PREPARING TEACHERS FOR INTEGRATION OF DIGITAL TECHNOLOGY: A STUDY OF POLICIES, PROGRAMMES, FRAMEWORKS, MODELS AND PRACTICES

Dissertation

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By

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DECLARATION BY THE SCHOLAR

This is to certify that the M.Phil. Dissertation being submitted by me on the topic entitled "Preparing Teachers for Integration of Digital Technology: A Study of Policies, Programmes, Frameworks, Models and Practices" has been completed under the guidance of Dr. Kashyapi Awasthi. It is declared that the present study has not previously formed the basis for the award of any Degree, Diploma, Associateship or Fellowship to this or any other University.

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CERTIFICATE OF THE SUPERVISOR

This is to certify that the dissertation entitled "Preparing Teachers for Integration of Digital Technology: A Study of Policies, Programmes, Frameworks, Models and Practices" is the work undertaken by Ms. Kumari Pallawi under my supervision and guidance as part of her M.Phil. degree in this University. To the best of my knowledge, this is the original work conducted by her and the dissertation may be sent for evaluation.

Supervisor's Signature

Dr. Kashyapi Awasthi

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ACKNOWLEDGEMENT

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LIST OF ABBREVIATIONS

ADDIE:	Analyse Design Develop Implement Evaluate
ASSURE:	Analyse State Select Utilize Require Evaluate
B. Ed.:	Batcheler in Education
B. Ed. (Nursery):	Batcheler in Education (Nursery)
B. El. Ed.:	Batcheler in Elementary Education
BRC:	Block Resource Centre
CAL:	Computer Aided Learning
CBSE:	Central Board of School Examination
CIET:	Central Institute of Educational Technology
CLASS:	Computer Literacy And Studies in Schools
COVID-19:	Corona Virus Disease
CRC:	Cluster Resource Centre
D. El. Ed.:	Diploma in Elementary Education
DIET:	District Institute of Education and Training
DIKSHA:	Digital Infrastructure for Knowledge Sharing
DT:	Digital Technology
EPW:	Economic and Political Weekly
ICSE:	Indian Council of Secondary Education
ICT:	Information and Communication Technology
M. Ed.:	Master in Education
MHRD:	Ministry of Human Resource Development
MKO:	More Knowledgeable Others
NAEYC:	National Association for the Education of Young Children
NCERT:	National Council of Educational Research and Training
NCF:	National Curriculum Framework
NCFTE:	National Curriculum Framework for Teacher Education)
NETF:	National Educational Technology Forum

NISHTHA:	National Initiative for School Heads' Teachers' Holistic Advancement
NNL:	Nearest Neighbour Learning
NPE:	National Policy on Education
NPICT:	National Policy on Information and Communication Technology
NROER:	National Repository of Open Educational Resources
Ph.D.:	Doctor of Philosophy
PoA:	Programme of Action
PST:	Pre-Service Teachers
PT:	Pupil Teachers
SAMR:	Substitution, Augmentation, Modification and Redefinition
SCERT:	State Council of Educational Research and Training
SEP:	School Experience Programme
SWAYAM:	Study Webs of Active–Learning for Young Aspiring Minds
TP:	Teaching Practice
TPACK:	Technological Pedagogical And Content Knowledge
TT:	Trainee Teachers
UNESCO:	United Nations Educational Scientific and Cultural Organization
USA:	United States of America

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CHAPTER I

INTRODUCTION

Today's era is popularly known as the era of "Information and Communication Technology (ICT)". When computers were introduced in the second half of twentieth century to various fields including education, a revolution of information and communication came in the field in the form of digital technology as it functions through a binary computational code. Digital tools generate data in the form of digitized content, store and process it in digitized form and the technique applied in their functioning is called digital technology which includes overall computer technology in various form, like; mobile, various applications on mobile and computer, digital games, social media, interactive white board etc. In India, computers were introduced in 1980s in the field of education and slowly progressed to become an integral part of education system at all levels, though, there is big divide in the quantity and quality of its integration in education in different part of the country due to varied reasons. The life of human being has been influenced by digital technology and it has become an integral part of our life in one or the other way. The digital media being informative, handy and illustrative are frequently used by a large number of people for being connected with any person and to share information, views and thoughts. Similarly, these media are used by various stakeholders in the area of education including teachers and students for sharing information, gaining, creating and sharing knowledge, conceptual clarity, problem solving, collaborative and co-operative working in course of learning and teaching process (Bhatia & Haider, 2015.; Toki & Pange, 2013.; Kanvaria, 2011). Digital media made it possible to learn anytime, anywhere with anyone/any group which has been working like a life-line for learners in present situation of pandemic due to Corona Virus Disease (COVID-19).

It is a well-known and proven fact that education plays a very important role in human life. It has been evolving continuously since the beginning of human history. All countries make their efforts to develop their system of education to meet the challenges of time along with maintaining, expressing and promoting their own specific socio-cultural identities. It is a well-accepted fact with the evidence from the real situation at ground level that this new technology has given a new direction to the traditional

practice of teaching-learning, communication of knowledge and information, evaluation, record keeping and management. It has been proved quite helpful in the field of education, as 'quick and time bound evaluation', 'organised record keeping with ease' and 'effective management due to organised, effective and fast communication' have become a regular practice by and large throughout the world. Education sector has adopted digital technology to a large extent and worldwide since the beginning of its development. Digital technology plays a great role in the field of education as it helps to follow both the major principals of education deliberated in "Learning: the treasure within; report to UNESCO of the International Commission on Education for the Twenty-first Century (Delors et.al.,1996)". It has been continuously helping since its advent, in life-long learning and strengthening the four pillars of education as it provides opportunity of learning by disseminating knowledge and information through internet twenty-four hours a day and all seven days of a week (24X7). It supports all those individuals on this earth whomsoever desires to access and retrieve knowledge and information, to learn from accessed information and knowledge, to evaluate themselves (either self-evaluation or with the help of experts by sharing their learning with them through sharing platforms available on social media), to create knowledge and to disseminate knowledge to others.

Development in the area of digital technology has been continuously and significantly influencing the 'technology of education' as well as 'technology in education'. The traditional method of teaching has been modified largely with the advent of different types of digital media. Audio-visual media, internet, social media etc. are some of the digital technology-based media systems which have affected the teaching-learning method of different subjects and the process at school as well as college levels throughout the world including India.

1.1 SCHOOL EDUCATION AND TEACHERS:

Schools are usually the first place where children are introduced to formal education. They spend their entire childhood in school for gaining knowledge and learning different skills for a bright future ahead. It is stated in the Report of The Education Commission, 1964-66, Government of India (Part 1.01of chapter-1), "*the destiny of India is being shaped in her classroom"*. This statement signifies the importance of

schools as learning place for children. This learning takes place with the help of teachers under their guidance and care. Each and every society, state and country always try to develop their schools by making appropriate policies, plans and programs and incorporating all kinds of advanced tools, technologies and methods which are helpful in the up-gradation of its education system. Teachers play a great role in implementing these policies, plans and programs and incorporating these tools and techniques. To make their role effective they need to be competent in each and every aspect of their profession. Therefore, teacher education, either pre-service or in-service is one of the major components of providing quality education in schools. Knowledgeable teachers, proficient in professional skills give direction to shape the future of the students. Teachers own experiences of professional development towards creating knowledge make them capable to develop required skills and adequate competencies in students for creating knowledge (Fullan, M., 2006). As the school education system need to address the challenges of the time, the teachers are required to step forward, meet the challenge and carry forward the whole system in new direction along with maintaining the quality and socio-cultural identity of traditional system of education. Digital technology in education is the need of the time. Learners were called *"Digital Natives"* and teachers *"digital immigrants"* by Marc Prensky (2001) as the learners in those years were born in digital age playing and learning with digital tools but the teachers came from old traditional system. Therefore, it was quite difficult to make a co-ordination among them. Now, those digital natives are grown up and some of them are the part of teaching community. But, using digital technology for the purpose of self-need in daily life and using it in professional work, primarily to make the teaching and learning more effective is different to some extent from each other, though, some basic competencies are similar for both the purposes. Technology works just as a tool. Teacher plays the most important role in terms of helping and motivating the kids to learn to work with these tools and to work together (Bill Gates, 1997). This is the reason for what teachers need to be educated and skilled through properly planned training programmes. These programmes should be designed according to the requirement of school education. Therefore, teacher education is addressed along with school education in policies and programmes at national and international level.

1.2 POLICIES, PROGRAMMES AND FRAMEWORKS: DIGITAL TECHNOLOGY IN TEACHER EDUCATION

United Nations Organization plans, formulates and publishes various frameworks and programs regarding improvement and betterment of education at each stage beginning from the early childhood care and education to higher level of education, professional education to competency development including teacher education, viz.; educational development goal (under millennium development goals), twenty first century skills, ICT Competency Framework for Teachers (UNESCO, 2011) etc.. These plans, programmes and frameworks are created taking in consideration the development of whole world. It is expected that the member countries will consider these broader frameworks while making their own plan of development. Countries are free to decide their own extent of development based on their own requirements, resources available and consent of the people concerned. It is expected by united nations organization that all the countries will reach at the highest level of development step by step if they will continue to plan, implement, evaluate, modify and re-plan to continue the cycle. Keeping in view the integration of information and communication technology in pedagogy, it was a need of the hour for UNESCO to think over the large digital divide among different countries and to formulate a framework to guide school education system as well as teacher education system of different countries to understand the expected competencies to be developed in the teachers to fill up this divide and to improve learning in schools by integrating digital technology effectively in pedagogy and other professional work.

India has also tried to keep the developments in the field of education up to the mark. It is stated in "National Policy on Education (NPE,1986)" that the country should derive maximum benefit from the assets already created through its economic and technical development and it should ensure that these benefits reach all people from all sections of the country. Education has been seen as the highway to reach this goal. It helps to provide new tools, technologies, methods and other resources to its educational institutions by implementing various policies and plans. When the "National Policy on Education (NPE, 1986)'' was modified in 1992, it emphasized on the necessity of utilizing educational technology and employing "Computer Literacy And Studies in Schools (CLASS)" (POA, 1992). After that, another more comprehensive centrally

sponsored scheme came in 2004 known as "Information and Communication Technology @ Schools" which was further modified in 2010. The significant role that can be played by ICT in school education has also been highlighted in "National Curriculum Framework (NCF), 2005". In 2012, "National Policy on Information and Communication Technology in school education" was launched which states about revising the curricula meant for pre-service teachers' education for modifying and including relevant application of ICT for developing ability in ICT enabled education. ICT competencies for students and school teachers have been described in this document. "National Curriculum Framework for Teacher Education, 2009" also emphasizes on orienting and sensitizing teachers through teacher education for appropriate use of digital technology. "The draft of new policy on education, 2019" also emphasizes on impowering teachers through proper training and supportive facilities to lead various activities related to the integration of technology in the teaching learning and assessment process in the classroom and in other related tasks.

1.3 INTEGRATION OF DIGITAL TECHNOLOGY: PRACTICES FROM FIELD

Taking into consideration of the importance given to integration of this new technology in school education and teacher education this aspect of development in these areas of education needs in-depth research. A lot of investigations has been done worldwide including India on ICT integration in school education and teacher education but this area requires more research for making the use of digital technology more effective for teacher education which would result in its more effective use in school education at each level and in teaching and learning process of each subject. But, due to socio-cultural, economic and other demographic variations in different region of the world there are significant differences in integration of digital technology in pedagogy. Some of the countries have successfully integrated it in pedagogy in various school subjects but many are lagging behind including India. Lack of infrastructure, surrounding environment, attitude of teachers and other stakeholders in education system towards the integration of digital technology, competency of teachers and lack of motivation for logical integration of digital technology are some of the major challenges in this area. Apart from the challenges mentioned above preparing teachers for integrating digital technology in pedagogy, both through pre-service and in-service training, is also a big

challenge. Developing digital pedagogical competencies in teachers is a matter of concern and integrating such technologies effectively in classroom is equally important. Therefore, researches have been carried out in this context, and models and frameworks have been developed and validated by the scholar for assessing and improving digital pedagogical competencies of teachers, and improving the process, quality and intensity of integration of digital technology; for example, "TPACK (Technological Pedagogical And Content Knowledge by Koehler & Mishra, 2006) framework, SAMR (Substitution, Augmentation, Modification and Redefinition) model (Puentedura, 2006), Generic model (Wang,2008)" etc..

There is great potential in digital technology in bridging the gaps amongst universities, between public and private institutions, and also the inter-state gaps in imparting quality education. The digital technology through its multiple features could aid in knowledge generation, knowledge sharing, networking of professionals, and creating a common resource pool and much more.

This study explores and reviews policies, programs and practices in the context of Indian scenario towards preparing teachers to integrate digital technology in teaching-learning process and other professional work of the teachers. This study tries to analyse these policies, programmes and practices through national and global views with reference to "The UNESCO's ICT competency framework for teachers", and the research work done by various researchers, teacher educators and educationists working in this area for searching out the benefits, problems, factors affecting and supporting, attitude of different stakeholders in education that affect the planning of teacher education, and methods adopted for learning to integrate digital technology for effective and desired outcome. It further tries to delineate practices of integration of digital technology in teacher education at ground level through the lenses of teacher educators.

1.4   RESEARCH QUESTIONS:

1. What do the policies and programs tell about digital technology integration in teacher education?
2. What are the existing frameworks and models available for making integration of digital technology effective in teacher education?
3. How is digital technology being integrated in teacher education?

1.5   OBJECTIVES:

1. To review the policies and programmes on integration of digital technology in education and draw implications.
2. To document various frameworks, models and practices on integration of digital technology in teacher education.
3. To delineate practices of integration of digital technology in teacher education and factors affecting.
4. To explore the knowledge and awareness among teacher educators about policies, programs, frameworks and models.

1.6   OPERATIONAL DEFINITION OF THE KEY TERMS:

1. **Teacher educators:** Teachers (Lecturer/ Professor) working in teacher training institutions as mentors of pre-service school teachers.

2. **Pre-Service Teachers (PST)/Trainee Teachers (TT)/ Pupil Teachers (PT):** Student teachers enrolled in teacher education programme in teacher's training institutes/colleges.

3. **In-service Teachers:** Teachers serving in school.

4. **Practicum/School Experience Programme (SEP)/Teaching Practice (TP):** An important part of the pre-service teacher education programme to give hands-on experience to pre-service teachers of teaching practice and other important roles of a teacher in a school.

5. **Digital Technology (DT):** Digital tools generate data in the form of digitized content, store and process it in digitized form and the technique applied in their functioning is digital technology which includes overall computer technology in various form, like; mobile, various applications on mobile and computer, digital games, social media, interactive white board etc. Information and Communication Technology (ICT) has been used interchangeably with this term at some places in this study.

6. **Digital Media:** The electronic devices used for storing the data and communication methods utilized for transmitting the data in the form of digitized content which include text, audio, video, and graphics.

7. **Digital Technology Integration:** Integrating digital technology in any form in the process of teaching and learning and other related tasks of teachers and students in school (during service or practicum) and teacher training institution to explore, create and share knowledge and information.

8. **Social Learning Methods:** Teaching-learning methods, like; "collaborative and co-operative learning", commonly known as 'learning together' which require the students to work in groups formed by them or by the teacher to fulfil their learning interests and integrating digital technology.

9. **"Social Constructivism Learning Theory":** learning depends on the surrounding environment of the learners along with his/her own experience where 'more knowledgeable others' play a major role in learning. Students learn with each other through co-operation and collaboration and by getting experience through seeing other doing the act and sharing knowledge with each other.

10. **ICT Competency Framework:** ICT competency Framework for teachers developed by UNESCO (United Nations Educational Scientific and Cultural Organization), 2011 and ICT competency levels given in National Policy on Information and Communication Technology in School Education, 2012.

11. **Policies and Programmes:** Educational policies and some related programmes at national level in India having teacher education and ICT as a component.

12. **Models and Frameworks:** Models and frameworks developed by pedagogues and researchers working in the field of digital technology/ICT in education for effective integration of digital technology in teaching-learning process and for assessing digital pedagogical competencies.

1.7   RATIONALE OF THE STUDY:

- Policies, programmes, curricular and competency frameworks make and show the path for development in right direction. Therefore, it is needed to explore and observe the facts given in these documents regarding preparing teachers for the integration of digital technology and the awareness among teacher educators and pupil teachers regarding these policies, programs, curricular and competency frameworks because these future teachers will be the real implementers of these policies at ground level.

- The field of digital technology is ever emerging and it has been equipping human being with new tools and techniques continuously. Therefore, it is the need of the time to search what kind of studies are being done in the area and to identifying major themes those need to be taken care of to contribute for preparing teachers for integration of digital technology.

- It is the need of the twenty first century to make teachers competent in the digital skills. They get motivated when they observe the benefits of integration of such technologies applied by their educators. Therefore, this area needs to be investigated in order to know the way of effective utilization of integration of digital technology, to search and solve problems, to remove barriers and to promote favorable conditions. In the present situation, due to COVID-19, technology is the only medium to learn and to teach. Stakeholders in the field are busy in finding which tool would work better. This situation itself rationalizes the need of this study.

1.8   SIGNIFICANCE OF THE STUDY:

The facts observed through the review and analysis of various educational policies, programmes, ICT competency frameworks and curriculum frameworks regarding preparing teachers for integration of digital technology will help teachers, teacher educators and researchers in this field to synchronize their activities with the aspirations of national development with digital initiatives in the field of education.

Reviews and analysis of various models/frameworks developed by the pedagogues and educationists to plan and apply instructional activities by integrating digital technology, to assess ICT competency of teachers, their mentors and pupils, and to assess the level

of digital integration in classroom practice will help teachers, teacher educators and pupil teachers to apply these frameworks and models in their day to day practice for making the integration of digital technology effective. Lessons have been derived from these studies and visionary accounts have been gained for the future implications as it would be useful for the practitioners in selecting appropriate method and model for the digital technology integration according to their requirement, even it would motivate and help them to develop their own model suitable to their working environment and need.

This study provides an insight of benefits of learning together by adopting various social learning methods like collaborative learning and co-operative learning. It provides evidence how learning becomes easier and effective when done through social media. Knowledge and information regarding various barriers and challenges faced by the teacher educators, pre-service teachers and in-service teachers in utilizing these learning methods would help others to be prepared to face similar challenges and to remove barriers specifically when social media is utilized for collaborative and co-operative learning.

1.9   PRESENT STUDY:

This study reviews educational policies, programmes, ICT competency framework for teachers and curriculum framework regarding preparing teachers for integrating digital technology in the process of teaching-learning and other professional activities. It also reviews the literature of research reports based on practices and models and frameworks available for effective integration of digital technology.   Further, it explores the practices in real situation at ground level for preparing pupil teachers for the purpose mentioned above. The flow of study begins from introduction of the study and moves forward to review of literature, methodology of the study, analysis of data and information, summary and conclusion, and bibliography. Overall, six chapters are there in this study. The details of these chapters are given below.

Chapter-I is introductory in nature which gives a brief idea of the whole study including introducing the background of the problem, enlisting the research questions to be answered, setting the objectives, technical definition of key terms, rationale and significance of the study, and brief introduction of each chapter.

Chapter- II deals with the review of educational policies, programmes, ICT competency framework and curriculum framework in its first part. In the Second part, it deals with the review of models and frameworks developed by pedagogues and educationists for the planning and applying teaching-learning process including digital technology, for assessing digital competencies of teachers, mentors and pupils and for assessing and improving the level of digital technology integration in teaching-learning process in the classroom.

Chapter-III deals with the review of literature related to this study available through various sources, like, national and international journals, ResearchGate, J-Store, Academia, webpages, books, doctoral thesis and many more. Though, many research papers and articles from books, journals and conference proceedings, and abstracts of doctoral thesis have been studied and many of them have been referred in this study but only twenty-eight of them have been selected for thematic review of the literature.

Chapter-IV presents the methodology of this study. Detailed account of the methodology of this study has been given in this chapter which includes theoretical paradigm of the study, methodology and delimitations of the study. Theoretical paradigm consists of social learning methods and social constructivism learning theory. Methodology consists of research design, tools and techniques of the study, population and sample, and technique of data analysis.

Chapter-V deals with analysis and interpretations of data and information collected through both primary and secondary sources. Analysis has been done in three parts. First part deals with the analysis of facts observed and obtained through review of policies, competency frameworks, curriculum frameworks and models and frameworks developed by pedagogues and educationists for effective integration of digital technology and interpretations based on it. Second part deals with the analysis of review of literature to understand practices of integration of digital technology. Third part deals with analysis and interpretations of data and information obtained from primary sources, teacher educators, through interviews conducted with them which results in developing an understanding of practices of preparing teachers for integration of digital technology in their professional work at ground level.

Summary of the study and a brief account of major observations, findings and their future implications have been presented in Chapter- VI. This chapter further incorporates conclusion and recommendations.

CHAPTER II

INTEGRATION OF DIGITAL TECHNOLOGY IN TEACHER EDUCATION: REVIEW OF POLICIES, PROGRAMMES, FRAMEWORKS AND MODELS

Teacher education has always been seen as a part of larger structure comprising of overall school education system from pre-primary to higher secondary. At present this whole system has been named as 'Samagra Shiksha' in India and the programme meant for holistic development of all the components including teacher education is named as 'Samagra Shiksha Scheme'. In the light of this holistic combination policy makers have been formulating policies and programmes for ICT in teacher education as a part of this combination since the beginning much before giving the name 'Samagra Shiksha Scheme' which have been making the path for preparing teachers for integration of digital technology. It was realized by policy makers and educational planners throughout the world that ICT competencies of teachers play the most important role in effective integration of digital technology in school education. Therefore, structured parameter of ICT competencies defined for teachers across the globe with scope for contextualization was the need of the time to evaluate these competencies. UNESCO developed an ICT competency framework for teachers in 2011. This chapter presents the review of these policies, related programmes, curriculum framework and ICT competency framework in the context of integration of digital technology in teacher education. This chapter also contains the review of some of the models and frameworks developed by pedagogues and researchers in the field of education for effective integration of digital technologies in teaching-learning process which were already applied and evaluated by them as well as other researchers and pedagogues in real working situation.

2.1 POLICIES, PROGRAMMES, AND FRAMEWORKS ON DIGITAL TECHNOLOGY IN EDUCATION:

The process of review was initiated from the Computer Literacy and Studies in School (CLASS) programme and moved forward to National Policy of education- 1986, Programme of Action-1992, Information and Communication technology @ school (ICT@ school)-2004, National policy on Information and Communication Technology

in School Education- 2012, Samagra Shiksha Scheme-2018-19, ICT in Education Curriculum for Teachers 2019, Draft National Education Policy -2019, and, then, to the most recent National Initiative for School Heads' Teachers' Holistic Advancement (NISHTHA)- 2019-20. All of these were reviewed in the context of finding insights for integration of digital technology in teacher education. ICT Competency framework for teachers developed by UNESCO and ICT competency levels formulated by the policy makers of India keeping in view the present and future need of school education system, mainly the need of children (given in National policy on ICT in School Education-2012), were also reviewed to develop an understanding about the expected ICT competencies which need to be developed in teachers so that they would become competent to help students to develop these competencies in themselves.

2.1.1 Computer Literacy And Studies in Schools (CLASS) Project, 1984-85

Computer Literacy and Studies in Schools (CLASS) was introduced as a pilot Project in 1984-85 by introducing BBC micro-computers to 250 Schools of secondary and higher secondary level through the governments of respective states and further, more schools were added to it. 500 schools were added in 1985-86, 500 schools in 86-87 and 700 schools in 87-88 (Gupta,1996). It was a Centrally Sponsored Scheme during the 8th Five Year Plan from 1993 to 1998. In-service training for teacher for integrating computers in teaching learning process and in other activities of school began with the introduction of computers in school through the CLASS project. Three teachers from each selected school were trained for developing computer skills to be utilized in their professional work and to develop them as resource teachers to train other teachers in future. But the training programmes were full of barriers like selection of teachers from assigned schools without considering their attitude towards learning new technology. Most of the teachers were above the age of forty years and the method of training were planned without such considerations mostly suitable for young learners. There was lack of hands-on experience for teachers as one computer was made available for three teachers. Resource centres, usually, did not take much interest in such training programmes resulting in weak support provided by them to the teachers (Gupta, 1996). This scenario continued till the implementation of the ICT@schools in 2004. Programme of Action-1992 mentions that the CLASS project, which initiated the use

of computers in school sector, became successful in increasing the awareness among teachers, students and parents regarding the importance of computer literacy. But it could not achieve success up-to the desired level due to the shortcomings in the strategy of its implementation. Some of the major shortcoming identified through close scrutiny of the desired goals, implementation strategies and success achieved were involvement of multiple agencies in implementation and lack of accountability taken by them. Some of the other reasons were 'over emphasis on one-time input' related to hardware and no further ongoing inputs related to instructional process, lack of adequate training for teachers and their low motivation and lack of proper curriculum and teaching materials regarding this (POA_1992.pdf).

2.1.2 National Policy on Education (NPE), 1986

The National Policy on Education, 1986 was formulated before the popularization of internet technology in India. But, the potential of computer technology in the field of education at different level was recognized by the policy makers. Modern communication technologies were found capable to manage the constraints of time and distance (part 8.10 of NPE-1986). The policy considered that such technologies would be utilised for spreading of useful information, training of teachers and improving quality of education (part 8.11 of NPE-1986). Nothing more has been mentioned about digital technologies or Information and Communication Technologies in this policy. It has been mentioned that the teaching of Mathematics will be redesigned to bring it at par with modern technological devices (part 8.17 of NPE-1986), but nothing has been said about how the teachers will be prepared to incorporate such changes in the teaching-learning process.

2.1.3 Programme of Action (Poa), 1992

It was proposed in this Programme of Action that the CLASS project would be expanded but there was a concern about the subject to the condition of availability of resources required for effective implementation of this project in two thousand senior secondary schools under the planned coverage of 8th five years plan. The POA further says that the access to computers would be improved in these schools to extend the facilities for CLASS. It was planned to strengthen the management system to made it more effective for the implementation of CLASS project. The policy emphasized on encouraging computer application on operational basis at both secondary and higher

secondary level along with providing facilities of computers in these schools. It was proposed to make effort to provide computer literacy in secondary level institutions to equip children with required computer skills (part 5.13 of NPE-1986 As modified in 1992, MHRD, 1998) so that they would become fit to work effectively in the emerging world of new technology. Developing communication technology for improving classroom transaction and computers for interactive learning were proposed. It was proposed to make the inputs from educational technology an integral part of both pre-service and in-service teachers' training provided through District Institute of Education and Training (DIETs).

2.1.4 Information and Communication Technology (ICT)@ School, 2004 (Revised in 2010)

The ICT@ school was launched in December, 2004 and revised in 2010. The main purpose of this programme was to provide opportunities to secondary stage students to build their capacity in ICT skills and the opportunity to learn by using computer as learning aid which is commonly known as Computer Aided Learning (CAL) process. The emphasis was given to use teaching learning process which is ICT enabled. In the revised policy document (2011), provision for ICT capacity enhancement of all teachers and national ICT awards for teachers were planned (section 2 of amended guidelines of ICT in Schools Scheme,2011). Out of four components of this document third component is meant for teachers' related interventions. The revised scheme document states that the training in use of ICT in teaching during the pre-service secondary teachers' training courses will be compulsory and it would be of 55 hours duration (part 5.2.1 of the ICT @ School document). In-service training has been planned in two phases for all teachers. First phase has been termed as (part 5.2.2 of the ICT @ School document)) Induction training which is meant for first time induction training in ICT for all teachers in the sanctioned schools for 10 days and 8 hours per day making it a 80 hours duration (part 5.2.2.a of the ICT @ School document) and second phase in the form of refresher training in use of ICT in teaching to all teachers of the sanctioned schools every year for 5 days and 8 hours per day per teacher making it a 40 hours duration(part 5.2.2.b of the ICT @ School document).

It was planned to motivate teachers by giving awards to those who are using ICT for innovation in different aspects of education like; developing digital content and

resources themselves, sharing and dissemination of self-developed and other digital content. Other areas of focus were enriching school libraries with digital content and resources developed at library itself, ICT capacity building of teachers, both in-service teachers and pre-service teachers, by developing ICT content enabled subject teaching skills, digital content sharing skills, developing and becoming part of online professional groups for continuing education, collecting and sharing resources and making contribution to the strengthening of subject and area specific knowledge by active participation.

2.1.5 National Curriculum Framework (NCF), 2005

Though, the National Curriculum Framework (NCF), 2005 is primarily meant for school education it becomes like the spark in the plug for thinking about the teacher education curriculum as it is expected to be in synchronization of the needs of the school education to fulfil the demand of properly educated, well-trained and competent teachers.

NCF-2005 has dedicated one small section on computer science by recognising the tremendous effect of this technology on modern society along with recognizing the need for educated people to utilize such tools and technologies in most effective way for the betterment and development of human being and betterment of society resulting in betterment of the country. The curriculum framework clearly indicates the distinction between Information Technology curriculum and Computer Science curriculum. First one is the use and application of tools available through such technologies and the second is the knowledge about how these tools should be designed and developed. Both of these have been considered equally important for giving place in school curriculum. It talks about the most difficult challenge to provide access and connectivity of computers for all children which is a technological as well as an economic challenge. But the curriculum framework, further, suggests that it is a need to address these challenges seriously because of the growing impact of computer technologies.

Though, above description shows that the focus has been given on ICT as school subject in different form, a thorough analysis of the framework gives a little glimpse of integration of ICT in teaching-learning process of different subjects also and other day to day working of teachers, students and other staff of the school. It is emphasized that the curriculum development for computer science and information technology should

focus on serving as the basis for the beginning of a discussion between educators, administrators and general public. (part 4.6.3 of NCF).

In context of teachers, it is advised to design textbooks, handbooks and workbooks for teachers having the information about existing stocks of audio and video materials of good quality and the sites on Net where such materials are available. While describing the beneficial uses of technology the curriculum framework emphasized on the important role of mass media in supporting teacher training and facilitating classroom learning which can be equally beneficial for both pupil teachers and children. It is beneficial for teaching and learning at any place. It further states the importance of internet related functions like; sharing information which provide a large platform for dialogue, discussion and debate on diverse issues which is quite beneficial for teacher education. It is advised through the framework that these technologies should be integrated in pedagogy with larger purposes and not be used just as an add-on. Teachers and students should not become like a passive learner in the form of a mere consumer that operate technology only for listening or viewing something but everyone should be a critical thinker and creator of his/her own contents. Interaction and intimacy should be maintained while using such technologies, only then it would become fruitful.

It is evident from the NCF-2005 document that it does not give any detailed account of how to integrate digital technology in teacher education but it suggests how such technologies should be used by the teachers for making teaching and learning more effective. The framework talks about designing supportive materials. It talks about role of Internet and mass media in any form of learning 'either in classroom or outside the classroom' either in group-learning or in self- learning, about mass media platforms for interacting with others, sharing with them and learning from those interactions, discussions and debate. Potential of such technologies in the process of evaluation has also been noticed by the planners as it makes the process of evaluation more transparent. It talks about providing chance to teachers to get first-hand experience of creating programmes themselves with the help of technology and using them in their professional work. Such opportunities will help to develop an interest in the information and communication technology. The planners of this curriculum framework are concerned about inadequate availability of computers and linkage facilities in training institutes. They considered this problem as one reason coming as a barrier in the path of adequate utilization of the potential of information and communication technology

for changing the ethos of schools and training institutions. It advises to use technology in critical way promoting active participation of both teachers and students and maintaining the process of interaction and intimacy for better outcome.

Above description related to the use of technology by the teachers and students guides how teacher education should be designed to train and prepare both, pupil teachers and in-service teachers for effective integration of digital technology in pedagogy and that design will guide teacher educators to make them competent to integrate such technologies for modifying and redefining the task instead of using them as mere substitution to other resources. When teacher educator will use such technologies after critical thinking then pupil teacher will also learn to use them for effective result. This effectiveness needs to be brought in each and every area of school education and teacher education. Therefore, the teacher education needs to be oriented towards preparing teachers for the integration of digital technology in all aspects of their profession as described above which comprises of teaching-learning process, evaluation, interaction, extra-curricular activities etc. to fulfil the actual meaning of integration of digital technology which is meant for enhancement, modification and/or transformation of the task after critical evaluation rather than mere substituting the old technology with new. This would only be possible if the pupil teacher will observe their educators using such technologies effectively.

2.1.6 National Curriculum Framework for Teacher Education (NCFTE), 2009

This National Curriculum Framework for Teacher Education emphasises on making teachers competent to integrate digital technology after thinking its critical utilization for developmental purposes and not just for the sake of integrating or for any kind of detrimental utilization. Teachers are expected to be competent to integrate it for any specific purpose in professional work either for self-learning, teaching -learning process or any other work of a pupil teacher or in-service teacher. They are expected to be competent to differentiate between useful integration of such technologies and mere substitution of some other aids by technology in the teaching-learning process. The framework perceives the demand of such technologies in some schools as a fashion statement rather than essential tool. Though, the framework recognises its potential to make learning liberating, it states that the technology is being used mostly for cosmetic

purpose in education. The framework considers information and communication technology as an appropriate resource in the form of digital tools for providing support to pre-service and in-service teachers for their development in context of academic and professional skills and knowledge.

Such technologies are considered as very useful and significant tools for receiving and disseminating information, keeping in touch with other professionals in the field of education, seeking support from other experts from the field and giving support to them whenever it is required. Creating and promoting collaborative and supportive academic learning environment and breaking the isolation of teachers have been considered as some of the best uses of such technology by the planners of this framework.

The framework suggests to develop "the centre for teacher resource and academic support" where provision should be made for different types of material including digital resources, like; multimedia materials, internet access, platform for teacher interaction, study sessions and academic support through such technologies along with face to face mode, development of learning and teaching materials for use in schools and sharing across schools. These suggestions made by the formulator of the curriculum framework for teacher education to utilize digital technology as a resource itself and to develop various resources signify the need of integration of such technologies in teacher education.

2.1.7 The UNESCO ICT Competency Framework for Teachers, 2011

United Nations Educational, Scientific and Cultural Organization's (UNESCO) Information and Communication Technology Competency Framework for Teachers (2011) has mentioned three different stages of integration of technology in teaching and learning where technology literacy has been given the first place which would enable students to learn more efficiently and will make it easy to apply second and third approach for knowledge deepening and applying it to complex, real-world problems, and to make students capable for knowledge creation. In this framework, teachers' work has been classified into six aspects and teachers are expected to be competent in integrating digital technology in all of these six aspects beginning from the first stage of competence to the top most stage of knowledge creation. This framework has explained with examples how to integrate digital technology at different level of knowledge development and all six aspects have been described in this context. It is

envisioned in this framework that teachers should be competent in integrating ICT in all of these six aspects and through all three levels of ICT competencies. The framework states that teachers should be competent in understanding ICT policies and innovations in education, using ICT in curriculum and assessment, and integrating ICT in pedagogy, self-management, organization and administration, professional learning and collaborative groups learning.

Table 2.1: The UNESCO ICT Competency Framework for Teachers
(Source: Executive Summary, page 3, The UNESCO ICT Competency Framework for Teachers. Version 2.0)

	TECHNOLOGY LITERACY	KNOWLEDGE DEEPENING	KNOWLEDGE CREATION
Understanding ICT in Education	Policy awareness	Policy understanding	Policy innovation
Curriculum and Assessment	Basic knowledge	Knowledge application	Knowledge society skills
Pedagogy	Integrate technology	Complex problem solving	Self-management
ICT	Basic tools	Complex tools	Pervasive tools
Organization and Administration	Standard classroom	Collaborative groups	Learning organizations
Teacher Professional Learning	Digital literacy	Manage and guide	Teacher as model learner

2.1.8 National Policy on Information and Communication Technology (ICT) In School Education, 2012

As per the preamble of "National Policy on Information and Communication Technology (ICT) in school education (2012)" all possible information and communication technologies which can be helpful in improving school education in

India should be considered comprehensively as a crucial need of the time. The policy has been prepared keeping in view the wholistic structure and requirement of school education system. Teacher is one of the important components of school education system. Therefore, integration of such technologies in teacher education has also been included in this policy.

This policy on ICT In School Education has explored the potential of ICT in different forms of its functions which are able to respond various challenges in the Indian education system. Teacher's capacity building, supporting on-going teachers' capacity building programmes, promoting 'creative, analytical, aesthetic and problem-solving abilities and sensitivities' in students and teachers are among these potentials of ICT. To create a demand for best utilisation of and optimal returns on the potentials of ICT in education by creating a conducive environment of collaboration, co-operation and sharing has been envisioned as one of the policy goals

The policy talks about ICT literacy and competency enhancement for both teachers and students (part 4.2 of the policy). It has mentioned three levels of ICT competencies, namely, Basic at stage-I, Intermediate at stage- II and Advanced at stage- III. These three levels of competencies have been presented by citing proper terms and actions related to those competencies which are given below in Table 2.2, as given in the policy document.

The policy suggests that these competencies will guide ICT curriculum for teachers. After reviewing 'ICT in Education Curriculum for Teachers 2019', it has been found that these competency levels have been taken as the key points around which the whole curriculum has been planned. It is expected that teachers will participate in selection and evaluation of digital content and resources. It is proposed that they will be encouraged to integrate digital technology in teaching-learning process, to develop their own digital resources and to share those resources with colleagues through their own digital repositories (part 4.3 of the policy). Another important issue addressed in this policy is to train teachers and students to take care of security measures related to internet, to use internet safely.

To fulfil above purposes, mentioned in the policy document, integration of digital technology in teacher education becomes quite essential and it should be well planned

so that such competencies can be developed among the teachers either pre-service or in-service.

Table 2.2: Stages of competencies

(Source: National Policy on Information and Communication Technology in School Education, 2012)

S. NO.	Levels	Competencies
1	Stage 1: Basic	Basic competencies of: • operating computers and other digital tools for storing, retrieving, processing and managing data • connecting, troubleshooting and disconnecting basic input and output devices and managing content from these devices • updating and securing computer • Connecting to internet, web surfing, using e-mail and search engines
2	Stage 2: Intermediate	Competencies of; • Using digital tools and software for creating and managing contents • Installing, troubleshooting and uninstalling basic software applications • Using search engines and websites for searching and retrieving data and managing resources
3	Stage 3: Advanced	Competencies of using different software applications and web resources for: • enhancing one's own learning in analyzing data, computing, designing, graphical and audio-visual presentations and communication, doing research, documentation and presentation • creating online networks for cooperative and collaborative learning and participating on other similar platforms • being aware of cyber security issues

2.1.9 Samagra Shiksha Scheme, 2018-19

It is an overarching programme initiated by government of India in 2018-19 under which there is a holistic integration of teacher education and school education from pre-primary to higher secondary level. The main aim of this programme is to provide quality education to equip children with skills and knowledge essential for their holistic development for future for joining the world of work or higher education. For improving the quality of education its main focus is on two T's which are teachers and technology. For capacity building of teachers NISHTHA (National Initiative for School Heads' Teachers' Holistic Advancement) programme has been introduced recently in 2019. Capacity building of teachers for integration of digital technology is one of the expected outcomes of this programme. There is provision of DIKSHA (Digital Infrastructure for Knowledge Sharing) portal for teachers to serve as national digital infrastructure for them which is helpful for sharing and upgrading their skills.

This programme proposes the provision for continuous capacity enhancement of teachers for the integration of digital technology in teaching-learning and other professional work. It proposes that teacher and teacher educators should be recognised for innovative use of digital technologies in their work for motivation. Every teacher is expected to be competent in selecting and using contents from free and open source software and subject specific tools.

2.1.10 ICT in Education Curriculum for Teachers, 2019

The key points of the "ICT In Education Curriculum for Teachers, 2019" are the three stages of 'digital competencies' which are taken from the "National policy on Information and Communication Technology (ICT) in School Education, 2012". This curriculum has been designed for the purpose of developing these competencies among teachers to achieve seven objectives. These objectives are related to effective use of ICT tools, software applications and digital resources into teaching-learning process, evaluation, selection of ICT resources after proper evaluation. Other objectives are to make teachers able to search, organize and create their own resources, to use technology safely taking care of ethical and legal issues, to make the class inclusive with the help of technology and to use technology to participate in teachers' professional networks.

It is stated that the content is able to draw upon competencies from different levels to ensure the completion of all levels and it is rolled out as a series of short courses. It is

proposed to give a diploma in ICT in Education after the completion of three induction and twenty refresher courses. These courses are proposed to be conducted in face to face mode at central level but states are free to choose any of the two mode either face to face or online mode.

2.1.11 Draft: National Education Policy, 2019

The cover page of the draft of this policy indicates that teaching and learning with digital technology has been taken as one of the key focus area because one of the four pictures of learning activities on this page shows that a boy is learning with the help of laptop and a lady standing beside him is explaining something while both are looking at the screen. The boy seems as a student and the lady his teacher. As per as concerned with preparing teacher, it is stated that such technologies will be utilised widely in the process of continuous professional development of teachers. There is provision to provide the facility of access to internet and various digital platforms to the teachers both at school and home (part 3.4 of P5 of the draft). Draft of the policy suggests that departments of education should offer online education to the teacher for their professional development and these programmes should be available in different formats, like evening, full-time, part-time, blended and online. It is proposed in the draft of the policy that these courses must be available for both, in-service teachers and beginner teachers. It is suggested that course should be designed to cater the purpose of professional development of in-service teachers and the purpose of mentoring for beginners.

Further, the draft of the policy has included the educational technology in additional key focus area where it focuses on to achieve four major aims out of which two are directly concerned with the preparation of teachers. Therefore, teachers need to be prepared in both of these areas. The first aim is concerned with teachers' professional development which suggests that the teachers must be trained adequately to utilise digital technology in such a way that it leads to achieve improved educational outcomes. The policy suggests that the teacher education must integrate these technologies in their own working like, teaching learning and other activities.

At the one hand policy suggests that there should be provision of online professional development programmes for the teachers as well as teacher educators and on the other hand it states that for the first-time student learner (pupil teacher) may not go well with

such online learning system. So, it suggests that they should be provided with the opportunity of classroom environment with faculty to mentor them and guide them. Policy believes that such environment will facilitate collaborative peer learning.

To develop the skills of integration of technology in both pre-service and in-service teachers, it talks about the provision of hands-on experience of utilising technology-based resources including practice of basic competencies of handling such tools (part 3.1 of P19 of the draft) in respective teacher education programmes.

The second aim is concerned with the impact of technology is the classroom activities including teaching learning and evaluation. Policy suggests that careful evaluation of each digital tool should be done to ensure that it is able to address the challenge without creating any new challenge. Therefore, it states that the teachers must be trained for it. The policy proposes impowering teachers through proper training and supportive facilities to take the initiatives and to lead various activities related to the integration of required technology in the teaching learning and assessment process in the classroom and in other related tasks in the institutions which can be improved through integration of technology (part 2.1 of P19 of the draft).

Focus has been given on using technology for different purposes like, improving the quality of teaching and learning by utilising smart and intelligent technology-based assessment system and by creating interactive contents which needs to be interesting for the learners. Tools based on virtual and augmented reality have been suggested to be utilised for this purpose (part 2.2 of P19 of the draft). As all these processes are directly related to the pedagogy, so, the teachers need to be trained to make them competent to fulfil these purposes.

It has been proposed to take some specific technology related/oriented policy action which include to provide some special courses for faculty's professional development through a platform like, SWAYAM (Study Webs of Active–Learning for Young Aspiring Minds), which would provide online learning facilities. There is provision of development of 'teacher professional learning communities' for widespread use by teachers to interact with each other and to exchange ideas. The draft of the policy proposed to develop an autonomous body, "NETF (National Educational Technology Forum)" that would provide a platform for sharing of ideas related to using technology to improve teaching and learning, assessment, administrative work and other

educational activities (part 1.1of P19 of the draft). There is provision for teachers to be trained to play their role effectively on this platform.

2.1.12 NISHTHA (National Initiative for School Heads' Teachers' Holistic Advancement), 2019-20

NISHTHA is the latest capacity building programme by Government of India for 4.2 million school teachers and Principals at elementary level in all government schools of India, faculties from SCERTs (State Council of Educational Research and Training) and DIETs, and resource persons from block resource centres (BRCs) and cluster resource centres (CRCs) which is conducted through blended mode. Improving quality of school education through integrated teacher training is the main aim of this programme. Capacity building of teachers for integration of ICT in teaching-learning and assessment is one of the eleven expected outcomes of this programme. It is launched under the centrally sponsored scheme of Samagra Shiksha. There are two modules given at the end of the document of this programme which describe various ways and activities to teach different subjects and how digital technology can be integrated for better learning. This programme itself integrate digital technology for conducting the programme and there is provision of post-training follow-ups. The web portal of NISHTHA has been designed as an interactive portal that is able to support post-training follow-ups.

Finally, after reviewing all of these policies it is found that they tell about integration of Information and Communication technology in school education but most of them did not mention directly and clearly integration of such technologies in teacher education, only few of them have been found to providing some insights related to integration of these technologies in teacher education. But, wherever integration of such technologies in school education has been mentioned and described, by and large it gives insights regarding preparing teachers for this purpose. Thorough analytical details about it have been presented in the chapter V: Analysis.

2.2 FRAMEWORKS & MODELS AVAILABLE FOR EFFECTIVE INTEGRATION OF DIGITAL TECHNOLOGY IN EDUCATION:

Teaching is not an easy task. It is a complicated process where teachers need to practice their art, craft and science to engage the mind of their students by creating a conducive learning environment where everyone enjoys thyself in the process of learning. The instinct of art helps teacher to create positive learning environment, the instinct of craft helps to improvise teaching-learning aids and the instinct of science helps to plan and organise steps and activities in teaching -learning process. For fulfilling the purpose of effective teaching and learning, a teacher needs to plan, organise and manage many things at a time; viz.; selecting proper teaching method, planning suitable, feasible and reasonable process and utilizing best suited teaching-learning aids which are simple and easy to use, easily available or can be made available easily and they become more effective if students are familiar with them. Most importantly, an aid become a blessing if it is in audio-visual form and handy. Teaching-learning aid in the form of digital technology is one of them.

For making the pedagogy and learning effective teachers need to shift and evolve their understanding constantly (Mishra & Koehler, 2016). For conducting the process of teaching and learning effectively either in classroom or outside the classroom, teachers usually, modify or transform or completely change and evolve the process and method of working. They are expected to be passionate towards adopting those innovations in the system which are found more productive in comparison with current practice after proper evaluation. It is evident from the literature that various practitioners in this area have experimented with innovations, some of them have developed models, frameworks etc. to improve or to modify or to transform the pedagogy. Some of them have done research at ground level, observed keenly and analysed everything to develop some theories. These theories, models and frameworks have been utilised further by teachers, teacher educators and researchers for either improving pedagogy skills or for doing further research based on these theories, models and frameworks. Even, policy makers gain insights from such theories and frameworks for formulating a policy relevant to the current and future need of the society. In case of integration of Information and Communication Technology in digital form in pedagogy, similar

research works have been conducted by the teachers, teacher educators and various other researchers, models and frameworks have been developed and tested by applying them in real situation. These models have been utilized by various researchers, teachers and teacher educators in pedagogy and modifications have also been done by them if required. Though, there are many models developed by different scholars from this field but due to the limitations of the study only five of them have been reviewed which were found more frequently than others in the literature and relevant to this study.

2.2.1 ASSURE model

The ASSURE model was designed by Heinich, Molenda & Russel in 1999 (Faryadi, 2007) and introduced by Smaldino, Russell, Heinich, & Molenda in 2004 (Donmezy, M., & Cagilta, K., 2016)) as an instructional system that guides teachers to develop lesson plans integrating technology and media and it is modified in 2008 by Smaldino, Lowther & Russell to be used in the classroom by the teachers. This model has been designed on the basis of Robert's Gagne's Events of Instruction. The main focus remains on the learner and the outcome in achieving learning objectives. ASSURE model has six steps. Each letter of this title (acronym) represents one step ("A-analyse Learners; S-state Objectives; S-select Methods, Media and Materials; U-utilize Methods, Media and Materials; R-require Learner Participation; and E-evaluate and Revise") and each step describes a set of tasks which is based on the selection of concept and content and use of relevant media and educational technology. The abbreviation of this title explains itself how systematically it organises learning by integrating method, media and materials according to the demand of the concept and content. These steps may be applied in linear fashion or in cyclic fashion. Though, linear fashion is used more frequently, cyclic fashion diagram was given by Heinich, Molenda, Russell and Smaldino in 1999 (cited by Molepo & Mothudi, 2014).

As concerned with the integration of digital technology, this model is not all about technology but it is included in this part of the present study because it has been considered as an initial step for moving towards developing models for the integration of digital technology in pedagogy. This model of instructional design has given emphasis on selecting and utilizing media according to the need of individual student as well as need of the class, topic, lesson and unit. Logical and effective use of digital technology is the talk of the time and research works have been going on to find out how digital technologies are being integrated to gain maximum benefit and how barriers

are being overcome and demerits are being reduced. In that case, this model is significant, as it allows to integrate any kind of technology only when the topic, lesson or unit of teaching and learning demands it or according to the requirement of individual student or a class and that too after proper analysis and evaluation.
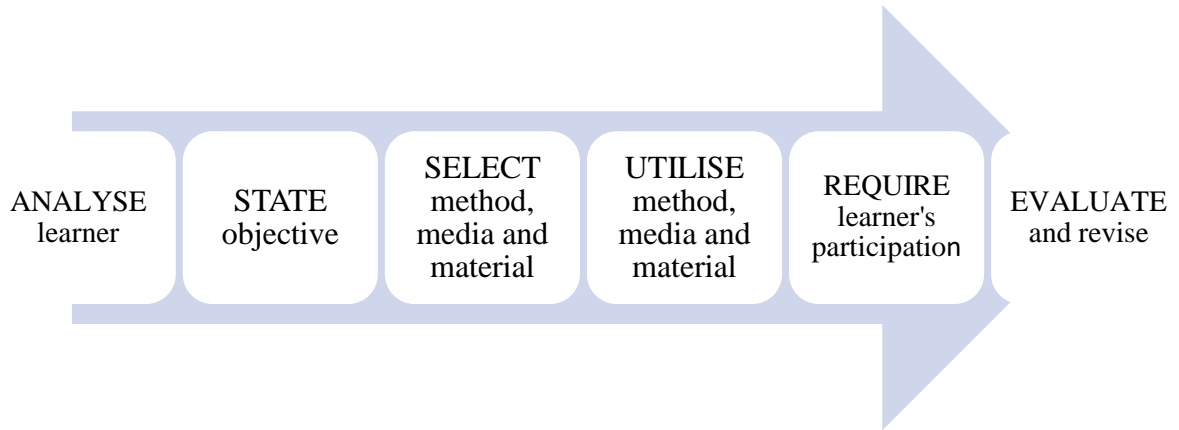
Figure 2.1: Steps of ASSURE model

2.2.2 ADDIE Model:

ADDIE has been accepted as an umbrella term in recent literature (Molenda, 2003)). It is not created by any specific individual as there is no any clear evidence about the origin of this model (Molenda, 2003., Donmezy & Cagilta, 2016). Molenda (2003) considered it as an evolved form of Instructional System Development (ISD) through the tradition of informal oral communication. It is considered as a process of designing instruction either with or without technology as per the requirement. Each letter of the term ADDIE (A-Analyse, D-Design, D-Develop, I-Implement, E-Evaluate) is considered as a step of the instructional design given below in the Figure 2.2. Analysis of learners is done to know their interest, attitude and previous knowledge. Analysis of learning context is done to understand learning environment. Designing of learning process begins from identification of objectives to be achieved. The process of delivery of instructions needs to be designed where activities and integration of technology are planned. At the third step, the development stage, contents and assessment tools are developed. At fourth step, during implementation instructional materials are delivered to provide support to the learners and at the last step evaluation is done. But evaluation depends on the planner of the instructional design which may be in the form of summative evaluation at the end of the process or may be in the form of both formative and summative evaluation during the implementation stage or at the end of the process.
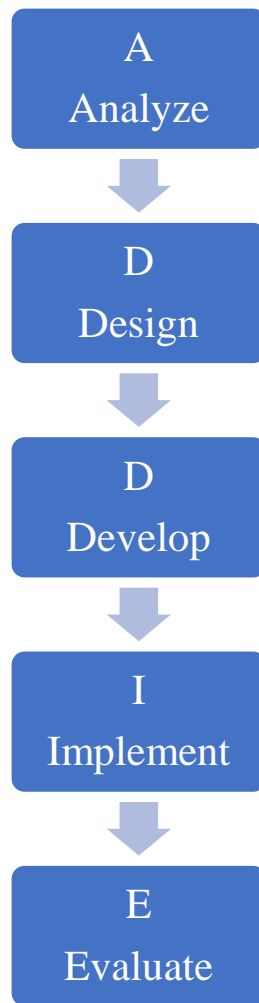
Figure 2.2: Steps of ADDIE model

2.2.3 TPACK framework

This has been observed as the most frequent framework that has been utilised by a number of researchers including teacher educators for evaluating teachers', pupil teachers' and teacher educators' technological, pedagogical and content knowledge as well as their competencies in these areas. It can be easily understood that the basis of this framework is "Lee S. Shulman's PCK (Pedagogical Content Knowledge) framework" what he proposed for the first time in 1986 specially for teacher educators that dealt with their competence related to their pedagogical content knowledge. The

PCK Model by Shulman gained remarkable popularity during those days in the field of teacher training and professional development of teachers.

"Punya Mishra and Matthew J. Koehler's (researchers from Michigan State University) developed TPACK (Technological, Pedagogical And Content Knowledge) framework" in 2006 for teachers for effective integration of Information and Communication Technology in education with prime focus on integration of technology in pedagogy that is based on Lee S. Shulman's PCK concept. Though, the TPACK concept is not owned by anyone (Koehler, 2012), the description of TPACK by this particular name has been found in the research paper entitled "Technological Pedagogical Content Knowledge: A Framework for Teacher Knowledge by Punya Mishra & Matthew J. Koehler, Michigan State University, 2006" and it is found through the literature review for this study that this is the most referred paper in the context of extensive explanation and presentation of TPACK. Therefore, this study has referred the TPACK given by Mishra and Koehler in 2006.

This framework has been created through a complex interplay of three basic forms of knowledge which are Content Knowledge (CK), Pedagogy Knowledge (PK), and Technology Knowledge (TK). Initially, the focus has been given to different types of content knowledge and then the interplay of all together. For example, at the initial stage, emphasis has been given on "Pedagogical Content Knowledge (Shulman, 1986) & Technological Content Knowledge (TCK), then, on Technological Pedagogical Knowledge (TPK) and finally, on Technological Pedagogical Content Knowledge (TPACK) (Mishra & Koehler, 2006)" which is the combination of all these three because these three cannot be effective in isolation.

Digital technology can be integrated effectively in pedagogy only when a teacher would develop his/her competency in all these three types of knowledge and would achieve a remarkable level of TPACK. The TPACK level of a pupil teacher, in-service teacher or a teacher educator decides how successfully he/ she can do critically developmental and effective integration of digital technology in academic tasks ranging from curricular to co-curricular activities. That is why many researchers have already applied this framework for studying the level of competencies of teacher educators, pupil teachers

and in-service teachers. Some of such studies have been reviewed for this study and presented in next chapter.

Figure 2.3: TPACK

Source: https://matt-koehler.com/tpack2/tpack-explained/
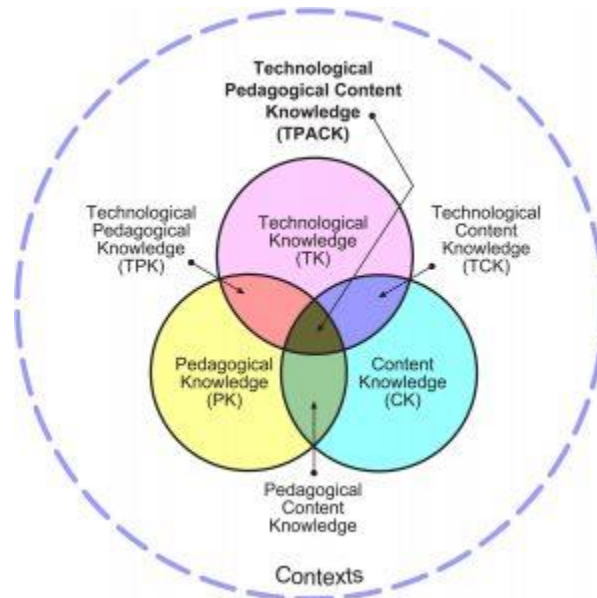
2.2.4 Generic model

Wang (2008) has proposed a model called 'generic model' for the integration of Information and Communication Technology (ICT) in effective way in the process of teaching and learning. This model consists of three fundamental elements related to teaching and learning which are pedagogy, social interaction and technology. The researcher has presented these three elements as three key components of a technology enhanced learning environment through a sound design to enable teachers to integrate ICT into teaching and learning in an effective way.

In the study, resulting in the development of this model, both, pedagogy and social interaction have been taken into central focus of a learning environment, and technology has been taken as an essential support. But, all of three have been considered equally important and essential for effective learning in the present learning environment full of ever emerging digital technologies. Theoretical foundation of knowledge and learning has also been considered which is "cognitive constructivism"

in this case. It is concluded that pedagogical design must support the needs of individual learners and it should satisfy their learning intensions.
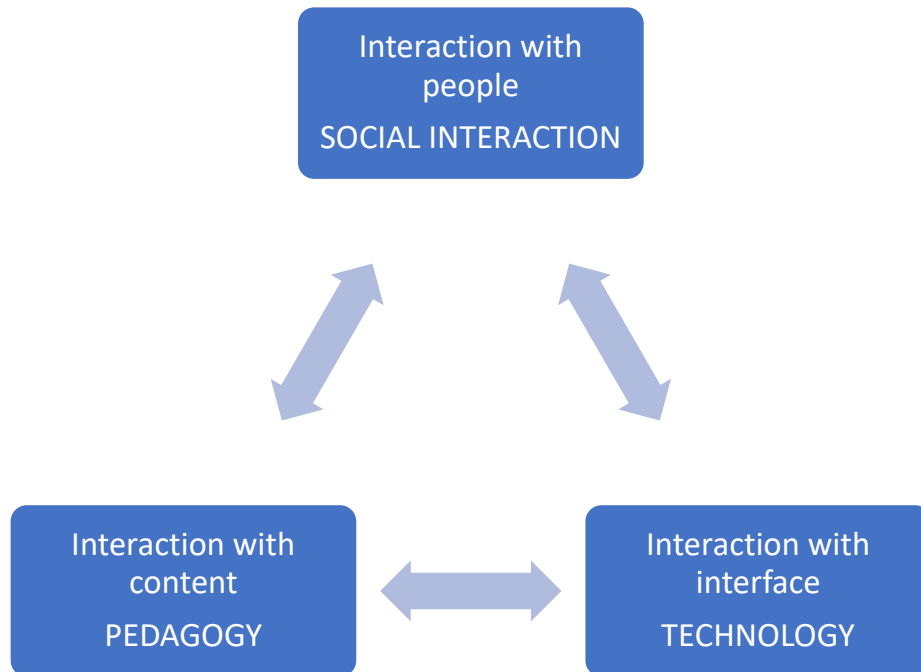
Figure 2.4: Generic model: Relationship between the model components and interaction (Source: Wang, 2008)

2.2.5 SAMR Model

"Substitution-Augmentation-Modification-Redefinition (SAMR)" Model for Technology Integration: Puentedura introduced "Substitution, Augmentation, Modification and Redefinition (SAMR) model in 2006 in collaboration with the Maine Department of Education and their learning technology initiative". It is not a pedagogical method, but a tool that guides pedagogues and tells them what kind of assignments they should give during students' learning process. It has four stages known as "Substitution, Augmentation, Modification and Redefinition". At first two stages (substitution and augmentation) the role of technology is to be used as a direct substitute for the original tool where no change occurs or little functional change in the form of improvement occurs. These two stages are known as enhancement level of

technology integration. At third and fourth stages (modification and redefinition) the role of technology is to function for modifying the task or creating new knowledge, redefining the task and providing new learning experience and both of these two stages are known as transformation level of technology integration.

Table 2.3: The four steps and two levels of SAMR Model of technology integration. (Puentedura, 2006)

S. No.	Steps	Level	Technology integration
1	Substitution	Enhancement	Technology utilized as a direct substitute of other tools with no functional change.
2	Augmentation		Technology utilized as a direct substitute of other tools with little functional improvement.
3	Modification	Transformation	Technology utilized for significant modification and redesigning of task.
4	Redefinition		Technology utilized for the creation of new knowledge and tasks.

Though, there are many models and frameworks developed by pedagogues and educationists for the effective integration of digital technology and assessing and improving ICT competencies of teachers, teacher educators and students, and assessing the level of integration of digital technology in teaching -learning process, only few are reviewed for this study which are found relevant for this study and frequently applied by researchers in this fields. After reviewing these models and frameworks, it is found

that these models and frameworks are easy to understand and equally easy to apply at ground level. Major observations from these models and frameworks regarding integration of digital technology have been presented in tabular form in chapter-V: Analysis and Interpretations.

CHAPTER III
REVIEW OF LITERATURE

The process of preparing teachers for integration of digital technology in their professional work begins at the pre- service training stage as teacher education programme. This is the foundation stone of the future carrier of a digitally competent 21st century teacher ready to harness the potential of such technologies for redefining the task for more effective outcomes. But this process continues throughout the professional life of a teacher as such technologies are emerging day by day in the form of more advanced tools and techniques. To keep teachers updated in the field to harness maximum benefits from digital technology, continuous professional development programmes are organised by government and educational organizations which are termed as in-service teacher education programmes. Therefore, this study attempts to review research papers based on the integration of such technologies in both pre-service and in-service teacher preparation programmes.

Effective integration of technology resulting in better transformation of teaching and learning depends on combined function of various factors which are used to be both internal and external factors for teachers. Access to good quality technologies is also an essential factor which contribute to effective technology integration (Paratore et.al., 2016). It is evident that only the knowledge of a teacher is not sufficient to make effective integration of technology in teaching and learning but without proper knowledge and sufficient training, external factors would not be able to make any difference though being in excellent form. Even if knowledge, training and resources are made available to teachers for the purpose of integration of technology in teaching, learning, evaluation and other related activities, it would not ensure effective integration if the teachers do not possess positive attitude towards it. Therefore, it is needed to explore all of those factors which are found impacting integration of digital technology in classroom process, evaluation, sharing information and other works undertaken by a teacher those need to be taken care of while preparing them for professional work as a teacher. Education programmes for teachers may not be able to solve the problem related to school-based external factors, but these programmes are able to make a large impact on internal factors which depends mainly on the teachers. These programmes

are able to develop positive teachers' beliefs, their knowledge pedagogical and technological skills and their efficiency for transformative and effective technology integration (Paratore et.al., 2016).

While going through the plethora of the literature, different themes were found which need to be discussed for this study. To systematize this exploration important themes emerging from the review of related literature were identified and the review has been presented here under five major thematic area. The first thematic area is based on policies, programmes and curriculum regarding preparing teachers for integration of digital technology, second is based on learning design, competency, level of integration, perception of teachers about training/learning. Third theme is based on using models and frameworks for effective integration of such technologies and to evaluate and improve digital competencies. Fourth theme is based on the factors affecting (and supporting) integration of digital technology, like, human factors- ICT competencies and attitude of teachers, pupil teachers, teacher educators, administrators and other supporting persons, their belief etc, and other resources - infrastructure and training facilities. Fifth theme is based on Social learning and integration of digital technology.

3.1 Policies, Programmes and Curriculum regarding Preparing Teachers for Integration of Digital Technology:

Policy perspective seems to be one of the least searched areas in the context of ICT integration in education as limited literature could be found on this theme related to this study which focuses on preparing teachers for integration of digital technology. It is evident from the findings of "content and authorship analysis study of five decades of research in the field of educational technology published in the British Journal of Educational Technology (BJET) between 1970 and 2018 (Issue 3), making a total of 1777 articles by Bond et.al. (2019). While doing thematic analysis of the content, authors observed seven main themes emerging from it, namely, learning, students, technology, research, school, training and time but it was a surprize for the authors that terms "policy" and "theory" did not appear at all in the overall concept map. Therefore, they saw the condition as highlighting the on-going calls for giving more emphasis on policy and theory perspective in this field. Another review study shared by twelve authors from twelve different places from ten countries (Kong et.al.,2014) reached to the conclusion that policies should be considered on this aspect of education that is

integration of technology in school education which itself include teacher development for this purpose. Stakeholders in this area should reflect those policies which deal with setting goals for curriculum including the development of 21st century skills, providing required digital infrastructure in schools, and addressing legal and privacy issues regarding e-resources (Vrasidas et. al., 2001). Authors opined that this process would require time. They suggested that new programmes in teacher education for integration of technology should be developed, implemented and evaluated by skilled personnel. They show the concern about resistance to change as an obstacle in the path which is deeply rooted in education systems. As new technologies have changed the process of teaching -learning from mere traditional classroom activities to creating and sharing knowledge, so, Henriksen et.al. (2016) considers 'learning of integration of technology and learning creativity' equally important for development in the field of education in 21st century. Curricular integration of technology and creativity require well thought prior planning. As creativity can be learned by doing, so, these authors suggest that sustained creativity, as a habit of mind, should be reinforced and supported. Therefore, Creativity and technology require to be placed in policy at all levels and both should be embedded across the curriculum. Authors, further, suggest that teacher education curriculum should integrate technology and creativity across the program and specific programmes focusing on these two major aspects should be placed in it.

3.2 Learning Design, Competency, Level of Integration and Perception of Teachers about Training/Learning:

Ever emerging digital technology has taken an important place in education, usually referred as one of the key components of education in twenty first century. Relevant digital skills essential for being a twenty first century teacher, competent enough to guide twenty first century learners need to be developed in them. For fulfilling this purpose researchers and teacher educators formulate different plans and programmes, make arrangements and implement them. While conducting such programmes, they observe the activities of student teachers/ in-service teachers/ teacher educators whomsoever may be the participants, observe each and every step of the programme, interact with learners to develop deep understanding of various factors and conditions, assess and evaluate learners as well as programme to find out positive and negative aspects. These findings help the teacher development community comprising of teacher

educators, policy makers and university departments to plan their future teacher development programmes for developing digital skills in them to enhance their digital competency. The findings of these research studies help the community to understand all related factors those need to be taken care of, which need to be modified or changed or to be continued for improving the process of learning to develop digital skills to be applied to improve teaching-learning process and assessment. For example, When pupil teachers utilized some digital tools and media accompanied by regular instructions of literacy methods course, a positive trend was found in the perception of their knowledge, their literacy content knowledge, their self-efficacy and willingness towards utilizing technology in their profession in future as a teacher (Paratore et.al., 2016). While studying weak and strong educational integration of ICTs model (Moreira et.al. 2019) in school, it was found that the teachers following strong educational integration of ICTs model were those who perceived themselves as sufficiently trained and having highly developed digital competence. It indicated that sufficient training resulted in better integration of digital technology in teaching -learning process as the training developed confidence and self-efficacy.

Teachers professional development, either pre-service or in-service, in the area of digital technology not only in technological skills but in the skill of how to integrate it in professional work is of prime importance which is reported by of O'Neal, Gibson & Cotton (2017). Using a qualitative approach, they explored elementary level teachers' belief regarding use of technology in pedagogy and required skills in students for being successful in urban school of USA. They reported positive view of teachers towards technology but they expressed the need of more guidance for effective utilization based on 21st century skills. It means they need more in-service training for their professional development not only in technological skills but the proper pedagogical utilization of those skills. It is noticed in the literature that though the teacher education programme was same for all respondents but the level of integration of digital technology were different (Hammond et.al., 2011). They (Hammond et.al., 2011) examined the use of ICT by pupil teachers during their teacher education programme continued for one year. They examined how and why ICT was used. Whole cohort having 340 respondents was explored through a survey by the researchers. Semi- structured interviews were also conducted with a small sample from the same cohort. It was reported that all respondents used ICT frequently in internship phase. Interactive White Board (IWB)

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was the most utilized tool by almost all respondents. They found three levels of categories of ICT users; "routine users, extended users and innovative users". First level users were focussed to use IWB, second level users gave chances to students also for using digital tools for themselves and third level users utilized such tools in many ways and made their efforts to solve problems related to barriers. A clear association was reported between belief of pupil teachers in the worth of ICT and the frequency of utilizing these tools by them. Sanchez-Garcia et.al. (2013) conducted a study among eighty-five teachers enrolled in a training programme of one-year duration. They were trained to utilize ICT in teaching. Three aspects related to ICT integration were explored by the researchers with the help of a Likert type questionnaire having 154 items. First aspect was based on uses of ICT, second aspect was related to attitudes in classroom and the third aspect was concerned with the satisfaction of participants with the training received. Teachers gave more value to the development of pedagogical skills and skill of creating new e-resources for classroom in comparison with the development of mere technological skills. More emphasis was given on hands-on practice in the guidance of mentors and collaboration of peers for progressing towards advance and effective utilization of technology in classroom. Aslam and Zhu (2015) conducted a study on 782 pre-service teachers through two-stage probability sampling method to see the association between their perception regarding integration of ICT in their coursework of professional education and their teaching experience practice. They conducted their study in three Turkish state universities with the highest and lowest number of the pupil teachers belonging to different subject areas. All pre-service teachers were injected the tool consisting of open-ended questions and 15 participants were subjected to interviews. The study reported variation among concerned universities in the context of availability of sources regarding integration of ICT. Some had more sources and some had less. The study further revealed the use of technology at basic level by student teachers for presentation in their teaching practices. The researchers suggested that the pre-service teachers should use advanced ICT skills in their teaching practices in order to upgrade the learning process significantly. Lim, Yan & Xiong (2015) examined the role of design of teacher education course and its implementation in development of ICT competencies in pupil teachers regarding education. The design of course had three major components which were developing curriculum, applying inquiry-oriented approach of learning for developing pedagogical competencies and utilizing online learning platform for sharing the experiences related to integration of technology in

pedagogy. The study reported that when all these components were utilized together the effectiveness of ICT in education was improved. Willis et al. (1999. Cited by Mumtaz, 2000) reported through their study that in spite of having positive attitude for using technology in pedagogy and other related work, teachers felt less confident about their ability as they had been thinking that they were not trained properly for this purpose during their teacher education programme. Even, teacher educators, in spite of having positive attitude, did not show strong background in integrating technology in their subject teaching in teacher education classes.

To make teachers competent for the integration of digital technology either before joining the service or during the service, it is important to assess their skill to know the problem and to plan effective training programme in this context. Training programmes preferred by teachers for their professional development in digital technology skills should also be noticed by the planners. To determine the ICT competence of the Nigerian in-service teachers, 25 items related to seven major key areas of ICT skills were constructed by Aduwa-Ogiegbaen (2009) to conduct a survey on those who were pursuing postgraduate programs in education in university. The study concluded that the teachers did not possess competence in various areas of ICT skill. Technology courses for in-service teachers in university, their mentoring, participating in conferences, workshops and seminars organized within the country were reported to be the preferred mode by teachers to acquire relevant skills in the ICT areas essential for integration of such technologies in their professional work. After conducting an exploration of digital literacy in ICT projects of pupil teachers, four sub-divisions of digital literacies were reported (Allen & Richardson, 2012: they cited Hockly, 2012). Language-based literacies which included familiarity with new online digital tools along with using graphical display in place of reading and writing in traditional way. Information based literacies comprised of gathering and utilizing information by digital search engines. connection-based literacies comprised of competency to utilise social media and networking; and, re-design-based literacies comprised of the competency of 'repackaging' and 'recasting' of existing digital material, and having a sensitivity towards potential intellectual property freedoms. These four types of digital literacies are equally important for other subjects also because all of these are required for being competent in digital skills up-to advanced level. Kanvaria (2011) shares his experiences about how in-service teachers' capacity building was enhanced with the help of digital

tools and technology. Teachers were helped to learn to use various digital tools including digital media for group learning like Google Groups, Classroom etc. They were facilitated to create their own accounts. Their activities were observed and outputs were analysed throughout the process. Positive outcome has been reported by the researcher. It was concluded that such capacity building programmes for in-service teachers are very helpful in their professional growth. The researcher opined that technology helped to enhance capacity building even in the skills of technology itself and professional growth of teachers. To train the teachers for effectively integrating digital technologies in teaching and learning process and other tasks of a teacher, their mentors are expected to be competent themselves. An experimental study was conducted among teacher educators by Gupta (2019) to see the effect of training on knowledge and skill development to use e-Learning tools and the researcher reported positive effect. The researcher has recommended to include the topics on latest e-learning tools and to embed Such technologies in every training programme for teachers. As training plays a very important role in developing these skills, and, providing chances of hands on experience plays a great role, therefore, the teacher educators are expected to be adaptive to these new tools and they should also be trained to integrate such tools in proper way.

3.3 Applying Models and Frameworks for Effective Integration of Digital Technology and Evaluating Digital Competencies:

As discussed in previous chapter there are various models and frameworks developed by the researchers and teacher educators for planning and applying proper integration of digital technology so that these technologies work as enhancers and modifiers of teaching–learning process. Other purpose of these models and frameworks is to function as a tool for the assessment of digital competencies and level of effectiveness of technology integration in teaching- learning process. These models and frameworks have been utilized by researchers in their studies which have been explored in this study primarily in the context of teachers' education, both pre and in-service. Some of the studies done on school subjects and classroom context have been referred here to explain how teacher can learn to improve the integration of digital technology in the teaching-learning process of a subject by utilizing these frameworks and models.

Some models were primarily meant for designing any instructional activities for teaching and learning and these models have been utilized by researchers for effective integration of digital technology in teaching and learning process, for example ASSURE model and ADDIE model. Through an experimental design, Lee & Lee (2014) conducted a study on pre-service teachers to see the effect on self-efficacy beliefs for technology integration through lesson planning practice. During the course lecture pupil teachers were already introduced with ASSURE model and they were given training on how to use computer software for multimedia development. Pupil teachers were then instructed to develop two instructional media products. These activities were included in their coursework. After these activities pre-test were conducted. Then the pupil teachers were given the chance of designing and developing their own lesson plan individually with integrating technology and using ASSURE model for their practice teaching and then post-test was conducted. Though, the pre-service teachers had the chance to play an active role as designers of lessons integrated with technology and they had previous knowledge of ASSURE model there was no significant difference in their attitude after the completion of study. Researchers opined that the teacher education courses usually follow the tradition of dealing with mastering pre-service teachers in technical skills of using computer technologies and ignoring to train them how to link these skills to transaction of curriculum. ADDIE model was utilized for designing the experimental study conducted among teacher educators by Gupta (2019) to see the effect of training on knowledge and skill development to use e-Learning tools. The experiment was completed successfully by planning interventions on the basis of this model and then implementing it. The achievements of teacher educators were reported to be positive, as they became able to develop the competencies in themselves to utilize new e-learning tools in their professional work.

While going through the plethora of related literature, TPACK was found one of the most utilized models by the researchers to check the competency level in technological pedagogical content knowledge of pupil teacher or teacher educators or both in some cases either for simply knowing their competency level or to give interventions after checking competency level to improve their competencies. SAMR model was utilized by many researchers to find the level of effectiveness of integration of digital technology in teaching-learning process. Both of these models were utilized together in

some studies to assess competencies of participants and level of integration of technology.

Genc & Akilli (2017) conducted a study to Investigate Pre-Service Science Teachers' Self-Efficacy Toward Technological Pedagogical Content Knowledge. "*Technological pedagogical content knowledge (TPACK) self-efficacy scale for pre-service science teachers on material development developed by Balçın and Ergün (2016)*" was used as a tool to collect the data of pre and post-test of this one year experimental study on a single group of pre-service science teachers to analyse their self-efficacy towards TPACK on material development. The study found that the level of self-efficacy increased at the end of the experimental phase. A transformative model called TPACK-COPR (TPACK Comprehension, Observation, Practice and Reflection) was developed by Jang & Chen (2010) for "integrating technology and using peer coaching for developing TPACK of pre-service science teachers". These pre-service science teachers read the literature related to the application of TPACK, they observed the model classroom presentations by their mentor instructor. They utilized various digital tools for learning, collaboration and sharing. They developed their own lessons to present during teaching practice, made videotapes of their presentations and finally they reflected on their own practice along with taking reflection from peers. These pre-service teachers utilized on-line sources for learning and participated in on-line discussion. It was reported that the TPACK of those pupil teachers was enhanced. A programme for professional development for teachers in the skills of evaluating digital contents and then selecting was designed by Xie et.al. (2017) which was of one-year duration. Along with learning through the programme, the teachers participated in surveys. They also participated in interviews and self-reflections. TPACK was utilized to study their perceived competencies and it was found that it kept on enhancing continuously during the programme. Thus, TPACK helped to assess the competency in technological pedagogical contentment knowledge of teachers as well as it helped to reach at the conclusion that providing training to develop the competency is effective in professional development.

To explain the ICT integration phenomenon with science, two types of interpretations have been described by Tsybulsky and Levin (2016). The first interpretation is 'ICT as tool' and second interpretation is 'ICT much wider than a tool'. They explored the second interpretation in the form of hypothesis stated as "*changes of teachers'*

worldview are vital for their understanding the role of technology in science education in its transformative stage." They developed and utilized a model named as 'a modified SAMR model for perception of technology to asses "teachers' worldview". Their hypothesis was confirmed by the results. Effectiveness of the proposed framework was proved. Chou et. al. (2012) conducted a case study of mobile learning programme organised as a pilot project for geography in 9th grade classroom in USA. There was provision for one-to-one learning by utilizing i-Pads. Level of integration of digital technology was observed with the help of Puentedura's SAMR model. This tool was utilized to analyse the instructional activities by the teachers. It was reported that in maximum no. of instructional activities with this tool remained at two lower levels of this model. But they opined that given time and more collaboration among teachers and more instructional activities would maximize the full potentials of iPads. Thus, this model helped them to assess the level of integration of technology and to understand the future course of work to be planned for professional development of teachers to improve instructional activities. Classroom ICTs integration opportunities and the challenges were assessed by Kihoza et. al. (2016) in relation to TPACK framework and SAMR model through a case study involving 206 pupil teachers and their teacher educators Low TPACK and low ICT competency were reported for pupil teachers but good level of TPACK and SAMR were reported in case of their educators.

3.4 Factors Affecting (& Supporting) Integration of Digital Technology in Teacher Education:

As the perception of teachers and their confidence due to their positive self-efficacy are major role players in making the integration of digital technology effective in pedagogy and other tasks of a teacher (Moreira et.al., 2019) it would be better to plan such training at the preliminary stage which is the pre-service training stage. It would automatically make the integration of technology in teaching -learning process and other professional work of teacher transformative and effective. In spite of mastering in digital tools, accumulating technological knowledge to develop teaching strategies to improve students' learning was found to be the major challenge for the teachers (Sanchez-Garcia, 2013). It is reported that traditional method of providing technological knowledge to pupil teachers were followed in teacher training college instead of providing knowledge and experience to utilize it properly in teaching-learning process

(Lee & Lee, 2014). Four elements are found affecting the teacher's learning of integrating technology in their professional work (Carney ,1998. Cited by Mumtaz, 2000). First element is condition of uncertainty regarding technology, new teaching contexts and converging reforms, second element is Situated learning that means the teachers should have direct experience of practicing of integration of technology through their mentors, third element is Collaborative reflection which would be possible through working in groups with peers and getting reflections from them to improve and fourth element is Long- term collegial interaction which supports long term sustainability of changes in practice. Therefore, such interactions should be maintained for effective integration of technology. The presence of these elements have been noticed in other studies also, like, the problem of accumulating technological knowledge to plan the strategy to integrate technology effectively (Sanchez-Garcia et.al., 2013) can be solved if the teachers get direct experience of the practice through watching their mentors integrating such technology in their class and experience of evidences of enhancement of interest, motivation, joy, fun and learning (Mumtaz, 2000). All of the elements mentioned above should be taken care of while designing any teacher education programme to develop digital competencies in them. Not only availability of adequate facilities affects the integration of technology in pedagogy but the skills to utilize them play a major role in this process. Therefore, training to utilise those facilities should be provided to teachers to enable them to progress in a technology-rich context, (Mumtaz, 2000). Innovative approaches of learning, like, blended, flipped and online mode have been considered effective for the integration of digital technology in teacher education programmes (Gupta ,2019). Different types of supports, like, infrastructure facilities and their availability during the training programme were found as the factors affecting pupil teachers' learning of integration of such technologies through hands-on experience. Hammond (2011) reported that such supports were required for all pupil teachers, though, some of them were competent to overcome limitations by making their own efforts in but were unable to overcome access problem. Hammond found these supports as a mediating factor in teaching-learning process.

It was observed by Wadhwani & Abraham (2017) that teachers were not oriented for smart class tools by manufacturers, even, minimal onsite training was not provided for operating digital tools like interactive boards that resulted in underutilization of these

tools. Researchers found this fact true for other new items also introduced by new technology. Inadequate professional development with Smart Boards is reported as a major challenge for integrating this digital technology in teaching-learning process. It is recommended by these researchers to organise capacity development programs for teachers to train them on plethora of interactive tools readily available in the software of interactive board to be used by them to add value to their classrooms. Gulbahar (2008) conducted a case study to explore the level of uses of information and communication technologies (ICT) by pre-service teachers and instructors in school of education in Turkey and examined the factors affecting it. Lack of appropriate instructional techniques, lack of infrastructure, insufficient quality and quantity of technology integrated lessons, incompetent educators, lack of mentoring, lack of time and medium of writing were reported as the factors affecting it.

3.5   Social Learning Methods and Integration of Digital Technology

Learning together with peers/colleagues has been found more effective in comparison with individual learning mainly in the case of learning technology and solving the problems related to its integration in professional work of a teacher. When actions, progress and output of in-service capacity building programmes to develop digital competencies utilizing the technology itself were observed and analysed during the entire process by Kanvaria (2011), it was found that learning through Google Groups along with face to face mode proved quite helpful to enhance the process of capacity building. The researcher suggested many digital tools for regular communication like, "Gtalk, Classroom, Blackboard etc." It is opined by the researcher that digital media would be quite helpful for future contact with peers and mentors to share ideas, information, knowledge, problems and experiences. Using a sharing platform available through online mode for sharing of experiences of using ICT in pedagogy along with innovative pedagogies in combination with more relevant course content has been found very effective in teacher education course as reported by Lim, Yan & Xiong (2015).

 A study was conducted on pupil teachers in University of Delhi by Kanvaria (2012) to find out and analyse their activities on Google group, and to discuss the problems faced by them during the entire process and to orient them to use it. The researcher applied observation method in small group case study through purposive non-random sampling.

The researcher concluded that utilizing Google group was very effective for pupil teachers for learning and proper orientation could make it more effective. "Discussion, debate, sharing knowledge, ideas and information, collaborating in projects, submitting the assignments, raising issues etc." were done through this platform by the pupil teachers. It helped to create collaborative learning environment and to develop various democratic values and professional qualities. Major barriers faced regarding collaboration through it were "lack of tools, lack of time and medium of writing." Bhatia & Haider (2015) conducted a study to explore the perception of pupil teachers of B.Ed. course from University of Delhi about the use of WhatsApp during internship. They explored the challenges and future potential of this tool mediated teaching and learning. This tool was reported very effective in creating a positive collaborative environment that supported learning during the entire programme as perceived by the pupil teachers.

More collaboration among teachers has been suggested by Chou et. al. (2012) as one of the measures along with more given time and more instructional activities to modify and redefine the instructional activities integrating digital technologies to maximize the full potentials of digital tools (iPads in this study) in classroom process. Toki & Pange (2013) examined the effects of self- evaluation by undergraduate students of Early Childhood Education in the University of Ioannina in the process of "working and learning in small self-selected groups called the nearest neighbour learning (NNL)" by the researchers. Positive learning outcome was reported which proved the importance of learning in groups with each other.

Wadhwani & Abraham (2017) reported the positive effect of utilization of social learning methods by the teachers to learn to operate digital tools (mainly the interactive board) with their peer were along with applying trial and error method individually.

After going through many research papers, some of them have been reviewed thoroughly and the findings from the reviews relevant to this study have been presented in this chapter under identified thematic area. Most relevant observations for this study from the review of related literature have been presented in chapter- VII: Analysis and interpretations, in tabular form and analysis has been done.

CHAPTER IV
METHODOLOGY

4.1   THEORETICAL PARADIGM:

Theoretical paradigm for this study emerged through the review of literature. While going through the literature related to this study including policy documents, curriculum framework, ICT competency framework, models and frameworks developed by the experts in the field and reports of research work, it was found that social learning methods in the form of co-operative and collaborative and social constructivism learning theory were relevant as the theoretical base of this study which was justified from the review of the literature and from the analysis of the experiences of teacher educators in the real situation at the ground level while preparing teachers for integration of digital technology.

4.1.1 Social Learning Methods: Co-Operative and Collaborative Learning

Social learning methods in the form of co-operative and collaborative learning are found very effective while preparing teachers for integration of digital technology. In co-operative learning students work in a group for completing their own task with the help of group where they co-operate with each other. In collaborative learning students work in groups to complete a single task in collaboration of each other where each member needs to take responsibility for the completion of the task. Both of these learning methods have roots in social constructivism of Vygotsky (Sawyer and Obeid, 2017).

4.1.2 Social Constructivism Learning Theory

This theory was presented by Vygotsky in his book "Thought and Language (1934)". According to this theory, a student learns through social interactions along with his/her personal critical thinking process which is termed as social constructivism. Co-operative and collaborative learning is an integral part of social constructivism where learners have a lot of information and knowledge to offer each other. In such type of learning it is not necessary for the learner to learn only with the teacher but he/she learns with the peers in the class. After completing the group work each learner internalizes

the knowledge but it occurs at different rate for each individual based on his/her own experience. According to Vygotsky, social interaction plays important role in more effective internalization. Vygotsky has described "more knowledgeable others (MKO)" in his theory where parents or teachers or any other person having more knowledge than the learner functions as more knowledgeable others for him/her. MKO may give instructions or model behaviour which was learnt and internalizes by the learners. Social constructivism is a form of cognitive constructivism where knowledge is constructed through social interactions.

As stated above, this study found that pupil teacher learnt from their surrounding environment constituted by peers, teachers and other knowledgeable persons at home or neighbourhood functioning as more knowledgeable others (MKO) as described by Vygotsky in his social learning theory. This "Social constructivism learning theory" was found relevant to the study where pupil teachers learnt from teacher educators and skilled peers, considering them as models. Teacher and peers both performed as more knowledgeable others in this case because pupil teachers and even, for in-service teachers as they learnt from them how to integrate digital technology effectively in their professional work and how to utilise it for self-learning. Pupil teachers learnt both concepts and digital skills more effectively through co-operative and collaborative learning. Fostering collaboration and co-operation among pupil teachers, developing positive social behaviour, developing the quality of resolving conflicts and building consensus are some basic qualities of general social interaction (Bonk & Cunningham, 1998) which were utilised during collaborative and co-operative learning either face to face or through social media. Learning groups were created to collaborate and work together with the help of social media and face to face mode where learning took place with peer and teacher. This is true for adult pupil teachers also in case of integration of digital technology in teaching-learning process and other tasks of a teacher.

4.2 METHODOLOGY:

4.2.1 Research Design:

This study was based on both primary and secondary data. The study was divided into three phases out of which first two phases were based on the facts and findings explored through the review of policies, programmes, frameworks,

models and literature from research studies. Third phase was based on primary data collected from the field. These three phases were as follows:

➢ In the first phase a thorough review of policies, programmes, curriculum framework, ICT competency framework and models and frameworks of ICT integration developed by pedagogues and educationists was planned and done to observe and analyze the facts given in these documents about how teachers should be prepared to integrate digital technology in pedagogy and teachers' other professional work.

➢ In the second phase, thorough review of available literature in the form of research studies were planned and done to understand how teachers are being prepared to integrate Digital Technology for improving pedagogy and teachers' other professional work in different parts of the world including India and to identify factors affecting integration of digital technology in teacher education, to understand the application of various frameworks and models of ICT integration for teachers' professional development which were applied successfully and reported through research report.

➢ In the third phase, interview was conducted with teacher educators working in teacher training institutions situated in Delhi to develop an understanding of practices of digital technology integration in teacher training institutions through their lenses.

4.2.2 Population and Sample:

Population:

Teacher educators (and pupil teachers) from teacher training institutions in Delhi were the population in this study.

Sample:

Twenty teacher educators were selected as sample from the population mentioned above through purposive sampling method for conducting interviews.

Table 4.1: Description of Sample

S. No.	Age-group	Gender	Courses taught	Years of exp	Qualification	Formal training of ICT
1.	40-45	F	B. Ed., B. El. Ed	6 years	Ph.D.	No
2	35-40	F	B. Ed.	10 years	Ph.D.	No
3	30-35	F	B. Ed., B. El. Ed	3 years	Ph.D.	No
4	40-45	F	B. Ed., D. El. Ed	16 years	Ph.D.	No
5	45-50	F	B. Ed., D. El. Ed & Taught in school	18 years	M.Phil.	Yes
6	25-30	F	B. Ed., B.Ed. (nursery), D. El. Ed	2&1/2 years	Ph.D.	yes
7	30-35	F	B.Ed. (nursery), D. El. Ed	3 years	Ph.D.	No
8	25-30	F	D. El. Ed & Taught in school	4 years	Ph.D. (pursuing)	Yes (2-weeks workshop only)
9	40-45	M	D. El. Ed	9 years	M.Phil.	yes
10	40-45	M	B. Ed., M. Ed.	18 years	Ph.D.	No
11	40-45	M	B. Ed., M. Ed., M. Phil.	10 years	Ph. D.	Yes
12	30-35	M	B. Ed., M. Ed., M. Phil	1 &1/2 year	Ph. D.	No
13	35-40	M	B. Ed.	10 years	Ph.D. (pursuing)	Yes (5days induction only)
14	35-40	F	B. Ed.	15 years	Ph.D.	Yes (1-week workshop only)
15	45-50	F	B. El. Ed.	23 years	Ph. D.	Yes

16	45-50	F	B. El. Ed.	10 years	M. Phil.	No
17	25-30	F	B. El. Ed.	7&1/2 Years	Ph.D. (pursuing)	Yes
18	50-55	M	D. El. Ed.	27 years	M. Com.	Yes
19	35-40	F	D. El. Ed.	12 years	Ph. D.	No
20	40-45	F	D. El. Ed, B. Ed.	10 years	Ph. D.	No

{Note: 45% of the total respondent (9 out of 20) belong to DIET & SCERT, 25% (5 out of 20) belong to Central universities (JMI & DU) education departments &30% (6 out of 20) belong to degree colleges functioning under Delhi University.}

Important facts about respondents based on table 4.1:

- 70% of the total respondents were female and 30% were male. There was no transgender respondent.

- 50% of the total respondents were below the age of 40 years and 50% were above 40 years.

- Overall, five types of courses of pre-service teacher education were noticed through the personal details of teacher educators. Some of the respondents had experience of teaching in two or more types of courses.

- 10% of the total respondents had more than 20 years of experience, 60% of the respondents had more than 10 years of experience and 25% respondents had less than or up to 5 years of experience.

- 65% of the total respondents had Ph. D. degree, 15% were pursuing Ph. D., other15% had M. Phil. Degree and only one teacher (5%) had post-graduate degree only.

- 50% of the total respondents had formal training of ICT out of which 30% had gone through equal to or less than two weeks of training under induction programme for faculty development.

Delhi has many teacher education institutions under two central universities, one state university and one state council of educational research and training providing teacher education courses on regular basis and most of them are equipped with digital technology infrastructure. Varied nature of teacher education courses are available in these institutions, named as, Diploma in Elementary Education (D. El. Ed.), Batcheler

in Elementary Education (B. El. Ed.), Batcheler in Education (B. Ed.), Batcheler in Education- Nursery (B. Ed. Nursery), Master in Education (M. Ed.) and, even, Ph.D. in Education. Due to possessing all these characteristics teacher educators in these institutions were perceived as being rich in experience of teaching different types of teacher education courses at different level and due to getting the chance (many of them) to work as resource person and as organizer in the professional development programmes organized for in-service teachers. As this study has been based on in-depth thematic analysis of interviews conducted with teacher educators to develop deep understanding of the perspective of policies, programmes, models, frameworks and practices regarding integration of digital technology in teacher education at ground level , so, the sample size has been kept small to make it feasible and to maintain the basic property of qualitative data analysis.

4.2.3 Tools and Techniques:

Tool:

A semi-structured interview schedule was developed for the interview with teacher educators on the basis of the themes identified through the review of educational policies, programmes, curriculum frameworks, ICT competency framework for teachers, models and frameworks developed by pedagogues and educationists for effective integration of digital technology and relevant literature from research studies. A flow chart of the process of preparing teachers for integration of digital technology in teaching-learning process and other professional work was prepared (figure:4.1) to develop a clear understanding.

Figure 4.1: Flowchart of different component in the process of preparing teachers for the integration of digital technology in education
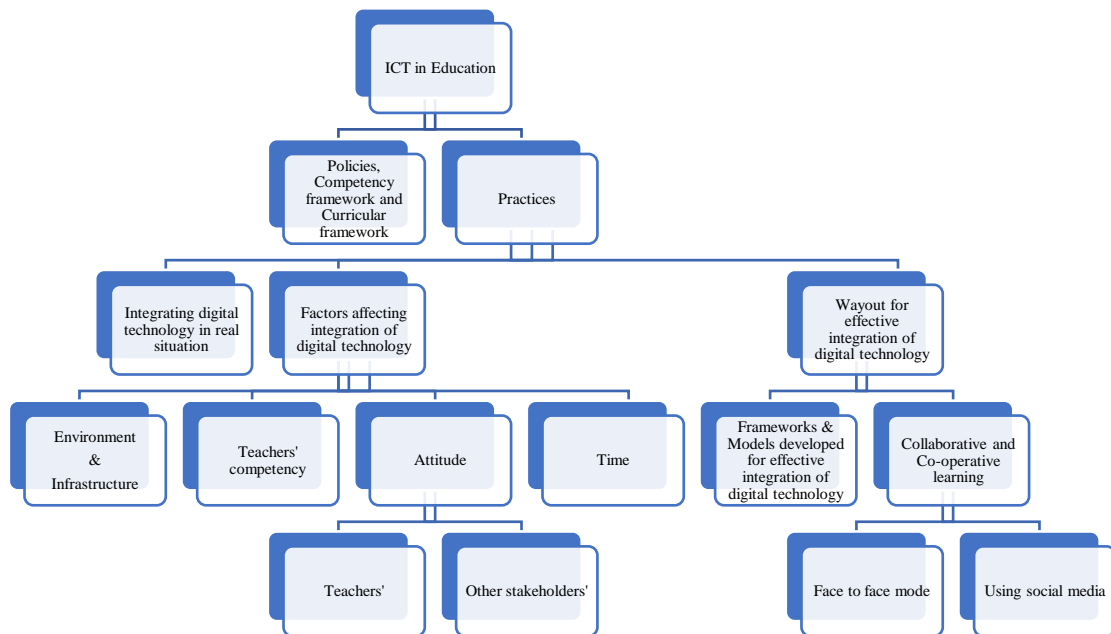
The ten themes identified and finalized for the interview schedule are given below:

- Educational policies and programmes having insights on preparing teachers for integration of digital technology
- ICT Competency framework
- ICT and curriculum framework for teacher education
- Integration of digital technology in classrooms and other activities of teacher educators and pupil teachers at ground level
- Problems/ barriers faced by the teacher educators and pupil teachers & their solution (if any)

- Models and frameworks developed by pedagogues and researchers for making the integration of digital technology more effective
- Co-operative and collaborative learning and digital technology
- Social media and learning
- Using digital technology: beneficial or harmful or both
- Digital tools and technology frequently utilized by respondents

Interviews with teacher educators were conducted by telling them to present their views based on their experience on these themes. Overall, nineteen questions were prepared which were placed under different themes. Their answers were analysed in chapter-V to reach the conclusion.

Technique of Collection of Information and Data:

This Collection of Information and Data has been conducted in three phases:

Table 4.2: Stages of study

S. No.	Phases of study	Details of the study
1	Phase -1	Review of policies, programmes, framework and models It is done in two parts.
	Phase -1-a	Review of policies, programmes, curriculum framework and ICT competency framework
	Phase -1-b	Review of Models and Frameworks developed by pedagogues and educationists for effective integration of digital technology in education
2	Phase -2	Review of related literature available through research work
3	Phase -3	Interviews with twenty teacher educators from the teacher training institution in Delhi

➢ Phase 1: Review of policies, programmes, curriculum framework and ICT competency framework and models and frameworks developed by

pedagogues and educationists for effective integration of digital technology in education was done by the researcher.

- ➢ Phase 2: Extensive search of available literature was done through reliable sources to find related literature for reviewing. Search for literature began from the University (National Institute of Educational Planning and Administration) library and moved forward to other libraries, websites and searching platforms like; J-store, Academia, Science direct, ResearchGate, Taylor and Francis etc. and websites of various international journals publishing articles in this area, like; British Journal of Educational Technology, Australian Journal of Educational Technology, Indian Journal of Educational Technology, Computer and Education etc. and books related to the study. After reading many research papers, abstract and findings of many other articles, some papers based on review study, books related to study, contents from some of the related websites etc., twenty-eight articles were selected which were relevant to this study. Many other articles were also referred at various places in relevant context in this study. After reviewing selected articles, major themes relevant to this study were identified and then literature review was presented under those thematic areas. Therefore, thematic review of literature was done. The analysis based on various thematic areas and their relevance to this study was presented in tabular form in the chapter dealing with analysis.

- ➢ Phase 3: Interviews with twenty teacher educators from the teacher training institution in Delhi were conducted on the basis of the semi-structured interview schedule developed by the researcher. Teacher educators were informed priorly and permission was taken from them personally through digital media or/and through face to face contact. In few cases, wherever, it was required, permission from concerned organization was taken by the researcher.

4.2.4 Data Analysis:

Thematic analysis technique was found relevant for analyzing the data collected through the review of policies, programmes, frameworks, models, research reports and through interviews with teacher educators. Thematic analysis of

literature was done after identifying major themes during the review. Analysis of the facts regarding preparing teachers for integration of digital technology obtained through the review of policies, programmes, frameworks and models was also done. Major themes for interviews were identified through the analysis of reviews of policies, programmes, frameworks, models and research reports and interviews were conducted on the basis of those themes. Analysis of interviews were done to understand the integration of digital technology in pedagogy in real situation' as practiced and experienced by the teacher educators.

Table 4.3: Analysis of secondary and primary data

S. No.	Details of analysis
1	Analysis of information and facts regarding preparing teachers for integration of digital technology obtained through review of policies, programmes, curriculum framework and ICT competency framework
	Analysis of information and facts obtained through review of Models and Frameworks developed by pedagogues and educationists for effective integration of digital technology in education
2	Analysis of information obtained through review of related literature available through research work
3	Analysis of interviews with twenty teacher educators from the teacher training institution in Delhi

Analysis of data and information collected through secondary sources has been presented in chapter-V and analysis of information and data collected through primary source (through interview with teacher educators) has been presented in chapter-VI.

4.3   DELIMITATION OF THE STUDY:

The study is delimited to:

- Teacher education only
- Delhi only

CHAPTER V

ANALYSIS AND INTERPRETATIONS

Thematic data analysis method was applied to analyse the data and information collected through both secondary and primary sources. Overall, it was done in three parts. In the first part (section 5.1 of this chapter), the reviews of policies, programmes, curriculum frameworks, and ICT competency framework was analysed for enlisting the inputs that guide for preparing teachers for integration of digital technology. Then, the reviews of models and framework developed by pedagogues and educationists for assessing and improving ICT competency of teachers, teacher educators and pupil teachers and assessing the level of integration of digital technology in classroom process was analysed for enlisting the inputs that guide teachers, teacher educators, researchers and pupil teachers effective integration of digital technology in teaching-learning process and other professional work. In the second part (section 5.2 of this chapter), the facts and information obtained from review of various studies presented in table and analysed thematically. In the third part (section 5.3 of this chapter), analysis of facts and information obtained through interviews with teacher educators was done. After analysis, interpretations and discussions were done. Details of the analysis are given below in the sequence:

5.1 OBSERVATIONS, ANALYSIS AND INTERPRETATIONS: POLICIES, PROGRAMMES, FRAMEWORKS AND MODELS

As phase-1 of the study was conducted in two parts, so, analysis has also been presented in two parts with the help of two tables. In the first part, there are facts regarding preparing teachers for integration of digital technology obtained from Policies, programmes, curriculum framework and ICT competency framework. In the second part, there are facts and information obtained from models and framework developed by the practitioners in the field for effective integration of technology, planning instructions with integration of technology, evaluating competency level of teachers, teacher educators and pupil teachers for integration of technology and assessing and improving level of integration of technology in teaching-learning process. It was already mentioned in techniques of collection of information and data that first of all

review of all of these policies, programmes, curriculum frameworks, ICT competency frameworks, models and frameworks developed by the practitioners for effective integration of technology in teaching -learning process was done. After reviewing documents of these policies, programmes, models and frameworks; facts, provisions, suggestions and information for integration of digital technology in teaching and learning process and other related work were identified, enlisted and presented in table:5.1 and table:5.2. Further analysis of these inputs was done separately for both of these tables and presented below each table.

Table 5.1: Observations through review of Policies, programmes and framework regarding preparing teachers for integration of digital technology

S. No.	Policies, programmes, curriculum framework and ICT competency framework	Observations
1	Computer Literacy And Studies in Schools (CLASS) project, 1984	• In-service training for teacher selected from assigned schools for integrating computers in teaching learning process and in other activities of school began. • No success up to desired level due to lack of adequate training for teachers and their low motivation
2	National Policy on Education (NPE), 1986	• The potential of computer technology in the field of school education was recognized • Modern communication technologies were found capable to manage the constraints of time and distance

3	Programme of Action (PoA), 1992	• To extend the facilities for CLASS • Proposed for effective implementation of this project in two thousand senior secondary schools under the planned coverage of 8th five years plan. • Proposed that the access to computers would be improved in these schools to extend the facilities for CLASS
	Proposed to utilize such technologies for spreading of useful information, training of teachers and improving quality of education • Proposed to redesign the teaching of mathematics to make it suitable to modern technological devices	
4	ICT@ school, 2004 (revised in 2010)	• Provision for ICT capacity enhancement of all teachers and national ICT awards for teachers • Out of four components of this document third component is meant for teachers' related interventions • Mandatory training in use of ICT in teaching: ➢ during the pre-service secondary level teachers' training courses- 55hours duration ➢ during in-service training for secondary level teachers – two phase- 1st phase: 80 hours induction & 2nd phase: 40 hours refresher • Other areas of focus ➢ enriching school libraries with self-developed digital content and resources

		➤ developing ICT content enabled subject teaching skills,
		➤ digital content sharing skills,
		➤ developing and becoming part of online professional groups
		➤ pooling in their resources and
		➤ actively contributing to the strengthening of domain specific knowledge.
5	National Curriculum Framework (NCF), 2005	• Did not give any detailed account of how to integrate digital technology in teacher education suggested to teachers how to use such technologies for making teaching and learning more effective
		• Emphasized on the important role of mass media in:
		➤ supporting teacher training and facilitating classroom learning
		➤ interacting with others, sharing with them and learning from those interactions
		• Suggested to provide chance to teachers to get first-hand experience of creating programmes themselves with the help of technology and using them in their professional work
6	National Curriculum Framework for Teacher Education (NCFTE), 2009	• Emphasized on making teachers competent for critical utilization of these technologies for developmental purposes
		• Recognized digital tools as appropriate resources for:
		➤ professional development and for providing academic support to pre-service and in-service teachers

		➤ Creating and promoting collaborative and supportive academic learning environment and breaking the isolation of teachers • Suggested to develop "the center for teacher resource and academic support" having provision of different types of material including digital resources
7	The UNESCO ICT Competency Framework for Teachers, 2011	• Three different stages of integration of technology in teaching and learning: ➤ technology literacy - first place - enable students to learn more efficiently ➤ knowledge deepening – second place- applying it to complex, real-world problems ➤ knowledge creation- third place- creating new knowledge • Teachers' work has been classified into six aspects: Understanding ICT in Education, curriculum and Assessment, Pedagogy, ICT, Organization and Administration, Teacher Professional Learning • Teachers are expected to be competent in integrating digital technology in all of these six aspects.
8	National Policy on Information and Communication Technology (ICT) In School Education, 2012	• Recognized potentials of ICT for: Teacher's capacity building, supporting on-going teachers' capacity building programmes, promoting 'creative, analytical, aesthetic and problem-solving abilities and sensitivities' in students and teachers • Categorized three levels of ICT competencies:

		➤ Basic, Intermediate and Advanced
		➤ All levels of competencies have been presented by citing proper terms and actions related to them
		• Proposed to encourage teachers:
		➤ to integrate digital technology in teaching-learning process,
		➤ to develop their own digital resources and
		➤ to share those resources with colleagues through their own digital repositories
		• Another important issue addressed: to train teachers and students to take care of security measures related to internet & to use internet safely.
9	Samagra Shiksha Scheme, 2018-19	• For improving quality of education main focus is on two T's: Teachers and Technology • NISHTHA programme for teachers having capacity building in ICT as a component • Provision of DIKSHA portal for teachers for sharing and improving skills and knowledge • Every teacher is expected to be competent in selecting and using contents from free and open source software and subject specific tools
10	Draft: National Education Policy, 2019	• Recognized the potential of utilizing such technologies widely in the process of continuous professional development of teachers • Provision of providing facility of access to internet and various digital platforms both at school and home to the teachers

		• Emphasized on: ➤ improving the quality of teaching and learning by utilizing smart and intelligent technology base assessment system ➤ creating interactive contents, interesting for the learners. ➤ utilizing tools based on virtual and augmented reality • Focus on achieving four major aims out of which two are directly concerned with the preparation of teachers: ➤ provision of teachers' and mentors' professional development through online education available in different formats and facilitating collaborative peer learning specially for beginners ➤ using technology in the classroom activities including teaching learning and evaluation and careful evaluation of each digital tool by the teacher before utilizing
11	ICT in Education Curriculum for Teachers, 2019	• Provision of a diploma in ICT in Education after the completion of three induction and twenty refresher courses • Emphasized on achieving three levels of competencies • Emphasized on achieving objectives of ➤ effective use of ICT tools, software applications and digital resources into teaching-learning process, evaluation, selection of ICT resources ➤ making teachers able to search, organize and create their own resources, using technology safely taking care of ethical and

		legal issues, making the class inclusive with the help of technology and use technology to participate in teachers' professional networks
12	NISHTHA (National Initiative for School Heads' Teachers' Holistic Advancement), 2019-20	• One of the expected outcomes: capacity building of teachers for integration of ICT in teaching-learning and assessment • Description on how digital technology can be integrated for better teaching and learning of different subjects at elementary level • Web portal of NISHTHA has been designed as an interactive portal to support post-training follow-ups

Analysis based on table: 5.1

After observing table:2.1, it was found that educational policies and programmes in India have given place to digital technology in its education system for making it effective since its introduction in education in India in 1980s. Though, these policies paid more attention on integration of digital technology in school education, there were guiding inputs for preparing teachers for this purpose. Some of the policies and programmes addressed teacher education directly. Provision of in-service training for teacher selected from assigned schools for integrating computers in teaching learning process and in other activities of school began with the CLASS project (1984). NPE (1986) recognised the potential of digital technology and proposed to utilize such technologies for spreading of useful information, training of teachers and improving quality of education. Programme of Action (PoA, 1992) made the provision to extend the facilities for CLASS. ICT@ school, 2004 (revised in 2010) had provision for mandatory training in use of ICT in teaching both for pre and in-service teachers. It emphasized on digital content developing and sharing skills in teachers, and developing and becoming part of online professional groups. A clear trend of progress in developing skills and utilizing digital tools for various purposes based on the new

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development in these technologies for preparing teachers for this purpose was noticed. National Curriculum Framework (NCF, 2005) suggested to provide chance to teachers to get first-hand experience of creating programmes themselves with the help of technology and using them in their professional work. National Curriculum Framework for Teacher Education (NCFTE, 2009) recognized the potential of digital tools for professional development and for providing academic support to pre-service and in-service teachers and creating and promoting collaborative and supportive academic learning environment for teachers. It suggested to develop "the centre for teacher resource and academic support". It was observed that collaborative learning was recognised as being beneficial for teacher's professional development.

The UNESCO ICT Competency Framework for Teachers (2011) gave the direction to school education system and teacher education programmes worldwide by presenting this framework. Teachers are expected to be competent in integrating digital technology up to the third sage of competency called knowledge creation in all six aspects of their professional work described in this framework. National Policy on Information and Communication Technology (ICT) In School Education (2012) categorized three levels of ICT competencies, named as, Basic, Intermediate and Advanced levels. which can be seen as the result of UNESCO's competency framework. It emphasized to train teachers and students to take care of security measures related to use of internet.

There was provision of teachers' and mentors' professional development through online education in the Draft: National Education Policy, (2019). It emphasized on evaluation of each digital tool by the teacher before utilizing which can be seen in the light of National Policy on Information and Communication Technology (ICT) In School Education (2012). ICT in Education Curriculum for Teachers (2019) emphasized on achieving three levels of ICT competencies and the whole curriculum was designed keeping in view these competencies. Samagra Shiksha emphasized on developing digital skills through NISHTHA and DIKSHA. Thus, these policies and programmes have included digital technology among other key areas of development in the field of education. As these technologies are ever emerging, so, policies, programmes and curriculum frameworks have also adopted new tools and technologies and new trends in the field for better utilization to progress in synchronization of other fast developing parts of the world in effective integration of such technologies in teaching-learning process and other professional work of a teacher. Only planning, developing and implementing policies do not serve the purpose. It is essential to make

the stakeholders aware about it, so that, they can utilize it properly to make its implementation effective. That is why interview with teacher educators was conducted in this study to understand about awareness among pupil teachers and teacher educators towards these policies and programmes and implementation at ground level.

Observations through review of Policies, programmes and framework regarding preparing teachers for integration of digital technology

Table 5.2: Observations through review of frameworks and models developed for effective integration of digital technology

S. No.	Models and frameworks	Given/developed by	Observations
1	ASSURE Model	Designed by Heinich, Molenda & Russel in 1999 (Faryadi, 2007) and modified in 2008 by Smaldino, Lowther & Russell	An instructional system that guides teachers to develop lesson plans integrating the use of technology and media
2	ADDIE Model	Not known Considered as evolved through informal oral tradition (Molenda, 2003)	An instructional system that guides teachers to develop instructions with or without integration of technology.
3	TPACK Framework	Developed by Mishra and Koehler in 2006 based on Shulman's PCK (pedagogical content knowledge) framework	Meant for evaluating teachers', pupil teachers' and teacher educators' technological, pedagogical and content knowledge and their competencies in these areas

4	Generic Model	Developed by Wang (2008)	Emphasis on integration of three components; pedagogy, social interaction and technology for effective learning.
5	SAMR Model (Substitution, Augmentation, Modification and Redefinition model)	Introduced by Puentedura (2006)	A tool that guides pedagogues about the kind of assignments, with the integration of digital technology, they should give during students' learning process

Analysis based on table: 5.2

As already discussed in chapter II, there were many models and frameworks developed by pedagogues and educationists for the effective integration of digital technology and assessing and improving ICT competencies of teachers, teacher educators and students and assessing the level of integration of digital technology in teaching -learning process, only few were reviewed for this study which were found relevant for this study and frequently applied by researchers in this fields. After reviewing these models and frameworks, it was found that these models and frameworks were easy to understand and equally easy to apply at ground level. It was found that ASSURE model and ADDIE model were basically meant for instructional design which were utilized by researchers for planning instruction with integration of digital technology. As both of these models follow proper steps, these were found effective for planning integration of digital technology in instruction for teaching and learning. In the course of time, with the advent of new technologies, teachers were required to be competent in various technological skills along with pedagogical skills. Therefore, a new framework was developed on the basis of Shulman's PCK framework and named as TPACK. This framework was found quite suitable for assessing and developing teachers' professional

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capacity for effective integration of digital technology. This was the reason behind its wide acceptance by researchers and pedagogues. This was observed as the most popular framework out of these five selected for this study through review of literature. SAMR model was utilized widely by the researchers and pedagogues to assess the level of integration of digital technology in classroom process and for improving it. Generic model emphasized on social learning along with pedagogy and technology which a new trend in this field and widely utilized now a days by the researchers. Thus, each model and framework reviewed in this study was developed for some specific purpose regarding effective integration of digital technology. Many researchers modified these frameworks and models according to their need and developed their own.

5.2 ANALYSIS AND INTERPRETATIONS BASED ON FACTS AND INFORMATION OBTAINED FROM REVIEW OF LITERATURE:

After doing extensive search of available literature through reliable sources to find related literature to achieve objectives of this study, reading more than sixty research papers, abstract and findings of many other articles and books., overall, twenty-eight research papers and articles were selected which were closely relevant to this study. These papers were reviewed thoroughly and the facts from the review relevant to this study were collected as data and information for this study. This collection from the review was analysed to identify major themes. All the information collected through the review were presented under identified thematic area. These thematic areas were as follows:

(1) first thematic area was based on policies, programmes and curriculum regarding preparing teachers for integration of digital technology: the way how the educational policies and curriculum frameworks need to be designed and researched for betterment.

(2) second thematic area was based on learning design, competency, level of integration, perception of teachers about training/learning: the way how the educational/training programmes were being organised to train them for the

purpose and how technologies were being integrated by the teachers and how they perceived the role of training for fulfilling this purpose

(3) third thematic area was based on using models and frameworks for effective integration of such technologies and to evaluate and improve digital competencies.

(4) fourth thematic area was based on the factors affecting (and supporting) integration of digital technology: like, human factors- ICT competencies, attitude and belief of teachers, pupil teachers, teacher educators, administrators and other supporting persons, and other resources - infrastructure and training facilities

(5) fifth thematic area was based on Social learning and integration of digital technology.

Findings from the reviews of twenty-eight research papers and articles, selected for this study as being closely relevant to it, have been presented in table:5.3. Name of authors, place of work, nature of sample and year of study have been given in the table along with findings under identified thematic areas. In the fifth column, at the bottom of each cell, number(s) of theme, emerged from that study has been mentioned. The specific serial number given to each theme has been mentioned above. These specific numbers have been utilized to see the frequency of most researched theme by the practitioners and researchers. Here is the table: 5.3, given below, created on the basis of review of literature related to this study and identifying important themes in these studies.

Table 5.3: Findings from literature related to current study: arranged under identified themes

Serial Number	Author/s Year	Title of the study	Place and sample	Major themes related to current study (theme no.)	Findings related to current study
1.	Mumtaz (2000)	"Factors affecting teachers' use of information and communications technology: a review of the literature"	England (author belongs to) Review study	Factors affecting	direct experience of the practice of mentors integrating technology experience of evidences that ICT can make their

					lessons more interesting, easier & motivating
				(thematic area: 4)	availability of adequate facilities & training to develop skills to utilize those facilities to progress in a technology-rich context
2.	Vrasidas et. al. (2001)	"Integrating Technology in Teaching and Teacher Education: Implications for Policy and Curriculum Reform"	Cyprus Conceptual paper	Policy, programme and curriculum framework (thematic area: 1)	need to reform policies, curriculum and teacher education programmes to prepare competent teachers to integrate technology in teaching and learning
3.	Gulbahar (2008)	"ICT Usage in Higher Education: A Case Study on Preservice Teachers and Instructors"	Turkey Pre-service teachers and instructors	Factors affecting (thematic area: 4)	Factors affecting use of DT: the quantity and quality of the lessons addressing technology in the curriculum, incompetent teachers resulting in lack of in-service training, and insufficient technological infrastructure
4.	Aduwa-Ogiegbaen (2009)	"Nigerian Inservice Teachers' Self-Assessment in Core Technology Competences and Their Professional Development Needs in ICT"	Nigeria In-service Teachers	Competency Factors supporting	teachers were not competent in many skill areas in ICT. preferred mode by teachers to acquire relevant skills in the ICT ↓

					Technology courses for in-service teachers in university, their mentoring, participating in conferences, workshops and seminars organized within the country
5.	Jang & Chen (2010)	"From PCK to TPACK: Developing a Transformative Model for Pre-Service Science Teachers"	Taiwan Pre-Service Teachers	Collaborative learning Utilizing social media Used TPACK (thematic area: 3, 4)	utilized on-line sources for learning and participated in on-line discussion. the TPACK of pre-service teachers were enhanced.
6.	Hammond et.al. (2011)	"How and why do student teachers use ICT?"	England Pre-Service Teachers	Competency in context of application Factors affecting (thematic area: 2, 4)	Levels (Competency)/types of DT user pupil teachers ↓ Routine users, extended users, innovative users Barriers-infrastructure and access
7.	Kanvaria (2011)	"Technology enhanced capacity building: Web 2.0 tools for in-service teacher education"	India In-service teachers	Applying social learning competency (thematic area: 5,2)	Collaborative learning with the help of DT to learn DT for professional work and communication ICT Competency development Capacity building
8.	Kanvaria (2012)	"Googling the Group: Teacher Education Through ICT"	India Pre-Service Teachers	Applying social learning methods Factors affecting	Developing professional qualities and democratic value by working collaboratively through google group

					Barriers; Unavailability of computers Lack of time, more workload, medium of writing and reluctance towards using new tech.
9.	Allen & Richardson (2012)	"Exploring Digital Literacy in Student-Teacher ICT Projects"	Sweden Pre-Service Teachers	Competency Learning design (thematic area: 2)	four types of digital literacies are important for teachers ↓ Language-based literacies, information-based literacies, connection-based literacies and re-design-based literacies
10	Chou et.al. (2012)	"A case study of mobile learning pilot project in K-12 schools"	USA In-service teachers	Applying SAMR (to observe level of use- Competency of teachers) Factors affecting (teachers' view) (thematic area: 3, 4)	Integration of tech at two basic level of SAMR Teachers' opinion: More time, more instructional activities and more collaboration among teachers to maximize potential
11	Sanchez-García et.al. (2013)	"Development and ICT: The Effectiveness of a Training Program for In-Service School Teachers"	Spain In-service teachers	Learning design Factors affecting (thematic area:2, 4)	In-service training accumulating technological knowledge to develop teaching strategies to improve students' learning was reported as a major challenge for the teachers
12	Toki &	"Social earning Theories as	Greece	Applying social	NNL can contribute better

	Pange (2013)	tools for learning in an ICT educational system"	Pre-Service Teachers	learning method (thematic area: 5)	learning of integration of ICT
13	Lee & Lee (2014)	"Enhancing pre-service teachers' self-efficacy beliefs for technology integration through lesson planning practice"	Republic of Korea Pre-Service Teachers	Utilizing ASSURE model for LP Factors affecting (thematic area: 3, 4)	Developing self-designed ICT integrated LP Traditional method of providing technological knowledge instead of providing knowledge and experience to utilize it in teaching-learning process
14	Kong et.al. (2014)	"E-learning in School Education in the Coming 10 Years for Developing 21st Century Skills: Critical Research Issues and Policy Implications"	Conceptual paper by 12 contributors from 10 countries	Policy Curriculum (thematic area: 1)	stakeholders in this area across different countries/regions should consider policies that focuses on the goal-setting of curriculum including ↓ to develop 21st century skills, bridging gap between school and society, availability of digital technology in school and the issues of privacy and legal aspects of using data in e-learning process
15	Bhatia & Haider (2015)	"Pre-Service Teachers' Perception towards Use of WhatsApp (Mobile Learning Application) in	India Pre-Service Teachers	social learning (with the help of DT)	DT: WhatsApp – perceived as an effective tool to create virtual and positive learning environment during SEP,

		School Experience Programme"		(thematic area: 5)	Increased collaborative thinking and learning
16	Lim et.al. (2015)	"Development of pre-service teachers' information and communication technology (ICT) in education competencies in a mainland Chinese university"	China Pre-Service Teachers	Factors affecting competency development (thematic area: 2,4)	innovative pedagogies+ relevant course material+ online learning platform → enhanced the effectiveness of ICT in education
17	Aslam and Zhu (2015)	"Pre-Service Teachers' Perceptions of ICT Integration in Teacher Education in Turkey"	Turkey Pre-service teachers	Way of integrating Level of use of ICT in TP (thematic area: 2)	differences among the universities in terms of ICT integration sources, some had more whereas, others had less. participants used ICT at basic level for presentation in their teaching practices.
18	Kihoza et.al. (2016)	"Classroom ICT integration in Tanzania: Opportunities and challenges from the perspectives of TPACK and SAMR models"	Tanzania Pre-service teachers and teacher educators	Using TPACK & SAMR to find the level of competency and level of integration (thematic area: 3)	TPACK & SAMR construct based Competencies: Pupil teachers-low level Tutors (Teacher educators)- good competency level
19	Tsybulsky & Levin (2016)	"SAMR Framework for Study Technology Integration in Science Education."	Israel (Tel Aviv) In-service teachers (undergone specific training course in university)	Developing & utilizing modified SAMR (thematic area: 3)	Developed modified SAMR for perception of Technology to assess teachers' worldview regarding ICT integration in science education. Indicated high efficiency for it

20	Paratore et.al. (2016)	"Engaging preservice teachers in integrated study and use of educational media and technology in teaching reading"	USA Pre-Service Teachers	Competency Learning strategy (thematic area: 2)	a positive trend was found in the perception of teachers about ↓ their knowledge, literacy content knowledge, self-efficacy with technology and eagerness to integrate technology in their profession in future after integrating numerous technological devices and educational media in a literacy methods course
21	Henriksen et.al. (2016)	"Infusing Creativity and Technology in 21st Century Education: A Systemic View for Change"	USA and The Netherlands (authors belong to) Conceptual paper	Policy, Curriculum (thematic area: 1)	Creativity and technology require to be placed in policy at all levels and both should be embedded across the curriculum
22	O'Neal et.al. (2017)	"Elementary School Teachers' Beliefs about the Role of Technology in 21st-Century Teaching and Learning"	USA In-service teachers	Factors affecting (based on teachers' beliefs) (thematic area: 4)	teachers see value of tech for T-L but they require more guidance on - 21st-century skills and skills of integrating technology effectively
23	Xie et.al (2017)	"Teacher professional development through digital content evaluation"	USA (Ohio) In-service teachers	Utilizing TPACK to assess competency development through PDP (thematic area: 3)	teachers' perceived TPACK regarding learning integration of technology increased continuously with the time all over the PD program on evaluating digital contents
24	Genc &	"The Investigation of	Turkey	Competency	self-efficacy towards TPACK

	Akilli (2017)	Pre-Service Science Teachers' Self-Efficacy Toward Technological Pedagogical Content Knowledge"	Pre-Service Teachers	Utilizing TPACK (thematic area: 3)	on material development increased after the completion of experimental phase on material development
25	Wadhwani & Abraham (2017)	"Exploring the Optimum Utilization of Interactive Whiteboards in Classrooms"	India In-service teachers	Factors affecting and supporting Social learning (thematic area: 4,5)	Inadequate professional development with Smart Boards was found as a major challenge in its integration in teaching social learning methods utilized by teachers to learn to operate digital tools
26	Bond et.al. (2019)	"Revisiting five decades of educational technology research: A content and authorship analysis of the British Journal of Educational Technology"	England (authors belong to Germany) Review study	Policy perspective (thematic area: 1)	After searching themes of research in the papers published in BJET in five decades, found seven themes but policy and theory did not appear Emphasis on research regarding policy perspective for integration of technology in education
27	Moreira et.al (2019)	"Models of educational integration of ICTs in the classroom"	Spain In-service teachers	Competency (based on level of use) Factors supporting (acc. To teachers' view)	weak and strong educational integration of ICTs teachers (with strong integration of ICT) perceived themselves as

|				(thematic area: 2,4)	sufficiently trained and having highly developed digital competence
28	Gupta (2019)	"Capacity Building of Teacher Educators for e-Learning Tools: An Experimental Study."	India Teacher Educators	Competency Used ADDIE model for planning instruction (thematic area: 2,3)	Capacity building for e-learning tools through blended learning, flipped learning, online learning helped to learn digital skills

Analysis based on table: 5.3

While going through the literature, research papers and articles were selected on the basis of their relevance with this study. When the details and findings of these studies were placed in this table, it was observed that these studies covered around a period of twenty years, beginning from the year, 2000 and ending at the year, 2019. Around fourteen countries were covered in these studies. Pre-service teachers, in-service teachers and teacher educators constituted the population and sample in these studies. In few studies, school students were also a part of the sample which was not taken into focus for this study. After tabulating all the information in the relevant columns and cells of the table, analysis was done to identify the most researched theme and less researched theme and a sequence of frequency of various themes were recorded in table: 5.4 given below and a pie chart was plotted for presenting the frequencies.

Table: 5.4: Total counts of frequency of themes

S.no. of themes	Themes	Frequency (Count of studies)	% of Frequency
1	policies, programmes and curriculum regarding preparing teachers for integration of digital technology	4	10
2	learning design, competency, level of integration, perception of teachers about training/learning	10	25
3	using models and frameworks for effective integration of such technologies and to evaluate and improve digital competencies	8	20
4	factors affecting (and supporting) integration of digital technology	13	32.5
5	Social learning and integration of digital technology	5	12.5

Figure: 5.1: Graphical representation of frequency of themes
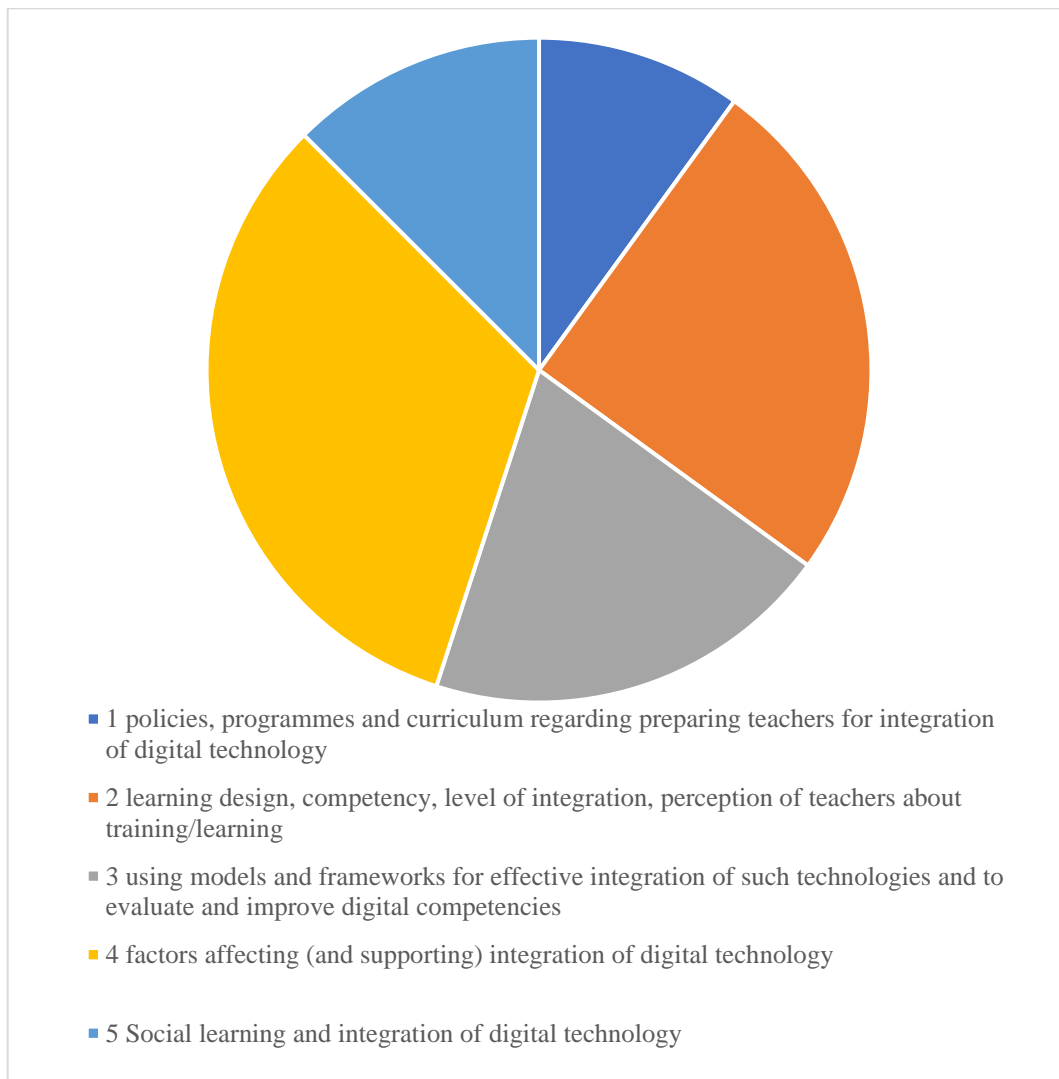
It is clearly visible through the pie chart (Figure: 5.1) that the factors affecting integration of digital technology was the most frequently researched theme in this area (32%) on the basis of literature reviewed for this study randomly selected from various international secondary sources on the basis of the relevance of this study. Second most frequent theme was learning design, competency, level of integration, perception of teachers about training/learning (25%), third frequent theme was using models and frameworks for effective integration of such technologies and to evaluate and improve digital competencies(20%), fourth theme was Social learning and integration of digital technology(13%) and the least searched theme was policies, programmes and

curriculum regarding preparing teachers for integration of digital technology(10%). There was similarity in the least frequently searched theme observed through reviewing related literature for this study and the review study conducted by Bond et.al. (2019). These authors could not find the theme regarding policies emerging out from their review study when they listed seven themes emerged from the review. Therefore, there was a need to conduct studies to explore this theme at ground level which was the rational of this study. Learning design, competencies and perception of stakeholders were in focus in this area of research and still this theme holds importance for being researched due to ever emerging trends in the area. Holding third position in frequency shows the importance of frameworks and models in this area of research which are already in application since the beginning of this century but still evolving. Though, social learning methods are not new but now these methods have become more popular due to the significant role played by them in learning with digital technology and learning digital skills too by face to face method or with the help of social media.

On the basis of all these themes emerged from the review of literature and policies, programmes, frameworks and models, a semi- structured interview schedule was developed to conduct interview with teacher educators and interviews were conducted. Data and information collected through those interviews were analysed and presented in next chapter.

5.3 ANALYSIS OF DATA AND INFORMATION OBTAINED THROUGH INTERVIEWS WITH TEACHER EDUCATORS

 Thematic analysis method was applied to analyse the data and information collected through primary sources. Teacher educators were the primary sources in this study for collecting information regarding preparing teachers for integration of digital technology which was mainly focussed on pre-service teacher education. Data and information obtained through interviews conducted with them resulted in developing an understanding of practices of preparing teachers for integration of digital technology in their professional work at ground level. Twenty teacher educators were selected as through purposive sampling method for conducting interviews. Various characteristics of the sample have been described in chapter- IV (Table: 4.1). Due to possessing all these characteristics teacher educators in these institutions were perceived as being rich

in experience of teaching different types of teacher education courses at different level. As already described in methodology section overall ten themes were identified for conducting interviews with teacher educators. Relevant questions were asked under each theme for clear understanding of the facts shared by teacher educators based on their working experience at ground level. Overall, nineteen questions were asked under ten themes. Researcher kept on asking questions emerging during the interview to get clear understanding of the facts presented by teacher educators and to understand the ground reality of preparing teachers for integration of digital technology as practiced and experienced by the teacher educators. It is observed by the researcher that teachers were overloaded with their own work schedule. Therefore, some of them kept on going for some work and coming back to the researcher while giving interview to the researcher, but most of them managed their time for the interview to be completed in one sitting. Teachers were kind enough towards the researcher's proposal and they gave their consent for the interview just after the first request made by the researcher and a cordial environment has been maintained throughout the interview. Once the teacher educators were introduced with the objectives of the study and major points of interview, most of them began to give information in their own flow and researcher had the responsibility to grab that information and facts which were required for this study In most of the cease, their answers were not objectively placed as "yes" or "no" but they gave their reply in subjective way with explaining some reasons behind it. Their replies were analysed to reach the conclusion Thematic analysis of the experiences shared by teacher educators through interview conducted with them was done which is given below:

5.3.1 Educational policies and programmes having insights on preparing teachers for integration of digital technology:

In chapter -II, and chapter-V the relevance of educational policies and programmes to guide and provide insights to all the stakeholders for preparing teachers for integration of digital technology has already been described in detail. Teacher educators are the most important role players in the process of preparing teachers for their future profession and making them competent to face the challenge at ground level which may come in their way in any or many form/forms. All the countries throughout the world make educational policies and programmes on the basis of the development in the field of education worldwide and their own social, cultural and developmental

demands. UNESCO formulates various policies and frameworks in the field of education for the purpose of guidance for all its member countries. These countries keep in consideration the frameworks and policies developed by UNESCO while formulating their own policies and frameworks to keep the pace of development with the development of other countries worldwide. India has also developed and implemented such policies and frameworks for keeping the pace of development parallel to the development in this field worldwide. Only making and implementing policies do not work effectively if the stakeholders are not informed about them and if they are not aware about inputs and guidance offered through them. As teacher educators are one of the main stakeholders of teacher education and their professional development, so, they should be well informed and aware about all the policies and programmes in the field of education. They should know the expectations of our education system for the development in this field according to the demand of present and future. Therefore, following question related to policy aspect was asked to the teacher educators:

1. Are teacher educators and pupil teachers informed and aware about educational policies and programmes having insights on preparing teachers for integration of digital technology? Kindly explain.

Fifteen teacher educators out of twenty replied "not informed, no awareness" in the response of the first question regarding awareness and information about educational policies having insights on preparing teachers for integration of digital technology/ICT (figure 6.1). Teacher educators, those replied positively about the awareness regarding such policies and programme talked about NCF, NCTF, ICT@ school, New Policy on ICT in Education, 2012. One teacher out of five (those responded positively) said that as there are many policies, some with the centre and some with the state, so, he found it difficult for a teacher or teacher educator to visit all these policies. But it is the known fact that teacher educators and teachers should visit educational policies implemented at national level and the policies implemented by their respective states. One of the teacher educators said that he was critical about policy due to big divide among schools in context of infrastructure and access to ICT. Therefore, he felt that policy makers should ensure the availability of infrastructure and its access before implementing the policy. One teacher out of five (those responded positively) said that she did not find

anything for teacher educators or pupil teacher in those policies, those were mainly about school education. Therefore, it can be said that policy should be modified (Vrasidas et. al., 2001) after a certain period and it should be clearly stated and communicated to all stakeholders. Another teacher out of these five said that she knew that there was something about it in policies but was unable to recall any such policy but she opined that ICT people (teacher educators) might be knowing more about it. One of the teachers out of these five said that initially she was not aware about it in spite of being an ICT teacher and as per her experience most of the teacher educators and pupil teachers were not aware about it because they were not informed properly. She just knew about it when she gave assignment to pupil teachers to search such policies and to prepare a presentation. Those presentation were quite informative about these policies.

On the other side, the teacher educators those responded 'no awareness' about such policies had one most common reason that the stakeholders were not informed about such policies through proper channel and they did not take interest themselves as integration of ICT was not mandatory in curriculum. Teacher educators were already laden with other workload, even most of the teacher training institutions had been suffering from shortage of staff, remained dependent on contractual teacher educators. Regular staff had to take many responsibilities and contractual staff had to suffer with uncertainty of career. Therefore, there was low self-motivation and lack of time to go through the documents of educational policies and programmes and even the ICT competency frameworks. Two respondents (those said 'no awareness') mentioned the name of NISHTHA who had recently got informed about NISHTHA programme and they said that this programme might be fruitful in this area and another respondent with similar response mentioned about Rastriya Madhyamik Shiksha Abhiyan in the context of ICT integration in teacher education but he said that insights regarding preparing teachers for integration of digital technology were not sufficient in these documents. Though, there were only twenty respondents in this study, but they shared their holistic experience which included their pupil teachers and other teacher educators working with them. Therefore, their response is significant which was analysed in percentage value also (75% not informed, no awareness) and given below in figure 6.1.

Figure 5.2: Percentage of respondents 'informed and aware' & 'not informed and not aware' about educational policies and programmes having insights on preparing teachers for integration of digital technology/ICT

% of respondents

■ Informed and aware   ■ Not informed and no awareness
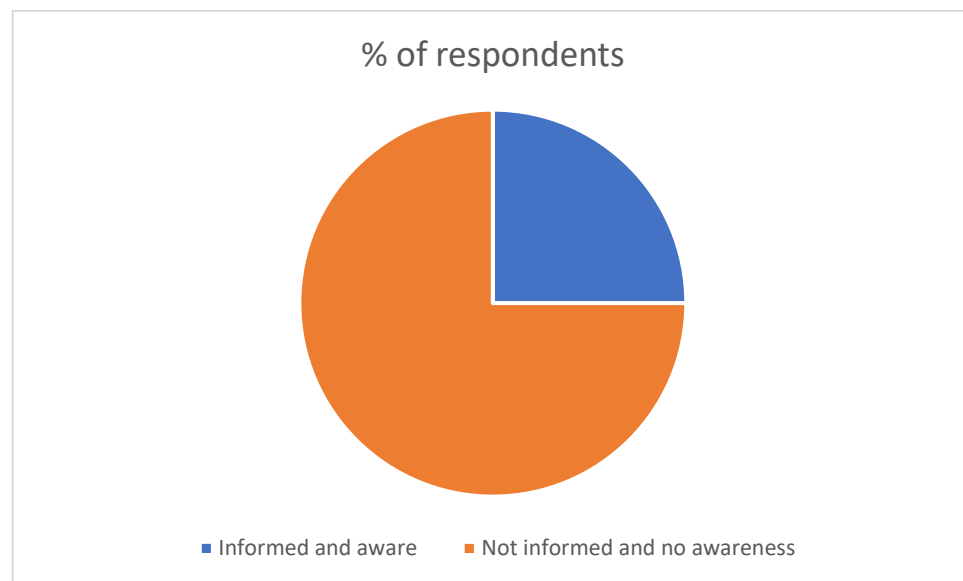
## 5.3.2 ICT Competency framework

Preparing teachers competent in twenty first century skills is one of the major challenges for all stakeholders in the field of education and teacher educators are the key role players. ICT skills for integration of ever emerging digital technologies in teaching- learning process and other professional activities of a teacher keep a key place among various twenty first century skills required for being a competent teacher. UNESCO's ICT competency framework for teachers, 2011 and three levels of ICT competencies given in New policy on ICT in school education has already been described in this study in chapter II and previous part of this chapter. For preparing teachers competent in these skills, all the stakeholders are expected to be well informed about both of these documents. Only then, they will be able work together to reach up-to the advanced level of skills which is the need of the time. Therefore, following question related to ICT competency framework was asked to the teacher educators:

1. Are teacher educators and pupil teachers, informed about ICT competency framework for teachers? Do teacher educators and pupil teachers use competency framework developed by UNESCO and CIET (given in New

Policy on ICT in school Education, 2012) for self- evaluation for effective integration of digital technology? Kindly, explain.

Fourteen teacher educators out of twenty (70%) replied "not informed, no awareness" (Figure 6.2) when asked about ICT competency framework for teachers developed by UNESCO and another one given in New Policy on ICT in school Education, 2012 (Government of India, developed by CIET, New Delhi). Out of other six teacher educators (those responded 'Yes') one said that she was not aware before going through major points of discussion through interview, she had just seen that there were two documents; one document of UNESCO on it and another on CIET's site showing level of ICT skills. But she felt that it was like too much burden on teachers. Another teacher educator felt that though, these documents told about ICT skills for teachers but teacher educators and teachers need to think themselves because things are changing day by day. Out of these six teachers only two had information about both of these competency frameworks. Out of other four, two had information about UNESCO's framework only and another two had information about competency levels given in New policy on ICT in education (Government of India, developed by CIET, New Delhi) only. Anyone of them never utilized these frameworks for self- evaluation or for evaluating ICT competency of pupil teachers.

Figure 5.3: Percentage of respondents 'informed' & 'not informed' about ICT competency framework (given by UNESCO and New policy on ICT in school education, 2012)

89
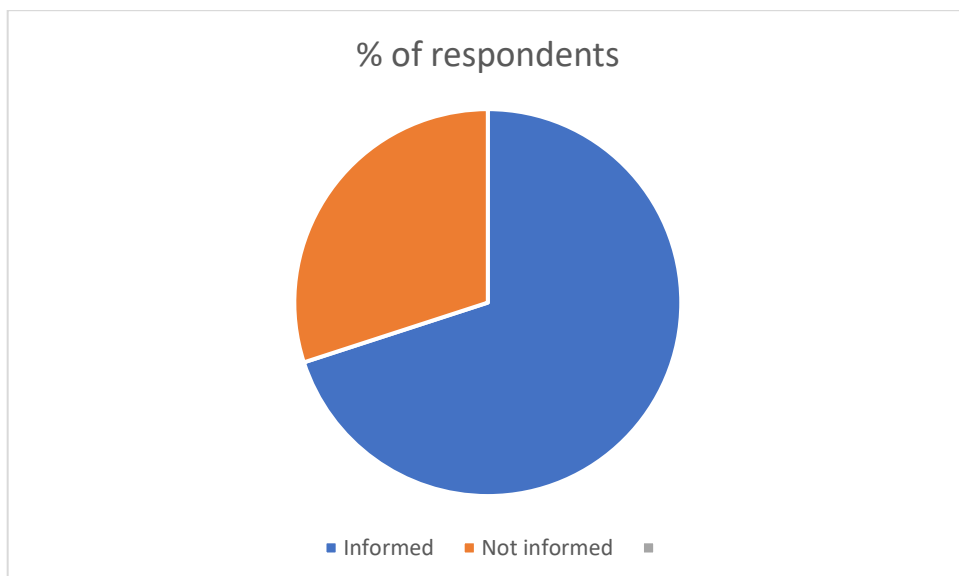
5.3.3 ICT and curriculum framework for teacher education

In India, there is one National Curriculum Framework for Teacher education (NCFTE, 2009). Curriculum and syllabus for teacher education are prepared on the basis of this framework throughout the country. Therefore, all the stakeholders in teacher education should have knowledge about it and all the key components included in it for maintaining the quality and standard of teacher education comparable to international standard at present. Preparing teachers for the integration of ICT is one of the key components of twenty first century skills which is the demand of the current education system. Two questions, given below were asked by the researcher to the respondents:

1. Are teacher educators and pupil teachers informed about the curriculum framework for teacher education and does it guide for integration of ICT in teaching- learning process and other professional work of a teacher?

2. Does the curriculum/syllabus for teacher education used in your institution provide clear guidelines for the integration of digital technology in teaching- learning process and other professional activities of a teacher?

All twenty (100%) respondents replied 'yes' as a response to question no. 1. All of them were agreed that the framework mentioned about integrating digital technologies in teaching- learning process and other professional activities of a teacher but eight respondents said that there was little input regarding integration of digital technology which was not clear to understand. One respondent said that it was good at theoretical perspective only. Another respondent said that it only mentioned about infrastructure not about how to integrate. One of the respondents said that it stated about critical use of ICT in teaching-learning process. This response 'critical use of ICT' is the key feature of integration of digital technology which is evident from the review and analysis of this framework given in respective chapters.

In the response of question, no-2, all twenty respondents (100%) replied 'yes'. All were agreed that the curriculum and syllabus for teacher education used in their institution provided guidance for integration of digital technology in teaching- learning process and other professional activities of a teacher. But, most of them talked about ICT as a subject or as a part of another subject 'Educational Technology'. ICT as subject was only an optional paper in B. El. Ed. course. It was a part of the Subject Educational

Technology in D. El. Ed. course. In both of the central universities, in B.Ed. course it was taught in workshop mode and only internal evaluation was being done, giving less weightage to it resulting in low motivation among students towards attending all sessions of workshop and doing hand-on practice. In the B. Ed. Course of these universities there were optional papers on ICT but it was reported that only few students used to opt it as an option. They told that there was a little input for integration of digital technology in other subjects. In the view of respondents, ICT as a subject was very important for developing ICT skills in pupil teachers. Therefore, respondents opined that it should be a compulsory subject in each and every teacher education courses because teacher educators, teaching other subjects, cannot manage time to develop digital competencies in trainees for integrating it in pedagogy and other professional work. Some of the respondents said that as there was no clear guidance for integrating digital technology in their subject of teaching, even, it was not mandatory to integrate up-to any suggested extent, so, it was not being used frequently by most of the teacher educators due to some other reasons. Therefore, teacher education curriculum framework should be modified according to the demand of time (Kong, 2014), having integration of ICT as a main component for developing twenty first century skills.

5.3.4 Integration of digital technology in classrooms and other activities of teacher educators and pupil teachers at ground level

Preparation of teachers for integration of digital technology in teaching-learning process and other professional activities of teachers begins at the pre-service education stage in actual sense. It is done in the classroom process, co-curricular and extra-curricular activities at both places, teacher education institution and school where pupil teachers do their practice of teaching and other professional activities through School Experience Programme (SEP). If teacher educators integrate digital technology themselves in these processes for critical utilization, then pupil teachers get motivated by observing the benefits of integration and they learn such skills simultaneously. Gradually, they become competent if they get the chances of hands on experience in their day to day work either in teaching and learning or other corresponding activities. Therefore, following five questions were asked to the respondents in this context:

1. Do the teacher educators and pupil teachers of your college/institute/university and other similar institutions visited by you or known to you integrate digital technology in their professional work/tasks?
2. How are digital technologies being used in teaching-learning process and other activities in teacher education to prepare teachers for integration of digital technology and what are the purposes for which digital technologies are being used by the teacher educators and trainees of your institution and other similar institutions visited by you or known to you?
3. How does incorporating digital technologies in the classroom and other related activities outside the classroom affect students and their learning?

4. How does incorporating digital technologies in the classroom and other related activities outside the classroom affect teachers and teaching?
5. How can digital technologies be best used by teacher educators and pupil teachers to enhance learning?

All twenty respondents (100%) replied 'yes' as a response to question no. 1. All of them were agreed that teacher educators and pupil teachers of their college/institute/university and other similar institutions visited by them or known to them integrated digital technology in teaching- learning process and other professional activities. One of the respondents said that youngsters (teacher educators) were using digital technology more than elder teacher educators with few exceptions. She further explained that most of the elder teacher educators, usually, did not take interest in integrating technology because it was not mandatory and ever emerging. Some of them the respondents shared their concern that as, digital technology was ever emerging, so, there was limitation for a teacher to learn. He/she had to learn his/her subject, then pedagogy then this new thing, technology. Personal life needs to be maintained and taken care of. Another respondent said that around 70% people in her institution were using digital technology for different purposes in professional activities. Another respondent said that it was being used but limited due to varied reasons.

As the response of second question, Power Point presentations (PPTs) and integrating videos in teaching-learning process were found as the most common digital tool and

technique utilized by all respondents, their pupil teachers, other teacher educators in their institution and many other teacher educators and pupil teachers known to them. Other way of utilizing digital tools and techniques by the respondents, their pupil teachers and their colleagues were showing movies, stories, rhymes, using projectors, interactive white board, software for basic operations like, MS-word for writing, MS-excel for data related work, various Apps for different purposes like Blog, Moodle, Google Classroom, various search engines like Google Search, Wikipedia, JSTORE etc. A list of digital tools utilized by the respondents has been given under the last theme of interview. Different purposes for utilizing digital tools and technology, as reported by the respondents were searching information both for classroom activities and co-curricular activities, making the classroom process interesting and effective by integrating movies, video clips, pictures through digital media, collaborating in learning through digital media, sharing information through these media, making and submitting assignments, keeping evaluation records, providing immediate guidance to students if required. One of the respondents said that it was quite helpful for the teaching of maths through various Apps, digital quiz, games etc. She said that after her classroom presentation on how to utilize these Apps to make things easy and effective like making 3-D diagrams and different types of charts , pupil teacher got motivated and they tried themselves, did self- evaluation as well as took feedback from their peers and teachers, again became motivated, developed positive self- perception (Paratore, et.al., 2016) and then utilized these resources in their teaching practice. Most of the teacher educators reported that digital technology was being utilized by pupil teachers during their school experience programme. Two respondents said that such tools were very useful for the teaching of language. One of them had frequently utilized digital tools for teaching 'the method of teaching of English grammar' and another teacher educator utilized YouTube videos and pictures available through different digital sources to teach 'methods of teaching poems and about their poets' in Hindi. Showing movies and then discussing critically about the points concerned to the content of the subject were found very effective by many respondents. One of the respondents found it quite helpful in searching content related to gender issues, showing videos clips, movies to students and then taking their reflections, giving them assignments on patriarchy and matriarchy and finally achieving very impressive learning outcome which was not possible through any other medium. Respondents from DIETs said that they utilize digital tools during morning assembly for conducting quiz. Respondents from different types of institutions

reported that digital technology was being utilized effectively in various co-curricular and extra-curricular activities and during the orientation of new batches of students.

As the response of question no. 3, all respondents replied positively. Many positive effects were cited by the respondents, like, enhancement of concentration, critical thinking, ICT competency and learning. Students were motivated. Interest was created as students found something new in class. It helped in time saving, concept clearance, making learning easy, interesting, attention grabbing and permanent. Classroom became active, illustration became better by using videos, and understanding became better by utilizing digital technology critically and properly. Quick access to information in the classroom and during other related activities in real time result in better, faster and more effective communication. One of the respondents said that each and every effect depended on the competency of the teacher educator and pupil teachers.

Almost similar responses to that of question no. 3 were given by the respondents for question no. 4, like, it helped in instant Information search, giving clear illustration through 3-D pictures of biological systems and other things related to other subjects, Classroom management, better communication, discipline management, interest creation, effective teaching and learning. Only lecture makes teaching boring, so these tools helped to make a change resulting in giving pace to teacher to understand students and their learning. Burden was reduced for teachers. With the integration of digital technology, teaching -learning process became attention grabbing that created interest.

 One of the respondents said that sometimes a single video clip worked more than thousand words. He mentioned about utilizing digital technology in enabling unit for differently abled pupil teachers in his department of education. Another respondent said that it depended on willingness and competency of teacher. He found only few teacher educators as frequent users, though, almost all were familiar with these technologies. Whenever used by teacher educators, they felt blessed with technology but, sometimes, when it was continued for long duration without interaction, it became boring. So, only critical integration helped. One respondent said that Classroom interaction became better, debates and arguments on videos improved communication skills, better illustrations became possible in less time. Teacher enjoyed teaching learning process along with students.

In the response of last question, all respondents opined that there should be proper orientation for all teacher educators, not only for ICT teachers, regarding policies, competency levels, competency framework and all new trends in this field. One of the respondents said that if integration is expected in all subjects across the curriculum of teacher education, then the essential training should be provided to all teacher educators irrespective of their subject of teaching, at least once in a year to update with policies and every new thing in the field of ICT. Theoretical and practical, both types of knowledge are essential. Another respondent had similar view. He suggested that ground work of preparation should be done before taking in new things/tools/techniques in education. Motivation, information and training should be provided as prior work of implementation.

A teacher educator suggested that it should be made compulsory to some extent either as an ICT subject or as integrating in different subjects with some hands-on work. Another respondent also shared similar view that to some extent it should be mandatory for both teacher educators and pupil teachers. He opined that until it becomes mandatory no one wants to take the pain. Many respondents said that there should be availability of sound infrastructure and more resources for all the stakeholders, teacher educators and pupil teachers in teacher training institutions and for students and teachers in schools and students should get the chances of full hands on experience. One of the respondents said that licencing and paid resources should be provided by the university/ institution itself. Another respondent said that ICT resource room should be available in these institutions. One of the respondents suggested that every classroom should have smart class facilities. Another respondent said that some apps worked on personal system but did not on classroom's system or on projector's system. It is opined that maintenance and availability of tools should be ensured. It is felt by the respondents that authenticity of sources should be ensured and which was mostly dependent on teachers.

Other suggestions by the respondents were; no fund crunch should be there in teacher education institutions, there should be some way out for bridging the gap between students having or not having access to digital tools/device at home, provision of orientation for each subject teacher to use digital technology critically more than showing PPTs and videos only. Every teacher should have personal system given from institution with the provision of replacement of systems after every 10 years. There

should be provision of specific training courses for teacher educators according to their requirement and feasibility of time. There should be some open training system from government side for all teachers, teacher educators without any restriction of access. One respondent said that restriction means policy planners/government don't want to make it available for everyone that means don't want to make integration universal for all institutions, all teachers and all teacher educators throughout the country. So, it should be freely available. Hopefully, all these suggestions may be fulfilled in coming years as it is observed through the analysis of policies and programmes that 'Samagra Shiksha Scheme'(see review and analysis of policies and programmes) has been focussing on all these aspects. Specially, NISHTHA programme has been designed keeping in view all those aspects which were suggested by the respondents in this study.

Some of the respondents felt that problem of shortage of faculty should also be solved, then, teacher educator will get time for their own learning and development. They opined that every faculty, either working on full time basis or on contractual basis, should have chances for professional development. They felt that faculty development programmes should have sessions on new developments in the field of education either in technology or something else. Some of the respondents felt that technical staff should be appointed for maintenance of digital tools.

Some of them shared their concern that there should be awareness about criticality of resources and time used on searching and utilizing them, an understanding about tools, how to use when to use how much to use which should be for everyone; teachers, teacher educators, school students and pupil teachers.

5.3.5 Problems/ barriers faced by the teacher educators and pupil teachers & their solution (if any)

It is evident from the literature reviewed (see chapter III) that teacher educators and pupil teachers face different types of problems/ barriers in the course of integration of digital technology in in teaching- learning process and other professional activities. Sometimes, it was beyond the limit of teacher educators and pupil teachers to solve the problem or remove the barrier which made it difficult to integrate digital technology in these activities. But, in many cases teacher educators and pupil teachers made their efforts to solve these problems and to remove barriers for integrating digital technology. Two questions were asked to the respondents in this context:

1. Do teacher educators and pupil teachers face problems/ barriers in the integration of digital technology in their teaching- learning process and other activities?

   Yes…………   No………

   If yes, then, please describe these problems/ barriers.

2. Have you/your student/your colleague/any other person known to you find/developed a solution for them?

   Yes…………   No………

   If yes, then, please describe

All twenty respondents (100%) replied 'yes' as a response to question no.1 and there was one most common problem of lack of sufficient infrastructure and other resources (also reported by Mumtaz, 2000; Gulbahar, 2008; Hammond et.al., 2011) which was reported by all respondents faced by them or pupil teacher in their institution or faced by pupil teachers in schools during school experience programme. Other problems were; internet connectivity, lack of time, lack of hardware support , problem of data storage and corruption of data due to lack of antivirus software, understaffing regarding technical support, lack of orientation/ training programmes for teacher educators, lack of facilities at work place and at home both for teacher educators and pupil teachers, accessibility and maintenance, and authenticity and reliability of data sources and content available through digital resources. The attitude of teachers was also found as a barrier as it was not mandatory to integrate technology in teaching-learning process and other professional was found more in schools as felt by the respondents. In case of infrastructure related problems, major ones were non-availability of digital tools in all classrooms, if available, there was connectivity problem and internet problem. In some institutions, there were few smart classes or projector room or computer lab. But in that case other problems arose, like, administrative problems and management problems. One of the respondents said that due to not so positive attitude of administration some problems existed regularly in the institution like, maintenance of infrastructure, cleaning the system, refilling of printer ink, losing the file from the common system, speaker and remote related problem, connectivity problem etc. Some respondents said

that though their institutions had three to four projectors but there was only one lap top with connector, so, only one teacher can use smart board at a time and there was no any electricity connection point for laptop or any other tool other than a point for projector. The problem of ICT competency among pupil teachers (Aduwa-Ogiegbaen, 2009) was reported by the respondents. One respondent said that around 40 percent students of her department had only basic ICT competency, they were unable to do even intermediate level applications but they learnt in group to some extent. Some of the respondent said that a small percentage (around 10% or less) of students, even, lack basic ICT competencies which became a major barrier. But they were motivated to learn with the help of peer group (similar view shared by Kanvaria, 2012). Sometimes, teacher educator invesedt time on helping them to learn ICT skills and till the end of the course they learnt at least basic competencies or more. One of the respondents said that everyone kept thinking that he/she was going digital but there was a gap of 1to 100 in ICT competencies (similar view shared by Hammond et.al., 2011). He opined that this should be the responsibility of the policy makers to do something to bridge that gap. Four respondents reported the problem of study material in different languages other than English like, Hindi and Urdu & typing problem for Hindi and Urdu medium student. They found some way-out to manage this problem with the help of mobiles to type in Hindi and then they made PPTs. It was reported that scanned PDF do not work properly with the Apps for visually impaired students.

As the response of question no.2, solution of problems related to infrastructure and competency of students were reported by the respondents. Most of the respondents said that they carried their own laptop for integrating technology in classroom process. But they felt that it was not possible for them to carry laptop every day. So, they needed to plan priorly. In case of connectivity and electricity problem, one respondent said that she used to carry her own laptop and connector. There was only one plug point in projector room (one classroom) so there was the problem how to keep charging the laptop then she brought an extension cable herself and began to use it by connecting it to another room across the corridor. Everyone passing through the corridor faced problem including the administrative and management people. After few days they decided to fix an extra plug point in the projector room and did it quickly. Thus, the problem was solved when felt by administrators themselves the urgency to solve . One teacher said that in case of unavailability of digital tool in schools, some pupil teachers

took prior permission from the head of their own institute to carry institute's projector to the school for priorly planned teaching practice and they carried projector with them and presented their lesson effectively with integration of digital technology in the presence of their supervisor. In case of the problem related to authenticity of content, data and sources, one respondent said that she used to search content from authentic sources and to give reference to her pupil teachers for their SEP, but she felt that it was a burden on her.

5.3.6 Models and frameworks developed by pedagogues and researchers for making the integration of digital technology more effective

Some models and frameworks have been developed by pedagogues and researchers working in the field of education for effective integration of digital technology, evaluating and developing technological, pedagogical and content knowledge and modifying and improving digital technology integration in classroom process. These models and frameworks are utilized by teacher educators and researchers worldwide which is evident from the review of literature (Genc et.al., 2017; Kihoza, et.al., 2016). Therefore, following questions were asked to the teacher educators:

1. Do you, your colleagues and pupil teachers know about models and frameworks developed by the educationists, pedagogues and researchers for effective integration of digital technology?
2. Do you, your colleagues and pupil teachers use any such model/framework for effective integration of digital technology? Kindly, explain.

Fourteen teacher educators out of twenty (70%) responded 'no' for the first question and six (30%) responded 'yes'. They said about themselves, their colleagues and pupil teachers according to their experience of working with them but they opined that it may possible that some of the colleagues know about these models and framework. Out of fourteen respondents one said that she has read about PCK but not about any ICT related model or framework, another one said that she has just read the term TPACK once and few lines of its description but do not possess any knowledge about it. All of them shown interest in these frameworks while interacting with the researcher during interview. Five of them felt that teacher educators should be informed about these things through proper channel, orientation programmes, conferences, seminars etc. All

six respondent(those responded 'yes') had knowledge about TPACK and they taught their students about it, only one teacher had knowledge about SAMR model and he opined that only ICT people might be knowing about these models and frameworks because there were lack of orientation programmes and discussion sessions on such topics which should be definitely communicated to the stakeholders in this field to help them to develop ICT competencies which is one of the key component of twenty first century skills for a teacher and to improve integration of digital technology in teaching-learning process.

All twenty respondents (100%) replied 'no' in the response of second question. No one had applied any model or framework for either planning of integration of digital technology or for evaluating technological, pedagogical and content knowledge or for enhancing the integration of digital technology in classroom process.

Figure 5.4: Respondents having or not having knowledge about models and frameworks
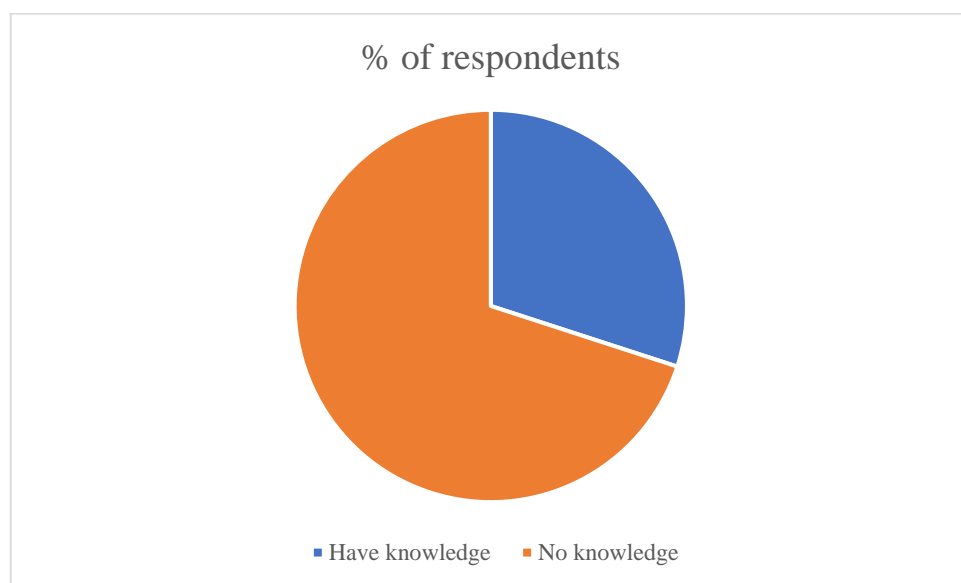
5.3.7 Co-operative and collaborative learning and digital technology

Social learning methods in the form of collaborative and co-operative learning were found quite helpful for learning and most suitable for learning digital skills as well as for learning through digital tools in the form of digital media as reported by various

researchers (Wadhwani & Abraham, 2017; Bhatia & Haider 2015; Toki & Pange, 2013; Kanvaria, 2012). Therefore, following question was asked to the respondents:

1. Do the teacher educators and trainee teachers of your institution follow social learning methods for effective learning, either face to face or with the help of social media platforms or both? Kindly, explain.

All the respondents (100%) replied 'yes' in the response of this question. All of them said that these learning methods were applied regularly for two purposes. First purpose was learning contents of the curriculum and second purpose was learning various skills including ICT skills. All of them said that while doing collaborative learning interactions took place through face to face mode and through digital media. WhatsApp was found as the most utilized tool because all respondents said that it was utilized by their pupil teachers and teacher educators for sharing information and knowledge and learning together. Some other Apps were also utilized for this purpose, e.g., Google Classroom, Google Drive and Classroom Blog. One of the respondents said that collaborative learning was always beneficial as per her experience. Once, they had project for pupil teachers in group and everyone had to prepare five slides and it was decided that equal marks would be given to the whole group. Some students did not had system at home, some did not had skills to do. But they completed the project successfully in collaboration and everyone learnt to make PPT along with learning the content. It is evident from this experience of teacher educator that collaboration helps to enhance learning and to making learning better as reported through literature (Wadhwani & Abraham, 2017; Bhatia & Haider 2015; Toki & Pange, 2013; Kanvaria, 2012). Similar experience was shared by another respondent that they used to make heterogenous groups and the pupil teachers with lesser competencies(around 30% of total student population in the institute) also learnt with their peers, someone was good in some aspect and some others were good in other things, ICT was used just as a medium, not enforced, but they took interest and learnt many skills. But in-service teachers (doing B.Ed.) did not know even the basic skills of ICT but over a period of time they learnt ICT skills during their course due to being mandatory of doing assignments and making e-portfolio and they learnt most of these skills through collaboration and co-operation with peers. Another respondent shared his view that

better learning took place in self-made groups (reported by Toki & Pange, 2013 also). But as the educators had to follow heterogeneous group principle, so, they usually made groups themselves. Initially, there was problem with some students but at the end students were benefitted through working in group. One respondent said that e-campaigns were launched in their college that helped in collaborative learning about their college environment, culture etc, like, gifting environment friendly things (e.g. plants) on social celebrations and during educational programmes. Thus, it is evident that collaboration and co-operation enhance learning which also reported through literature.

5.3.8 Social media and learning

Social media has become the part and parcel of human life nowadays. It is utilized for sharing information and knowledge and learning. It is evident from the literature that social media has helped in learning. Therefore, to develop an understanding of how social media is being utilized in India in teacher education at ground level, following questions were asked to the respondents:

1. Do the teacher educators and pupil teachers of your institution and other similar institutions visited by you or known to you use social media as teaching and learning tool? Kindly, explain (with examples, name of Apps. Etc.).

2. Do the teacher educators and pupil teachers of your institution have created professional learning groups on social media platforms? Kindly, explain.

3. Do you, your colleagues and pupil teachers of your institution take interest to be a member of larger professional learning communities through social media platforms? Kindly, explain. If possible, kindly, name those professional groups.

All twenty respondents (100%) replied 'yes' in the response of first question. It denotes that social media were widely used as teaching-learning tools in teacher training institutions. WhatsApp was reported as the most widely utilized social media App as all respondents said that it was utilized for learning in their own institution and many

other institutions known to them both by the teacher educators and pupil teachers. Its significant role in learning was reported through literature (Bhatia & Haider 2015) also. Other tools were Facebook pages, blog, Google mail groups(shared by Kanvaria, 2011), and Google Classroom.

Gmail groups and WhatsApp groups were created as professional learning groups on social media platform in most of teacher training institutions as told by respondents. Some institutions created google classroom and classroom blog for professional learning.

Nine respondents out of twenty (45%) said that they were members of larger professional learning communities through social media platforms, but only three had interacted with others on these platforms, others were utilizing these platforms only for searching contents and information. Eleven respondents said that they were not a member of any such groups, but one of them said that some senior teachers engaged in research work were the members of such groups through social media platform. ResearchGate, Academia, LinkedIn, Twitter, Facebook, Willy library, and Mendeley are reported as social media platforms on which respondents joined as members of these larger professional learning groups.

5.3.9 Using digital technology: Beneficial or harmful or both

It is always a topic of debate that using digital technology is beneficial or harmful or both. Therefore, following question was asked to the respondents:

1. What do you think about integration of digital technology in education?
- it is beneficial
- it is harmful
- both beneficial and harmful
- has no effect

   Please, explain

Seventeen respondents (85%) replied that it was both, beneficial and harmful'. Three respondents (15%) replied that it was' beneficial only' in case of education. Thus, only two options were opted. Benefits of integrating digital technology in education as told by respondents were its helping role in concept clarity, classroom management, immediate content search, access of information and transaction, enhancement in

interaction, easy and fast communication, making learning easy, interesting and long lasting (permanent), covering more content in limited time, making classroom environment active and making teaching easy and interesting. Two respondents said that digital Apps were very helpful in doing some work very easily that took more time and energy if done manually without technology, like, plotting different types of graph within minutes to decide which one was more suitable for the data, making 3-D diagrams of biological systems and many other things from other subjects also. when pupil teachers got their concept clear then they transferred their learning effectively to school students. They saved their time in drawing work and they utilized their time in critical thinking. One respondent said that Apps were very beneficial in teaching and learning accountancy for sharing content and creating presentations.

It became harmful when not utilized critically, reasonably and carefully. Various harmful aspects of using digital technology in education were cited by the respondents, like, health problems due to over-use and carelessness in maintaining posture while using such tools for longer duration. Cervical problem was reported to become frequent even in young learners. One of the respondents said that as a teacher educator she found 30-40% pupil teachers had been suffering from or suffered cervical problem. Young students in their teens and twenties were suffering such problems, this is a matter of concern. Same respondent felt that psychological problems were emerging when a person had so many groups and he/she had to interact with many groups. Sometimes disbalance arose in natural rhythm of life. Another respondent shared similar view. He said that last year he had cervical problem, then he left using ICT for 3-4 months. Then, again he started using it but limited. He said that cervical problem had risen 3-4 times more for few years in whole community. Carrying heavy laptops (as light weight laptops are expensive and it is difficult to afford for many) created backache and cervical problem. Problem of mental peace due to long hours on social media even for learning, exposure to radiation for long hours and eye-strain were also harmful. One teacher shared that cyberbullying was there but a very small percentage of students had experienced it.

It was felt by some of the respondent that using contents from digital sources without verifying authenticity was harmful for learners which was noticed by them during school experience programme. Sometimes, pupil teachers searched content from digital

sites for their lessons and incorporated it without checking its authenticity and relevance. Such errors were usually corrected by supervisors but not always. Posting contents and pictures for peers without checking their authenticity was also reported as harmful. Due to utilizing digital technology as a tool for teaching and finding it was easy to create digital charts, posters, 3-D diagrams, but pupil teachers were gradually becoming dependent on it. They were showing disinterest in making teaching aids manually. Therefore, in case of unavailability of digital system in school, technical issues or accessibility problem during school experience programme, they found themselves unable to use teaching aids and applied lecture only method or lecture-cum-discussion method.

Figure 5.5: Percentage of respondent having opinion on integration of digital technology as beneficial or harmful or both

% of respondents

■ Both, beneficial and harmful   ■ Beneficial only
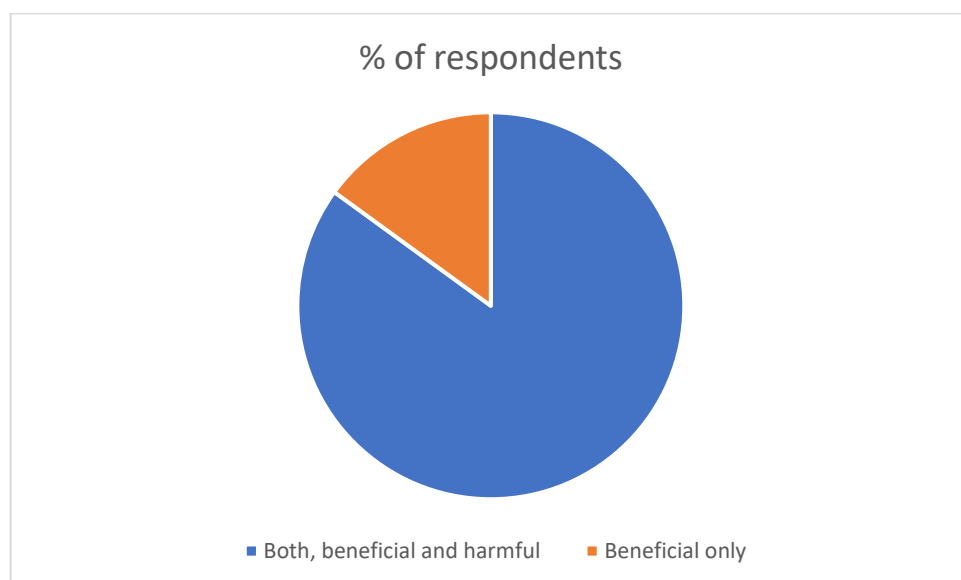
5.3.10 Digital tools and technology frequently utilized by respondents:

The question asked was:

1. What are the digital tools frequently utilized by you?

Overall, there are seventy-one tools enlisted here (table 5.5) which were utilized by respondents and their pupil teachers in their professional activities with the total no

(frequency) of respondents who utilized any specific App. Thirteen tools, utilized by maximum number of respondents, have been presented through figure 5.6.

Table 5.5: List of tools utilized by respondents with the frequency of respondents

S.No.	Name of tools	No. of respondents
1.	Academia	5
2.	Arts & culture	1
3.	Audacity	1
4.	Blog	3
5.	b-ok.org app	1
6.	Bolo app	1
7.	BYJU'S	2
8.	Cam Scanner (mobile)/ cs-scanner	4
9.	Cartography	1
10.	Dictionary	1
11.	eGyanKosh	1
12.	Eklavya app	1
13.	ePathshala	6
14.	EPW	1
15.	Expense manager (Accountancy)	1
16.	Facebook	5
17.	FreeMind	1
18.	G Suite (Google suite)	1
19.	GeoGebra (Maths)	3
20.	GIMP	1
21.	Gmail/ e-mail	5
22.	Google Classroom	4
23.	Google Docs	1
24.	Google Drive	6
25.	Google Forms (for feedback after any specific training session)	2
26.	Google Groups (Gmail based)	4
27.	Google Scholar	1
28.	Google Search	20
29.	google translate	4
30.	Grammarly	1
31.	Hot Potatoes (gaming, quizzing)	1
32.	Interactive white board	6
33.	Jodo Gyan (SCERT material for Class I & II)	3

34.	JSTOR	5
35.	Kahoot!	1
36.	Khan Academy	1
37.	KineMaster (video editing software)	1
38.	Lesson plan	1
39.	LinkedIn	4
40.	Mendeley	1
41.	Meritnation (for CBSE & ICSE classes)	1
42.	Microsoft Excel	14
43.	Microsoft PPT	20
44.	Microsoft word	20
45.	Moodle	3
46.	Movie Maker	2
47.	NAEYC App (for early childhood professional development)	1
48.	Notes	1
49.	NROER (videos based on NCERT syllabus)	1
50.	Photo editing software/ photo mixer/ Adobe	3
51.	Pinterest	1
52.	Plagiarism software	1
53.	ResearchGate	3
54.	SHAREit	1
55.	Shodhganga	3
56.	Shotcut	1
57.	skype	1
58.	Skyview	1
59.	Socrates	1
60.	Speech To Text	1
61.	SPSS (Statistical Package for the Social Sciences)	1
62.	SWAYAM resources	2
63.	TED Talks(sharing)	2
64.	TESS Indian	1
65.	The sources (Hindi, Urdu) learning site	1
66.	Toys From Trash (arvindguptatoys.com)	1
67.	Twitter	1
68.	WhatsApp	20
69.	Wikipedia	1
70.	Willey library(on-line)	1
71.	YouTube	19

Figure 5.6: Tools utilized by maximum number of respondents

% OF RESPONDENTS WHO UTILIZED THE TOOL
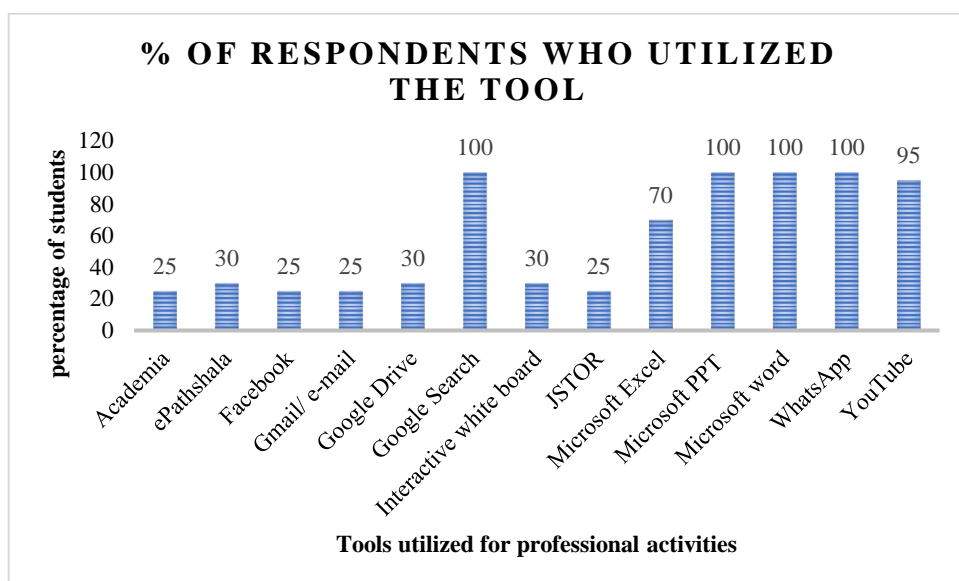
It is evident from above diagram that Microsoft Word, Microsoft PPT, WhatsApp and google search were the most utilized digital tools by teacher educators and pupil teachers followed by YouTube. Benefits of WhatsApp were reported in the literature (Bhatia and Hader, 2015). Microsoft Excel has been utilized by 70% respondents and their pupil teachers. Interactive white board, Google Drive and ePathshala have been utilized by 30% respondents and their pupil teachers followed by Academia, Facebook, Gmail and JSTORE utilized by 25% respondents and their pupil teachers.

After analysing the information given by teacher educators through interview based on their working experience in the field of teacher education the study reached at some conclusion. Though, this study was based on small sample size and interview method, it was quite helpful to develop an understanding of preparing teachers for integration of digital technology at ground level along with awareness and knowledge regarding it among teacher educators and pupil teachers, challenges faced by them and finding solutions.75% teacher educators reported no awareness regarding educational policies and programmes giving insights on preparing teachers for integration of digital technology70% teacher educators reported "no knowledge about any of the two ICT competency framework (UNESCO's and NPICT in school education, 2012). 100%

teacher educators never utilized any competency framework for self-evaluation or for evaluating competencies of pupil teachers. All of them were agreed that NCFTE and the curriculum/ syllabus utilized in their institution give some input for integration of digital technology but inputs are not so clear. All of them were agreed that teacher educators and pupil teachers of their college/institute/university and other similar institutions visited by them or known to them integrate digital technology in teaching-learning process and other professional activities. PPTs and videos were the most utilized tools by all teacher educators and pupil teachers.

Lack of awareness regarding policies and programmes, lack of infrastructure, connectivity, access and internet facilities and lack of time are reported as the most common problem/barrier in the path of preparing teachers for integration of digital technology. All respondent had faced problems more or less. 70% teachers had no knowledge about models and frameworks developed by pedagogues and researchers working in this field. Any respondent had not utilized any model or framework for improving the integration of digital technology.

All respondents were agreed that they utilized co-operative and collaborative learning methods which enhanced learning and improved learning outcomes. All were agreed that social media was being utilized by them, their colleagues, other teacher educators known to them and pupil teachers. Only 45% respondents were the members of professional learning community available through social media platform. 15% respondents opined that integrating digital technology was 'beneficial only' in education while 85% respondents opined that it was both beneficial and harmful. While sharing the benefits of digital tools they mentioned the name of various tools utilized by them in their professional activities.

Many suggestions were given by the respondents for improving the process of preparing teachers for integration of digital technology in their profession. The most common opinion and suggestion by all respondents was the provision of organizing proper orientation and training programme for all teacher educators, not only for ICT teachers, regarding policies, competency levels, competency framework and all new trends in this field. They felt that such programmes should be organised regularly after a certain period of time. Policies need to be modified in this context due to ever emerging digital technologies. Ground level preparation are required to be done before implementing any policy. Providing infrastructure facilities and proper training to all the stakeholders were felt as the basic need for operating and critically utilizing such tools and, taking

care of authenticity and cyber security. Need of proper maintenance, repair and replacement of tools was also felt. Need of provision of free access to online resources through the organization for teacher educators and pupil teachers was felt. Need of orientation and training for pupil teachers for critical use of digital tools and to take care of various challenges in the form of health issues, cyber security, time management, digital wellbeing and authenticity of content and resources was also felt by the respondents.

CHAPTER- VI
SUMMARY, CONCLUSION AND RECOMMENDATIONS

When computers were introduced in twentieth century to various fields including education, a revolution of information and communication came in this field in the form of digital technology as it functions through a binary computational code. Digital tools generate data in the form of digitized content, store and process it in digitized form and the technique applied in their functioning is called digital technology. Digital media made it possible to learn anytime, anywhere with anyone/any group which has been working like a life-line for learners in present situation of pandemic due to COVID-19. It became a challenge of the time for human being to be digitally competent to lead a comfortable life in the era of digital technology. All countries make their efforts to develop their system of education to meet the challenges of time along with maintaining, expressing and promoting their own specific socio-cultural identities. Schools are usually the first place where children are introduced to formal education. They spend their entire childhood in school for gaining knowledge and learning different skills for a bright future ahead. Knowledgeable teachers, proficient in professional skills give direction to shape the future of the students. Teachers own experiences of professional development towards creating knowledge make them capable to develop required skills and adequate competencies in students for creating knowledge (Fullan, M., 2006).

Digital technology in education is the need of the time. But, for utilizing the technology critically in education, teachers need to be educated and skilled through properly planned training programmes. These programmes should be designed according to the requirement of school education. Therefore, teacher education is addressed along with school education in policies and programmes at national and international level. But it is felt by different stakeholders in the field of education that for effective integration of digital technology in education, teacher educators, pupil teachers and in-service teachers needs to be informed about policies and programmes and should be oriented properly as they are the real implementers of these policies and programmes at ground level. Taking into consideration the importance given to integration of this new technology in school education and teacher education this aspect of development in

these areas of education needs in-depth research to get knowledge and information from the ground level. It would help to understand the processes, development, achievements, factors affecting in the real situation and to work for further improvement. This study was designed to fulfil all of these purposes.

6.1 RESTATEMENT OF THE PROBLEM:

Preparing Teachers for Integration of Digital Technology: A Study of Policies, Programmes, Frameworks, Models and Practices

6.2 RESEARCH QUESTIONS:

1. What do the policies and programs tell about digital technology integration in teacher education?
2. What are the existing frameworks and models available for making integration of digital technology effective in teacher education?
3. How is digital technology being integrated in teacher education?

6.3 OBJECTIVES:

1. To review the policies and programmes on integration of digital technology in education and draw implications.
2. To document various frameworks, models and practices on integration of digital technology in teacher education.
3. To delineate practices of integration of digital technology in teacher education and factors affecting.
4. To explore the knowledge and awareness among teacher educators about policies, programs, frameworks and models.

6.4 RATIONALE OF THE STUDY:

- Policies, programmes, curricular and competency frameworks make and show the path for development in right direction. Therefore, it is needed to explore and observe the facts given in these documents regarding preparing teachers for the integration of digital technology and the awareness among teacher educators and pupil teachers regarding these policies, programs, curricular and

competency frameworks because these future teachers will be the real implementers of these policies at ground level.

- The field of digital technology is ever emerging and it has been equipping human being with new tools and techniques continuously. Therefore, it is the need of the time to search what kind of studies are being done in the area and to identifying major themes those need to be taken care of to contribute for preparing teachers for integration of digital technology.

- It is the need of the twenty first century to make teachers competent in the digital skills. They get motivated when they observe the benefits of integration of such technologies applied by their educators. Therefore, this area needs to be investigated in order to know the way of effective utilization of integration of digital technology, to search and solve problems, to remove barriers and to promote favorable conditions. In the present situation, due to COVID-19, technology is the only medium to learn and to teach. Stakeholders in the field are busy in finding which tool would work better. This situation itself rationalizes the need of this study.

6.5   METHODOLOGY:

6.5.1 Theoretical Paradigm:

Theoretical paradigm for this study emerged through the review of literature. While going through the literature related to this study including policy documents, curriculum framework, ICT competency framework, models and frameworks developed by the experts in the field and reports of research work, it was found that following learning methods and learning theories were relevant to the context of this study and found effective in application through the information collected from primary sources.

Social Learning Methods: Co-Operative and Collaborative Learning

Social learning methods in the form of co-operative and collaborative learning were found very effective while preparing teachers for integration of digital technology.

Social Constructivism Learning Theory

This theory was presented by Vygotsky in his book "Thought and Language (1934)". According to this theory, a student learns through social interactions along with his/her personal critical thinking process which is termed as social constructivism. Co-operative and collaborative learning is an integral part of social constructivism where learners have a lot of information and knowledge to offer each other. In such type of learning it is not necessary for the learner to learn only with the teacher but he/she learns with the peers in the class. After completing the group work each learner internalizes the knowledge but it occurs at different rate for each individual based on his/her own experience.

This theory was found relevant for preparing teachers for integration of digital technology through the observations made through review of literature and findings from practices at ground level.

6.5.2 Research Design:

This study was based on both primary and secondary data. The study was done into three phases out of which first two phases were based on the facts and information explored through the review of policies, programmes, frameworks, models and literature from research studies. Third phase was based on primary data collected from the field.

6.5.3 Population and Sample:

Population:

Teacher educators from teacher training institutions in Delhi were the population in this study.

Sample:

Twenty teacher educators were selected as sample from the population through purposive sampling method for conducting interviews.

6.5.4 Tools and Techniques:

Tool:

A semi-structured interview schedule was developed for conducting interview with teacher educators on the basis of the themes identified through literature review.

Technique of collection of information and data:

This study was conducted in three phases:

Phase-1:   It was done in two parts.

Review of policies, programmes, curriculum framework and ICT competency framework &

Review of Models and Frameworks developed by pedagogues and educationists for effective integration of digital technology in teaching-learning process and other related activities

Phase -2:   Review of related literature available through research papers

Phase -3:   Interviews conducted with twenty teacher educators from the teacher training institutions in Delhi

6.5.5 Data Analysis:

Thematic analysis technique was applied for analysing the data collected through the review of policies, programmes, frameworks, models, research reports and through interviews with teacher educators. Details of analysis are given below:

- Analysis of facts and information obtained through review of policies, programmes, curriculum framework and ICT competency framework regarding preparing teachers for integration of digital technology &
  Analysis of facts and information obtained through review of Models and Frameworks developed by pedagogues and educationists for effective integration of digital technology in teaching-learning process and other related activities

- Analysis of facts and information obtained through review of related literature available through the reports of research work

- Analysis of interviews with twenty teacher educators from the teacher training institutions in Delhi

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6.5.6 Delimitation of The Study:

The study is delimited to:

- Teacher education only
- Delhi only

6.6 MAJOR OBSERVATIONS AND FINDINGS OF THE STUDY:

This study was conducted in three phases. Therefore, major observations and findings of this study have been enlisted in three groups; Phase 1, Phase 2 and Phase 3

Phase 1) Major observations on the basis of review of policies, programmes, curriculum framework, competency framework, models and frameworks:

- Educational policies and programmes in India have given place to digital technology in its education system for making it effective since its introduction in education in India in 1980s. Policies and programmes adopted new trends in this field according to the need of the time.
- Provision of in-service training for teacher of school began with the CLASS project (1984).
- NPE (1986) recognised the potential of digital technology and proposed to utilize such technologies for spreading of useful information, training of teachers and improving quality of education.
- Programme of Action (PoA, 1992) made the provision to extend the facilities for CLASS.
- ICT@ school, 2004 (revised in 2010) had provision for mandatory training in use of ICT in teaching both for pre and in-service teachers.
- National Curriculum Framework (NCF, 2005) suggested to provide chance to teachers to get first-hand experience of creating programmes themselves with the help of technology and using them in their professional work.
- National Curriculum Framework for Teacher Education (NCFTE, 2009) recognized the potential of digital tools for professional development and for providing academic support to pre-service and in-service teachers and creating and promoting collaborative and supportive academic learning environment for

teachers. It suggested to develop "the centre for teacher resource and academic support".

- The UNESCO ICT Competency Framework for Teachers (2011) gave the direction to school education system and teacher education programmes worldwide by presenting this framework about expected ICT competencies for teachers.

- National Policy on Information and Communication Technology (ICT) In School Education (2012) categorized three levels of ICT competencies and emphasized to train teachers and students to take care of security measures related to use of internet.

- Draft: National Education Policy, (2019) proposed professional development programme for teachers' and mentors' through online education. It emphasized on evaluation of each digital tool by the teacher before utilizing.

- ICT in Education Curriculum for Teachers (2019) emphasized on achieving three levels of ICT competencies and the whole curriculum has been designed keeping in view these competencies.

- NISHTHA programme and DIKSHA portal for teachers under "Samagra Shiksha Scheme" were found as the latest initiatives to develop competencies and sharing knowledge for integration of digital technology

- All the five models/frameworks developed for effective integration of digital technology which were reviewed in this study were introduced according to the need of the time and each of these has its own unique feature.

- ASSURE model and ADDIE model were basically meant for instructional design which were utilized by researchers for planning instruction with integration of digital technology.

- In the course of time, with the advent of new technologies, teachers were required to be competent in various technological skills along with pedagogical skills. Therefore, a new framework was developed on the basis of Shulman's PCK framework, named as TPACK and widely accepted by researchers and pedagogues.

- SAMR model was meant for assessing the level of integration of digital technology in classroom process and utilized widely by the researchers and pedagogues.

- Generic model has emphasized on social learning along with pedagogy and technology which is a new trend in this field utilized now a days by the researchers.

Phase 2) Major observations on the basis of literature reviewed for this study

Five major themes were identified from twenty-eight relevant articles randomly selected for this study which were researched by pedagogues and other scholars working in this field worldwide:

- factors affecting integration of digital technology (most frequently researched theme)
- learning design, competency, level of integration and perception of teachers about training/learning (Second most frequent theme),
- using models and frameworks for effective integration of such technologies and to evaluate and improve digital competencies (third most frequent theme),
- Social learning and integration of digital technology (fourth most frequent theme), and
- policies, programmes and curriculum regarding preparing teachers for integration of digital technology {least searched theme; (reported by Bond et.al., 2018 also)}.

Phase 3) Major findings on the basis of analysis of information from primary sources:

- majority of the teacher educators reported lack of awareness regarding educational policies and programmes having facts and insights regarding preparing teachers for integration of digital technology and lack of information and knowledge about any of the two ICT competency framework (UNESCO's and NPICT in school education, 2012). None of the teacher educators utilized any competency framework for self-evaluation or for evaluating competencies of pupil teachers.
- All respondents were agreed that NCFTE and the curriculum/ syllabus utilized in their institution gave some input to guide towards integration of digital technology but inputs were not so clear.

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- Integration of digital technology in teaching- learning process and other professional activities was reported by all respondents. But it depended on self-motivation of the teacher as it was not mandatory to integrate digital technology in these activities. PPTs and videos were the most utilized tools by all teacher educators and pupil teachers in teaching-learning process in classroom.

- Lack of awareness regarding policies and programmes, lack of infrastructure, connectivity, access and internet facilities and lack of time were reported as the most common problem/barrier in the path of preparing teachers for integration of digital technology. All respondent faced problems more or less.

- Majority of the respondents reported no knowledge about models and frameworks developed by pedagogues and researchers for effective integration of digital technology. None of the respondents had utilized any model or framework for improving the integration of digital technology.

- Utilization of co-operative and collaborative learning methods for enhancing learning and improving learning outcomes was reported by all respondents and social media was being utilized by all of them, their colleagues, other teacher educators known to them and pupil teachers. Only 45% of the respondents were the members of professional learning community available through social media platform.

- Few respondents opined that integrating digital technology was beneficial only in education while majority of the respondents opined that it was both beneficial and harmful if not utilized critically.

- Total seventy-one tools were enlisted in this study utilized by respondents and their pupil teachers.

- Microsoft Word, Microsoft PPT, WhatsApp and google search were the most utilized digital tools by teacher educators and pupil teachers followed by YouTube for teaching- learning and other professional activities.

6.7 IMPLICATIONS AND CONCLUSION:

Educational policies and programmes have included digital technology among other key areas of development in the field of education. As these technologies are ever emerging, so, policies, programmes and curriculum frameworks have also adopted new tools and technologies and new trends in the field.

To identify new trends in the field of digital technology in education literature needs to be reviewed frequently. It helps to identify various themes of research related to new trends. Only planning, developing and implementing policies and programmes do not serve the purpose. It is essential to make the stakeholders aware about it, so that, they can utilize it properly to make its implementation effective. That is why this study conducted interview with teacher educators to understand about awareness among pupil teachers and teacher educators regarding these policies and programmes and implementation at ground level. Though, the facts and information obtained through the observations made through initial two phases of study based on reviews dealt with both pre-service and in-service teacher education, third phase was limited to pre-service teacher education only. Lack of awareness regarding policies, competency framework and, models and frameworks developed by pedagogues for effective integration of digital technology were reported through the findings of this study. Various problems faced by teacher educators and pupil teachers were also reported which would help others to prepare themselves to face and make efforts to solve such problems. Significance of social learning methods and role of social media for making it easy to learn was reported through the findings of this study which would motivate others to utilize them in their teaching and learning. All respondents utilized social learning methods to construct knowledge with the help of peer and teacher. The importance of collaborative learning and sharing knowledge were emphasized in various policies and programmes also in the context of constructing knowledge with the help of others or by seeing others while learning with or about digital tools and digital media. This is the essence of "Social constructivism learning theory". Therefore, it is emerged from the major observations through policies, programmes, literature review and findings from the primary sources that utilizing this theory of learning is relevant for preparing teachers for integration of digital technology. It was opined by majority of the teacher educators that provision of orientation programmes and sharing information and knowledge about policies, programmes, ICT competency framework and models would be quite helpful for preparing teachers for effective integration of digital technology. NISHTHA programme which is the new initiative by the Government of India towards it may prove helpful in this context. Major observations done through the review and analysis of policies, programmes, frameworks, models and research reports/ articles and documented in this study would help teacher educators, in-service teachers and pre-service teachers in preparing for effective integration of digital technology. Though,

this study was based on small sample size and interview method, it was quite helpful to develop knowledge and understanding of preparing teachers for integration of digital technology in real situation at ground level through pre-service teacher education. But, due to small sample size, findings cannot be generalized.

6.8 RECOMMENDATIONS FOR PLANNERS OF POLICIES, PROGRAMMES AND CURRICULUM FRAMEWORK:

- Proper orientation and training programme should be organised regularly after a certain period of time for all teacher educators, not only for teacher educators dealing with ICT as a subject, for providing them information and enriching their knowledge regarding policies, competency levels, competency framework and all new trends in this field and for developing required competencies.

- Policies should also be modified in this context due to ever emerging digital technologies.

- Curriculum framework for teacher education and syllabus for teacher education in concerned organizations should be modified according to the modifications in policies and new trends in this field.

- Ground level preparation should be done before implementing any policy, like, infrastructure should be made available for all the stakeholders, proper training should be given for operating and critically utilizing such tools and taking care of authenticity and cyber security.

- Maintenance, repair and replacement of tools should be done properly. Regular staff should be appointed in each teacher training institution for this purpose.

- Free access to online resources should be provided to teacher educators and pupil teachers through the organization.

- Pupil teacher should be trained for critical use of digital tools and to take care of various challenges in the form of health issues, cyber security, time management, digital wellbeing and authenticity of content and resources.

6.9 SUGGESTIONS FOR FUTURE STUDY:

- Similar interview-based study can be conducted in remote areas of the country.

- Comparative study can be conducted between teacher training institutions situated in developed area and remote area.

- Tool can be developed on the basis of findings of this study to conduct survey study on similar topic.

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Appendix-I

Tool for semi-structured interview

PART- I

Personal information of the respondents

Instructions: Kindly provide following information

(**Note:** Your views, experiences and information provided by you will be kept confidential and your identity will not be disclosed to anyone.)

Your Name:

_____

Signature:

_____

Designation (Asst. Professor/Associate Professor/ Professor/ Head of the organization/ Head of the teacher training programme/ others):

_____

College/ Institute/ University Department/ Other organization (with address)

_____

_____

_____

Contact No. (working place): _____

Mobile No. (Personal): _____

E-mail id: _____

Age group:

(i)below 25 years (ii) 25-30 years (iii)30-35 years (iv) 35-40 years (v) 40-45 years

(vi) 45-50 years (vii)50-55 years (viii) 55-60 years (ix)60 years and above

Gender (Male/Female/Transgender): _____

Subjects (taught):

_____

Courses (taught):

_____

Total years of Experience (Teaching & working in related area):

_____

Educational Qualifications:

_____

Have you received any ICT related formal training? Yes/ No

If Yes, Provide details:

_____

For how many years have you been using computers and ICT (in digital form)?

Less than 1 year	1-2 years	2-4 years	4-6 years	6- 8 years	8 - 10 years	More than 10 years	Do not use

Kindly provide information, your views and perception based on your working experience in the field of teacher education under following themes related to preparing teachers for integration of digital technology.

Themes for the interview:

Your views, experiences and information regarding ground reality of 'Preparing Teachers (both pre & in-service) for Integration of Digital Technology':

- Educational policies and programmes having insights on preparing teachers for integration of digital technology
- ICT Competency framework
- ICT and curriculum framework for teacher education
- Integration of digital technology in classrooms and other activities of teacher educators and pupil teachers at ground level
- Problems/ barriers faced by the teacher educators and pupil teachers & their solution (if any)
- Models and frameworks developed by pedagogues and researchers for making the integration of digital technology more effective
- Co-operative and collaborative learning and digital technology
- Social media and learning
- Using digital technology: beneficial or harmful or both
- Digital tools and technology frequently utilized by respondents

Part-II

Themes for the interview and questions asked during the interview under each theme:

- **Educational policies and programmes having insights on preparing teachers for integration of digital technology**

  1. Are teacher educators and pupil teachers informed and aware about educational policies and programmes having insights on preparing teachers for integration of digital technology? Kindly explain.

- **ICT Competency framework**

  1. Are teacher educators and pupil teachers, informed about ICT competency framework for teachers? Do teacher educators and pupil teachers use competency framework developed by UNESCO and CIET (given in New Policy on ICT in school Education, 2012) for self- evaluation for effective integration of digital technology? Kindly, explain.

- **ICT and curriculum framework for teacher education**

  1. Are teacher educators and pupil teachers informed about the curriculum framework for teacher education and does it guide for integration of ICT in teaching- learning process and other professional work of a teacher?

  2. Does the curriculum/syllabus for teacher education used in your institution provide clear guidelines for the integration of digital technology in teaching-learning process and other professional activities of a teacher?

- **Integration of digital technology in classrooms and other activities of teacher educators and pupil teachers at ground level**

  1. Do the teacher educators and pupil teachers of your college/institute/university and other similar institutions visited by you or known to you integrate digital technology in their professional work/tasks?

  2. How are digital technologies being used in teaching-learning process and other activities in teacher education to prepare teachers for integration of digital technology and what are the purposes for which digital technologies

are being used by the teacher educators and trainees of your institution and other similar institutions visited by you or known to you?

3. How does incorporating digital technologies in the classroom and other related activities outside the classroom affect students and their learning?

4. How does incorporating digital technologies in the classroom and other related activities outside the classroom affect teachers and teaching?

5. How can digital technologies be best used by teacher educators and pupil teachers to enhance learning?

- **Problems/ barriers faced by the teacher educators and pupil teachers & their solution (if any)**

  1. Do teacher educators and pupil teachers face problems/ barriers in the integration of digital technology in their teaching- learning process and other activities?

     Yes…………   No………
     If yes, then, please describe these problems/ barriers.

  2. Have you/your student/your colleague/any other person known to you find/developed a solution for them?

     Yes…………   No………
     If yes, then, please describe

- **Models and frameworks developed by pedagogues and researchers for making the integration of digital technology more effective**

  1. Do you, your colleagues and pupil teachers know about models and frameworks developed by the educationists, pedagogues and researchers for effective integration of digital technology?

  2. Do you, your colleagues and pupil teachers use any such model/framework for effective integration of digital technology? Kindly, explain.

- **Co-operative and collaborative learning and digital technology**

1. Do the teacher educators and trainee teachers of your institution follow social learning methods for effective learning, either face to face or with the help of social media platforms or both? Kindly, explain.

- **Social media and learning**

  1. Do the teacher educators and pupil teachers of your institution and other similar institutions visited by you or known to you use social media as teaching and learning tool? Kindly, explain (with examples, name of Apps. Etc.).

  2. Do the teacher educators and pupil teachers of your institution have created professional learning groups on social media platforms? Kindly, explain.

  3. Do you, your colleagues and pupil teachers of your institution take interest to be a member of larger professional learning communities through social media platforms? Kindly, explain. If possible, kindly, name those professional groups.

- **Using digital technology: Beneficial or harmful or both**

  1. What do you think about integration of digital technology in education?

    - it is beneficial
    - it is harmful
    - both beneficial and harmful
    - has no effect

    Please, explain

- **Digital tools and technology frequently utilized by respondents**

  1. What are the digital tools frequently utilized by you?