in information processing accounts of cognition, focusing on perceptual channels or various kinds of central processing, including those thought to be rooted in cognitive style (Sibichen, 2010).

Developments in cognitive psychology, particularly in the area of working memory, suggested an important central executive function whereby the brain actively regulates learning and problem solving in a strategic fashion. From this concept Flavell derived the process of metacognition. Essentially conceived as thinking about thinking, metacognition is a process that has proven to be particularly attractive to educators, and underpins many current cognitive programmes. The renewed cognitive emphasis in education was fuelled by many studies demonstrating learning difficulties. Such people experience particular problems with metacognitive and self regulatory functioning, involving, for example, checking, planning, monitoring, reviewing, predicting and evaluating. Interventions in this area in the United States of America introduced a range of tactics drawing upon cognitive models. These include the use of advanced organisers (statements in learning materials that remind learners of procedures that they should employ in order to be more strategic in their approach), elaboration (in which students are actively encouraged to link material to be learned to information or ideas which they already have in mind), attributions (in which the reasons for a strategy succeeding or failing are considered), and thinking about and controlling one's thinking processes (metacognition) (Swanson, 2000). In
addition to the influx of cognitive concepts into education, a number of highly structured programmes were gaining attention. Some of these addressed domain-general (that is, non-curricular) functioning, which involves multiple processes, while some focused on specific processes such as inductive reasoning. These differ markedly from domain-specific programmes devised by those who argue that the teaching of thinking skills should be rooted within academic subjects. Research studies have highlighted the gains that can be achieved when specific cognitive and metacognitive strategies are embedded in the teaching of academic subjects such as reading and mathematics. Gradually, as had been the case with behavioural approaches, an emphasis upon the cognitive, in particular, the development of thinking skills has been assimilated into mainstream practice in schools.

Thinking skill is defined by Smith (2002) as 'a teachable, partially proceduralised, mental activity that reaches beyond normal cognitive capacities and can be exercised at will'. However, Smith notes that, on the basis of his definition, many ways in which this construct is currently employed may be inappropriate. It is important to have a comprehensive set of terms to use when thinking and talking about thinking and learning, especially when seeking to improve performance. Those terms need to be jargon-free and meaningful to learners as well as teachers. The take-up and success of some of the most popular thinking skills programmes are at least partly attributable to the simple language in which they are expressed. Although one place to start in trying to gain an overview of the conceptual field might be with a
framework or taxonomy of thinking, one can easily become confused by the range and scope of taxonomies available and mystified as to how they relate to one another. The situation becomes even more confusing when core concepts such as mind, consciousness and self are analysed in depth. Velmans (2000) and Metzinger (2003) are among the philosophers who have explored these areas. Social constructivist theories, drawing on the ideas of Dewey (1897, 1933) and Vygotsky (1934, 1978), emphasise the importance of a meeting of minds, expert and novice. Ideally, this takes place in the zone of proximal development, the area where the learner can succeed, but only when provided with carefully structured assistance (Tharp & Gallimore, 1988). Expert scaffolding is seen as a powerful means of helping learners develop self regulatory skills that not only assist in specific task completion but which also can be applied in a range of contexts. However, in sociocultural accounts of apprenticeship (Rogoff, 1990) and situated learning (Lave & Wenger, 1991), thinking and learning are themselves presented as social constructs, not as areas of experience which can be studied objectively using empirical methods. Some theorists such as Wells (1999) and Lipman (2003) are cautious of rigid systems of classification, yet still see the principal goal of education as enabling learners to acquire social skills and share knowledge, values and dispositions (Moseley, Elliott, Gregson & Higgins, 2005).

THE NEED FOR TEACHING THINKING

According to Fisher (2003), humans need to be educated which means that all people have the right to learn. He states that the key function of
education is to teach children to think critically, creatively and effectively (Fisher 2003). Another reason for teaching thinking skills is that students are enchanted by the topic. They enjoy solving problems and puzzles. Many students prefer to find the answer rather than be given it without 'thinking time'. In a changing world, it is difficult to assess what knowledge our students will need in the future. Therefore, it is logical to provide them with the skills necessary to deal with flow of information. Kagan (2003) makes this view clear: 'In the face of the accelerating information explosion, having the student memorise one more fact is of little value compared to having the students learn how to categorise, analyse, synthesise, summarise, and apply information'. Psychologists also promote the interest in developing students' thinking. The works of Bruner, Sternberg, Vygotsky, Gardner and others have contributed to the increasing concern with the development of intellectual potential of students. Their achievements put us in a better position today to plan intelligent approaches to developing students' intellect than was the case during the last swing of the pendulum. Sternberg (1987) lists four aims of teaching thinking at the general level.

(i) to make students better all-round thinkers, and also better thinkers in certain disciplines;

(ii) to help students learn to make the most of their best abilities;

(iii) to help to lessen their weakness in thinking skills;

(iv) to teach them to realise their potential (Presseisen, 2000).
ROLE OF THINKING SKILLS IN TEACHER TRAINING

Being a skilful thinker in this new millennium is of paramount importance. A glance at the developments of information technology and the knowledge explosion phenomena would quickly convince us of the need to be skilful thinker. One can find almost any information known under the sun by means of the Internet with only a few keystrokes on personal computers. Upon finding the pool of information however, it is the learner’s responsibility and challenge to differentiate between information nuggets and information garbage. One undeniably useful tool that could assist learner in such venture will be none other than the much discussed critical thinking skills. Therefore, the important task of educators is to instil these invaluable thinking skills into students so that they are equipped to stay competitive in this challenging and rapidly changing world.

Just as a teacher has to be trained extensively in their specialisation area, they also should be trained in thinking skills before expected to teach the same. One indication of such preparedness should be that the teachers show an improvement in their thinking skills as well as their disposition towards such thinking skills. As the development of thinking skills may take a longer period of time, the inclination towards such skills may appear earlier. In any case, it is with a certain inclination that one will do what one is inclined to do.

Many national documents related to education have espoused the need to develop students who can exercise thinking skills. Teachers have the task of preparing individuals for challenges that cannot be foreseen. Thinking
skills is used as a term for a range of higher-order intellectual powers including critical thinking, reasoning, problem solving, decision making, and creative thinking.

Costa (1997) explains thinking as manner in which an individual uses intellectual behaviours in response to questions and problems to which they do not immediately know the answer. He added that students must call upon their store of knowledge and experiences as sources of data to support, theories to explain, or processes to solve each new challenge (Costa, 1997). From this literature, perhaps the most pervading influence for developing thinking skills in students is the teacher. Dalzell (1997) argued that “teachers who themselves are effective thinkers and who are worthy models to emulate serve their students well.” Baumfield & Krajak (1997) supported this claim when they stated that the teacher needs to be able to model explicitly for students how to solve problems, make decisions, and reason. Effective teachers model what they espouse, and thinking skills are no exception (Costa, 1997). However, teachers are less likely to teach students to think if they themselves lack the skill (Gibbs, 1997). Consequently these teachers are unable to model the desired thinking behaviours. Research indicates that teacher-related factors such as their philosophical beliefs (Blane, 1969), professional preparation (McMillan, 1987), cognitive expectation (Pickford, 1988), instructional delivery, and the nature of their tests and assignments leads to the development of higher-order thinking skills in their students. Yet Gibbs (1997) offers a major premise that teachers who do not possess a particular skill
themselves are less likely to teach it. Teachers’ ability to exercise and promote higher-order thinking will impact students’ ability to develop these thinking skills and abilities themselves. Given this premise, assessing the thinking skills of teacher trainees is important. Currently, research is lacking in education in this problem area. Therefore, providing baseline data pertaining to pre-service teachers’ thinking skills would be fruitful to teacher education.

Many educational psychologists argued that thinking skills are important aspects in education (Sternberg, 1990). It is imperative that thinking skills should be made the educational goals where students can be trained to make sense of new information and not just acquisition of knowledge. The responsibility therefore lies in education where it is important that students be trained to think critically and creatively. It is realised that many teachers are not fully capable of incorporating thinking skills in their teaching strategies. So Teacher Training Programmes should prepare prospective teachers capable of utilising thinking skills in their teaching.

Incorporating thinking skills direct all teacher trainees to master thinking skills. Consequently, the teacher trainees should be: a) capable to think critically and creatively in order to achieve the goals of education; b) capable of decision making and solving problems; c) able to use their thinking skills, and able to understand language or its contents; d) able to treat thinking skills as lifelong learning; and finally e) well-balanced in terms of their intellectual, physical, emotional and spiritual development. Hence, in order to produce students who can think critically and creatively, firstly,
teachers should be trained to understand the meaning of thinking skills itself and its categories such as high level (explain, analysis, opinion, decision making, solving problems, and planning) and low level thinking that does not require wide and deep thinking. Secondly, teachers should understand creative and critical thinking, vertical and lateral thinking as well as convergent and divergent thinking. Thirdly, teachers should be given guide books on the thinking skills that students should acquire. However, when presenting information to students during teaching, teachers should not be constrained by the thinking skills categories. Among the skills that should focus on are forming relationships, compare and contrast, classify, evaluate, rank, identifying right from wrong, facts from opinion, cause and effect, bias, to give reasons for causes, to foresee consequences, making inferences and summary, generalisations, interpret, identifying main, supporting and detailed ideas as well a making decisions and solving problems. Method of teaching is indirect, that is, teachers have to inculcate these skills while teaching their individual subjects. It is crucial that students be equipped with thinking skills in order to function and cope successfully in a highly technical society that is undergoing rapid changes.

To improve student performance on thinking skills, schools of education must improve teacher training. They must teach cognitive skills to pre-service teachers before training them to teach these skills in the classroom. They must integrate thinking skills into all aspects of teacher
preparation and train future teachers to be models of effective thinking strategies (Presseisen, 2000).

SIGNIFICANCE OF THE STUDY

The National Curriculum Framework (2005) as proposed by National Council of Educational Research and Training (NCERT) India, focuses on the issues of connecting knowledge to life outside shifting from rote learning to constructing knowledge providing a wide range of experiences for the overall development of a child. The recent developments in technology have changed the world outside the classroom. Educators and policymakers believe that Information and Communication Technologies (ICT) are of supreme importance to the future of education and, in turn, for the country at large. As ICT is becoming an integral element for educational reforms and innovations at secondary schools, this situation calls for an enhancement of pre-service education on ICT for prospective teachers. Techno-pedagogical skills refer to the skills to use technology for pedagogical reasons and competence to integrate technology in teaching.

In techno-pedagogy, there are three areas of knowledge namely: Content, pedagogy and technology. Speaking truthfully, technology integration entails the understanding and negotiating of the relationships among the aforementioned three components. Good teaching is not simply adding technology to the existing teaching and content domain. Rather, the introduction of technology causes the representation of new concepts and requires developing sensitivity to the dynamic, transactional relationship between all three components suggested by
the Techno-Pedagogical Content Knowledge (TPCK) framework (Mishra & Koehler, 2003).

Teaching children to become effective thinkers is increasingly recognised as an immediate goal of education. If students are to function successfully in a highly technological society, then they must be equipped with lifelong learning and thinking skills necessary to acquire and process information in an ever changing world.

Many teacher trainees know the content well but have not learned to transform or translate that knowledge into meaningful instruction. Although pre-service teachers do have a degree of knowledge with regard to ICT, they have little know-how or techno-pedagogical ability with which to integrate those technologies into their teaching practice. Directly or indirectly teacher education programme will benefit from techno-pedagogical skills. Technological pedagogical content knowledge extends beyond proficiency with technology for personal use to an understanding of how technology can be integrated with subject matter and the technology itself.

The role of information and communication technologies in the school classroom is becoming increasingly prominent, both because of the need for children to develop skills that will empower them in modern society and because of the potential value of such technologies as tools for learning. One of the challenges facing teacher educators is how to ensure that graduate teachers have the necessary combination of skills and pedagogical knowledge
that will enable them to both effectively use today's technologies in the classroom as well as continue to develop and adapt to new technologies that emerge in the future.

One of the challenges facing teacher educators is how to ensure that graduate teachers have the necessary combination of skills and pedagogical knowledge that will enable them to both effectively use today's technologies in the classroom as well as continue to develop and adapt to new technologies that emerge in the future.

Knowledge of ICT and skills to use ICT in teaching-learning has gained enormous importance for today's teachers. Teachers are expected to know to successfully integrate ICT into his/her subject areas to make learning more meaningful. This knowledge development during pre-service training has gained much importance with the notion that exposure to ICT during this time is helpful in increasing student teachers' willingness to integrate technology with classroom teaching. Pre-service teachers need to plan to use computers in their classrooms. Integrating technology in the classroom redefines established teacher-learner relationships and teaching-learning styles.

In order to use technology effectively in the classroom and to gain insight into ways of making academic information more accessible to learners, teacher trainees should have to think critically and creatively. These reflections help them to improve their teaching skills.
Preparing teacher trainees to use technology effectively is a major area of concern for teacher education. Effective use of technology includes such activities as linking curriculum outcomes with various technologies, establishing a learning context of discovery and process in the use of technology, collaborating with others both face-to-face and virtually to achieve learning outcomes, simulating real world environments, and assessing outcomes. Technology can provide powerful environments eliciting modern views of learning but may not change teachers' beliefs and practice. It depends on how teachers interpret the uses of tools and how they use them to transform the learning processes. Teacher trainees have to enact, reflect, examine, and change their beliefs and practices with the introduction of new technology. Successful implementation of these activities in the classroom increases teacher trainees' teaching competencies. This is a new area that has immense scope in the teaching learning scenario. So the investigator feels that this area of study is extremely significant.

STATEMENT OF THE PROBLEM

Teacher trainees can use technology effectively and efficiently for achieving curriculum objectives to assist them. Technology can provide powerful environments eliciting modern views of learning. It depends on how teachers interpret the uses of tools and how they use them to transform the learning processes. To plan and prepare these activities authentically and accurately, thinking skills are very essential. Successful implementation of these activities in the classroom depend upon their problem solving ability, decision making,
logical reasoning, critical thinking, creative thinking and lateral thinking. Further, techno-pedagogical skills in teaching contribute a lot towards teaching competency. Though there are many factors which are influencing the teaching competency of the teacher trainees, the investigator selected techno-pedagogical skills and thinking skills.

TITLE

TECHNO-PEDAGOGICAL AND THINKING SKILLS OF THE SECONDARY TEACHER EDUCATION STUDENTS

OPERATIONAL DEFINITIONS

The investigator adopted the following definitions for the terms used in this title.

TECHNO-PEDAGOGICAL SKILLS

Techno-pedagogical skills refer to the skills needed to use technology for pedagogical reasons and competence to integrate technology in teaching.

In the present study investigator intends to measure skill in learning, preparing lesson plan, preparing learning material, implementing instructional strategy, communication, evaluation and guidance.

(i) Skill in Learning

Learning is the process by which an individual acquires knowledge, attitudes and skills that are necessary to meet the demands of life. Learning is an ongoing process that depends on experience and leads to long-term
changes in behaviour potential. Techno-pedagogical skill enhances teacher trainee’s learning.

(ii) **Skill in Preparing Lesson Plan**

Preparation of lesson plan involves the total person and his/her various talents. Imagination and planning is required to design a topic to teach properly in the classroom. Teacher trainees’ skill in designing the lessons in advance is very significant and influences their performance inside the classroom. A person with techno-pedagogical skills will design the lessons including the technological component whereas a person having no training in technological areas will have a different design for his/her class. Hence, it is an area for the researcher.

(iii) **Skill in Preparing Learning Material**

The skill of preparing learning material affects the way one performs inside the classroom. A poor teacher is one who is not at all prepared for his/her performance. The content knowledge of the teacher is the basic strength that gives confidence to the novice.

(iv) **Skill in Implementing Instructional Strategy**

The way one delivers the planned material is also very significant. Often learners lose interest in a class which is poorly conveyed. The variety of ways that a teacher adopts to execute the class activities manifest how skilful the teacher is.
(v) **Skill in Communication**

A teacher with poor communication skill is a real problem for the nation. It is that which distinguishes a good teacher from a bad teacher in the beginning. A person with good communication skills will definitely progress later much better than a poor communicator. The role of communication skill for the teacher trainee is of paramount significance.

(vi) **Skill in Evaluation**

A teacher should possess excellent skills to evaluate the performance of the learner at every step. On going evaluation, both formative and summative, makes a qualitative change for the learner as every significant learning involves or demands a lot of behavioural changes for which the learner may not be ready or willing due to various other pressures.

(vii) **Skill in Guidance**

A teacher with no sense of direction can never become worthy of the name at all. Student life is getting complex day by day. With the growing amount of technology and high standards of living, the student of today face many types of difficulties in making a curricular and co-curricular choice. They have difficulty in acquiring basic study skills for optimum achievement. They live with and share facilities with students from varied social and economic backgrounds, adjust to peers and parents, spend leisure properly and a host of issues related to environmental accommodation. The teacher trainees possess effective guidance skills in order to be efficient in their field of profession.
THINKING SKILLS

Thinking skills are relatively specific cognitive operations that can be considered the building blocks of thinking. It is the ability to reach sound conclusions based on observation and information.

In the present study investigator intends to measure critical thinking, creative thinking, logical reasoning, problem solving, decision making and lateral thinking.

(i) Skill in Critical Thinking

This type of thinking helps a person in stepping aside from his/her own personal beliefs, prejudice, and opinions to sort out the facts and discover the truth even at the expense of his/her basic belief system. It is a challenging thought process which leads a person to new avenues of understanding. Here one resorts to a set of higher cognitive abilities and skills for the proper interpretation, analysis, evaluation and influence as well as explanation of the gathered or communicated information resulting in a purposeful, unbiased and self regulatory judgement (Sibichen, 2010).

(ii) Skill in Creative Thinking

This type of thinking is chiefly aimed to create something new. It is in search of new relationship and associations to describe and interpret the nature of things, events and situations. It is bounded by any pre-established rules. The person himself usually formulates the problem and s/he is free to gather evidence and to invent tools for its solution.
(iii) **Skill in Logical Reasoning**

Logical reasoning is not a magical process or a matter of genetic endowment, but a learned mental process. It is the process in which one uses reasoning consistently to come to a conclusion. Problems or situations that involve logical reasoning call for structures, relationships between facts, and for chains of reasoning that lead one to one's set goals. To reason logically is to reason in steps. It involves taking the important ideas, facts and conclusions involved in a problem and arranging them in a chain-like progression that takes on a meaning in and of itself.

(iv) **Skill in Problem Solving**

Problem solving is a mental process and is part of the larger problem process that includes problem finding and problem shaping. Considered the most complex of all intellectual functions, problem solving has been defined as higher-order cognitive process that requires the modulation and control of more routine or fundamental skills. Problem solving occurs when an organism or an artificial intelligence system needs to move from a given state to a desired goal state. It is analysing a perplexing or difficult situation for the purpose of generating a solution. It is a process in which we perceive and resolve a gap between a present situation and a desired goal, with the path to the goal blocked by known or unknown obstacles. In general, the situation is one not previously encountered, or where at least a specific solution from past experiences is not known.
(v) **Skill in Decision Making**

Decision making skills enable a person to apply the knowledge one has in store in the form of information stored in brain or human mind. We each have a unique decision style that is founded in our attitudes, filtered by our assumptions and biases, and formulated from our thoughts. It is the process of selecting from among available alternatives. It is a selection process where one of two or more possible solutions is chosen to reach a desired goal. The steps in both problem solving and decision making are quite similar. In fact, the terms are sometimes used interchangeably. Most models of problem solving and decision making include at least four phases (i) an input phase in which a problem is perceived and an attempt is made to understand the situation or problem; (ii) a processing phase in which alternatives are generated and evaluated and a solution is selected; (iii) an output phase which includes planning for and implementing the solution; and (iv) a review phase in which the solution is evaluated and modifications are made, if necessary. Most researchers describe the problem-solving/decision-making process as beginning with the perception of a gap and ending with the implementation and evaluation of a solution to fill that gap.

(vi) **Skill in Lateral Thinking**

Lateral thinking is refers to solving problems through an indirect and creative approach. Lateral thinking is about reasoning that is not immediately obvious and about ideas that may not be obtainable by using only traditional
step-by-step logic. Lateral thinking involves discarding the obvious, leaving behind traditional modes of thought, and throwing away preconceptions.

SECONDARY TEACHER EDUCATION STUDENTS

They are those who are studying Bachelor of Education (B.Ed.) in colleges of education affiliated to Mahatma Gandhi University, Kottayam, Kerala after completing their graduation or post-graduation.

GENERAL OBJECTIVES

1. To find out the level of techno-pedagogical skills of the secondary teacher education students.

2. To find out the level of thinking skills of the secondary teacher education students.

3. To find out the relationship between techno-pedagogical skills and thinking skills of the secondary teacher education students.

4. To find out the significant factors with positive loadings of the variables namely skill in learning, preparing lesson plan, preparing learning material, implementing instructional strategy, communication, evaluation, guidance and thinking skills.

SPECIFIC OBJECTIVES

1. Techno-pedagogical skills of the secondary teacher education students

1.1 To find out whether there is any significant difference between male and female secondary teacher education students in their skill in learning, preparing
lesson plan, preparing learning material, implementing instructional strategy, communication, evaluation, guidance and techno-pedagogical skills.

1.2 To find out whether there is any significant difference between aided and un-aided college secondary teacher education students in their skill in learning, preparing lesson plan, preparing learning material, implementing instructional strategy, communication, evaluation, guidance and techno-pedagogical skills.

1.3 To find out whether there is any significant difference between graduate and post-graduate secondary teacher education students in their skill in learning, preparing lesson plan, preparing learning material, implementing instructional strategy, communication, evaluation, guidance and techno-pedagogical skills.

1.4 To find out whether there is any significant difference between secondary teacher education students who have attended computer course and who have not attended computer course in their skill in learning, preparing lesson plan, preparing learning material, implementing instructional strategy, communication, evaluation, guidance and techno-pedagogical skills.

1.5 To find out whether there is any significant difference among English, Mathematics, Natural Science, Physical Science and Social Science optional subject secondary teacher education students in their skill in learning, preparing lesson plan, preparing learning material, implementing instructional strategy, communication, evaluation, guidance and techno-pedagogical skills.
1.6 To find out whether there is any significant association between parents' annual income and skill in learning, preparing lesson plan, preparing learning material, implementing instructional strategy, communication, evaluation, guidance and techno-pedagogical skills of the secondary teacher education students.

2. Thinking skills of the secondary teacher education students

2.1. To find out whether there is significant difference between male and female secondary teacher education students in their critical thinking, creative thinking, logical reasoning, problem solving, decision making, lateral thinking and thinking skills.

2.2. To find out whether there is significant difference between aided and un-aided college secondary teacher education students in their critical thinking, creative thinking, logical reasoning, problem solving, decision making, lateral thinking and thinking skills.

2.3. To find out whether there is significant difference between graduate and post-graduate secondary teacher education students in their critical thinking, creative thinking, logical reasoning, problem solving, decision making, lateral thinking and thinking skills.

2.4. To find out whether there is significant difference between secondary teacher education students who have attended computer course and who have not attended computer course in their critical thinking, creative thinking, logical reasoning, problem solving, decision making, lateral thinking and thinking skills.
2.5. To find out whether there is significant difference among English, Mathematics, Natural Science, Physical Science and Social Science optional subject secondary teacher education students in their critical thinking, creative thinking, logical reasoning, problem solving, decision making, lateral thinking and thinking skills.

2.6. To find out whether there is significant association between parents’ annual income and critical thinking, creative thinking, logical reasoning, problem solving, decision making, lateral thinking and thinking skills of the secondary teacher education students.

3. **Relationship between techno-pedagogical skills and thinking skills of the secondary teacher education students**

3.1 To find out whether there is any significant relationship between techno-pedagogical skills and thinking skills of the secondary teacher education students.

3.2 To find out whether there is any significant relationship between techno-pedagogical skills and thinking skills of the male secondary teacher education students.

3.3 To find out whether there is any significant relationship between techno-pedagogical skills and thinking skills of the female secondary teacher education students.
4. Identification and clustering of variables representing a single construct from a set of variables

4.1 To find out whether there is any significant factor with positive loadings of the variables namely skill in learning, preparing lesson plan, preparing learning material, providing learning experience, providing demonstrations, evaluation, guidance and thinking skills.

NULL HYPOTHESES

1. Techno-pedagogical skills of the secondary teacher education students

1.1. There is no significant difference between male and female secondary teacher education students in their skill in learning, preparing lesson plan, preparing learning material, implementing instructional strategy, communication, evaluation, guidance and techno-pedagogical skills.

1.2. There is no significant difference between aided and un-aided college secondary teacher education students in their skill in learning, preparing lesson plan, preparing learning material, implementing instructional strategy, communication, evaluation, guidance and techno-pedagogical skills.

1.3 There is no significant difference between graduate and post-graduate secondary teacher education students in their skill in learning, preparing lesson plan, preparing learning material, implementing instructional strategy, communication, evaluation, guidance and techno-pedagogical skills.

1.4. There is no significant difference between secondary teacher education students who have attended computer course and who have not attended
computer course in their skill in learning, preparing lesson plan, preparing learning material, implementing instructional strategy, communication, evaluation, guidance and techno-pedagogical skills.

1.5. There is no significant difference among English, Mathematics, Natural Science, Physical Science and Social Science optional subject secondary teacher education students in their skill in learning, preparing lesson plan, preparing learning material, implementing instructional strategy, communication, evaluation, guidance and techno-pedagogical skills.

1.6. There is no significant association between parents’ annual income and skill in learning, preparing lesson plan, preparing learning material, implementing instructional strategy, communication, evaluation, guidance and techno-pedagogical skills of the secondary teacher education students.

2. Thinking skills of the secondary teacher education students

2.1. There is no significant difference between male and female secondary teacher education students in their critical thinking, creative thinking, logical reasoning, problem solving, decision making, lateral thinking and thinking skills.

2.2. There is no significant difference between aided and un-aided college secondary teacher education students in their critical thinking, creative thinking, logical reasoning, problem solving, decision making, lateral thinking and thinking skills.
2.3. There is no significant difference between graduate and post-graduate secondary teacher education students in their critical thinking, creative thinking, logical reasoning, problem solving, decision making, lateral thinking and thinking skills.

2.4. There is no significant difference between secondary teacher education students who have attended computer course and who have not attended computer course in their critical thinking, creative thinking, logical reasoning, problem solving, decision making, lateral thinking and thinking skills.

2.5. There is no significant difference among English, Mathematics, Natural Science, Physical Science and Social Science optional subject secondary teacher education students in their critical thinking, creative thinking, logical reasoning, problem solving, decision making, lateral thinking and thinking skills.

2.6. There is no significant association between parents' annual income and critical thinking, creative thinking, logical reasoning, problem solving, decision making, lateral thinking and thinking skills of the secondary teacher education students.

3. Relationship between techno-pedagogical skills and thinking skills of the secondary teacher education students

3.1 There is no significant relationship between techno-pedagogical skills and thinking skills of the secondary teacher education students.
3.2 There is no significant relationship between techno-pedagogical skills and thinking skills of the male secondary teacher education students.

3.3 There is no significant relationship between techno-pedagogical skills and thinking skills of the female secondary teacher education students.

4. Identification and clustering of variables representing a single construct from a set of variables

4.1 There is no significant factor with positive loadings of the variables namely skill in learning, preparing lesson plan, preparing learning material, implementing instructional strategy, communication, evaluation, guidance and thinking skills.

DELIMITATIONS OF THE STUDY

1. The present study is limited to the B.Ed. colleges affiliated to Mahatma Gandhi University, Kottayam area only.

2. Techno-pedagogical skill score is taken by adding the scores of all the seven dimensions, namely, skill in learning, preparing lesson plan, preparing learning material, implementing instructional strategy, communication, evaluation and guidance.

3. Thinking skill score is taken by adding the scores of all the six dimensions, namely, critical thinking, creative thinking, logical reasoning, problem solving, decision making and lateral thinking.