A Study on the Effectiveness of ICT Training on ICT competency, Reaction towards ICT and Confidence in using ICT of Teachers of Demonstration Multipurpose Schools (DMS)

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DECLARATION

I declare that this research entitled **"A Study on the Effectiveness of ICT Training on ICT competency, Reaction towards ICT and Confidence in using ICT of Teachers of Demonstration Multipurpose Schools (DMS)"** has been taken up as a part of the **Development of model for ICT integrated school** system under PAC Project.

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Chapter 1: Introduction

1.1 Background:

The swift pace of the technological revolution has brought about a rapid transformation in society as technology is influencing the field of education as most of the other spheres of our day to day lives opening a vast realm of possibilities, including but not limited to enhancing and transforming learning by successfully integrating ICT into the day to day practice of teaching and learning. Undertaking this immense task requires rethinking the role of teachers in planning and applying ICT by regularly updating and reforming teacher training (both in-service and pre-service) and focussing on professional development, to ensure that all teachers can harness technology for education. To be able to achieve this transformation in both teacher training and hence, school education, first it's important to recognize what constitutes competency then delve deeper to identify what comprises ICT competency of a school teacher. Competency is defined in diverse ways by different people, like, it's defined as "the set of knowledge, skills, and experience necessary for the future, which manifests in activities" (Katane et.al. 44).

Sampson & Fytros (2008), defines it as the "..skills, knowledge and attitude that an individual person needs to acquire, in order to perform an activity, within a specific context, whereas performance may range from the basic level of proficiency to the highest levels of excellence."

ICT Competency on the other hand, according to Potter and Darbyshire (2005) and UNESCO (2004), is defined as-

- Knowing when & how to apply or develop a particular skill in using an ICT resource
- Being aware of the reasons for using ICT and its effect on both users and context, and
- Having a critical and confident attitude towards learning with technology.

While the UNESCO ICT Competency framework for teachers says the following about it, "Digital Competence can be broadly defined as the confident and creative use of ICT to achieve goals related to an activity".

This study aims to compare some of these proficiencies, namely, use of ICT in teaching-learning, Basic Computer Operations and Devices, Office and Teaching Productivity tools, Internet and Network Application, Information and Data Management, Confidence in using ICT, Skill of Technology Operations and Concepts and Overall Perception of use of ICT in Teaching-Learning. Along with these ICT skills, the study also tries to compare the competencies required to employ these skills in the classroom to achieve the goals of ICT integration into teaching-learning, meaning Social and Ethical Values as well as teacher's Pedagogical and Professional Skills.

1.1.1 ICT and 21st Century Skills:

Twenty first century skills refers to the skills and abilities that a person needs to survive and contribute productively in today's world. Most of these 21st Century skills are such that they are inextricably linked to the demands of ICT integrated pedagogy required in current times to prepare conscientious & critical citizens with a penchant for gaining knowledge and skills

throughout their lives. Therefore, it's necessary to explore what an ICT incorporated Education looks like and how it can be achieved by overcoming the obstacles/challenges which has until now hampered it from reaching its full potential.

1.1.2 Integrating ICT in Education:

Integrating ICT in Education depends on the teachers ability and skills to integrate ICT in their pedagogy. The objective of integrating ICT in Education is to create an inclusive learning environment where all students can learn and become productive citizens. CT integration in education have the potential to transform the education system by improving the quality, access and efficiency of the education.

1.2 Rationale of the study

In order for teachers to be able to teach the 21st-century skills required to function productively & efficiently in a technologically oriented society, teachers not only need to learn basic computer skills but also need to develop proficiency in using a variety of tools for problem-solving, generation of new knowledge as well as taking informed decisions. Although our education system and educators have long since accepted and deemed compulsory the need for integration of technology with educational pedagogy, it's starkly visible that this acknowledgement has not been able to bring any significant change towards the betterment of the situation. After so many years of implementation, it's necessary to take a measure of where such programs have been successful and which institutions are struggling, based on some predefined & sufficiently substantiated (through a range of national & international research studies) criterion, which will open the doorway to the provision of much needed targeted support to such grappling institutions. This study is one such attempt to compare some of these pre-identified essential ICT competencies to take measure/to assess which institutions are faring better and which ones need more help to come at par to the standards demanded for taking a leadership role to create a technology-integrated classroom.

1.3 Statement of the Problem:

A Study on the Effectiveness of ICT Training on ICT competency, Reaction and Confidence in using ICT of Teachers of Demonstration Multipurpose Schools (DMS)

1.4 Objectives of the Study:

The following were the Objectives of this study:

1. To compare adjusted means scores of Reaction toward Use of ICT in Teaching-Learning of Teachers belonging to Ajmer, Bhopal, Bhubaneswar and Mysore Demonstration Schools by considering Pre- Reaction towards Use of ICT in Teaching-Learning as covariate.
2. To compare adjusted means scores of Reaction toward Basic Computer Operations and Devices of Teachers of Ajmer, Bhopal, Bhubaneswar and Mysore Demonstration Schools by considering Pre- Reaction toward Basic Computer Operations and Devices of Teachers as covariate.
3. To compare adjusted means scores of Reaction toward Office and Teaching Productivity Tools of Teachers of Ajmer, Bhopal, Bhubaneswar and Mysore Demonstration Schools

by considering Pre- Reaction toward Office and Teaching Productivity Tools of Teachers as covariate.

4. To compare adjusted means scores of Reaction toward Internet and Network Application of Teachers of Ajmer, Bhopal, Bhubaneswar and Mysore Demonstration Schools by considering Pre- Reaction toward Internet and Network Application of Teachers as covariate.
5. To compare adjusted means scores of Reaction towards Information and Data Management of Teachers of Ajmer, Bhopal, Bhubaneswar and Mysore Demonstration Schools by considering Pre- Reaction toward Information and Data Management of Teachers as covariate.
6. To compare adjusted means scores of Confidence in Using ICT by Teachers belonging to Ajmer, Bhopal, Bhubaneswar and Mysore Demonstration Schools by considering Pre-Confidence in Using ICT by Teachers as covariate.
7. To compare adjusted means scores of Skill of Technology Operations and Concepts of Teachers belonging to Ajmer, Bhopal, Bhubaneswar and Mysore Demonstration Schools by considering Pre- Skill of Technology Operations and Concepts of Teachers as covariate.
8. To compare adjusted means scores of Social and Ethical Values of Teachers belonging to Ajmer, Bhopal, Bhubaneswar and Mysore Demonstration Schools by considering Pre-Social and Ethical Values of Teachers as covariate.
9. To compare adjusted means scores of Pedagogical Skills of Teachers belonging to Ajmer, Bhopal, Bhubaneswar and Mysore Demonstration Schools by considering Pre-Pedagogical Skills of Teachers as covariate.
10. To compare adjusted means scores of Professional Skills of Teachers belonging to Ajmer, Bhopal, Bhubaneswar and Mysore Demonstration Schools by considering Pre-Professional Skills of Teachers as covariate.
11. To compare adjusted means scores of Overall Perception of use of ICT in Teaching – Learning of Teachers belonging to Ajmer, Bhopal, Bhubaneswar and Mysore Demonstration Schools by considering Pre- Overall Perception of use of ICT in Teaching – Learning of Teachers as covariate.

1.5 Hypotheses

The following were the Hypotheses of this study.

1. There is no significant difference in adjusted means scores of Reaction toward Use of ICT in Teaching-Learning of Teachers belonging to Ajmer, Bhopal, Bhubaneswar and Mysore Demonstration Schools by considering Pre- Reaction towards Use of ICT in Teaching-Learning as covariate.
2. There is no significant difference in adjusted means scores of Reaction toward Basic Computer Operations and Devices of Teachers of Ajmer, Bhopal, Bhubaneswar and Mysore Demonstration Schools by considering Pre- Reaction toward Basic Computer Operations and Devices of Teachers as covariate.
3. There is no significant difference in adjusted means scores of Reaction toward Office and Teaching Productivity Tools of Teachers of Ajmer, Bhopal, Bhubaneswar and Mysore

Demonstration Schools by considering Pre- Reaction toward Office and Teaching Productivity Tools of Teachers as covariate.

4. There is no significant difference in adjusted means scores of Reaction toward Internet and Network Application of Teachers of Ajmer, Bhopal, Bhubaneswar and Mysore Demonstration Schools by considering Pre- Reaction toward Internet and Network Application of Teachers as covariate.
5. There is no significant difference in adjusted means scores of Reaction towards Information and Data Management of Teachers of Ajmer, Bhopal, Bhubaneswar and Mysore Demonstration Schools by considering Pre- Reaction toward Information and Data Management of Teachers as covariate.
6. There is no significant difference in adjusted means scores of Confidence in Using ICT by Teachers belonging to Ajmer, Bhopal, Bhubaneswar and Mysore Demonstration Schools by considering Pre- Confidence in Using ICT by Teachers as covariate.
7. There is no significant difference in adjusted means scores of Skill of Technology Operations and Concepts of Teachers belonging to Ajmer, Bhopal, Bhubaneswar and Mysore Demonstration Schools by considering Pre- Skill of Technology Operations and Concepts of Teachers as covariate.
8. There is no significant difference in adjusted means scores of Social and Ethical Values of Teachers belonging to Ajmer, Bhopal, Bhubaneswar and Mysore Demonstration Schools by considering Pre- Social and Ethical Values of Teachers as covariate.
9. There is no significant difference in adjusted means scores of Pedagogical Skills of Teachers belonging to Ajmer, Bhopal, Bhubaneswar and Mysore Demonstration Schools by considering Pre- Pedagogical Skills of Teachers as covariate.
10. There is no significant difference in adjusted means scores of Professional Skills of Teachers belonging to Ajmer, Bhopal, Bhubaneswar and Mysore Demonstration Schools by considering Pre- Professional Skills of Teachers as covariate.
11. There is no significant difference in adjusted means scores of Overall Perception of use of ICT in Teaching – Learning of Teachers belonging to Ajmer, Bhopal, Bhubaneswar and Mysore Demonstration Schools by considering Pre- Overall Perception of use of ICT in Teaching – Learning of Teachers as covariate.

1.6 Operational Definition of Key Terms

1. **ICT Competency:** Digital Competence refers to the confident and creative use of ICT to achieve goals related to an activity. In this study skill of Technology Operations and Concepts are compared.
1. **Reaction towards ICT**: Reaction toward ICT refers to the way that teachers respond towards use of ICT. In this study, the reaction of teachers towards the use of ICT in teaching-learning, Basic Computer Operations and Devices, Office and Teaching Productivity tools, Internet and Network application, Information and Data Management are compared.
2. **Confidence of Teachers in Using ICT:** Confidence in using ICT refers to teachers' self perceptions about their ICT skills and the ease with which they can use ICT.

1.7 Delimitations:

1. Teachers who have have volunteered themselves are the part of the sample
2. Sample was selected on the basis of criterion. The study is delimited to teachers who have an active stake in ICT integrated education.

CHAPTER 2: REVIEW OF RELATED LITERATURE

2.1 ICT (Information and Communication Technology)

ICT has in a very short span of time become a basic building block of modern society (Daniel, 2002). UNESCO (2002) defines Information and Communication Technology as a scientific, technological and engineering discipline and management technique used in handling information, its application and association with social, economic and cultural matters. Based on the extensive work & reports of such internationally acclaimed organizations on ICT, the government of India came up with its own National policy on Information and Communication Technology in school education (MHRD, 2012), which defines ICT as all digital devices, tools, content, resources, forums and services, which can be deployed to realize the goal of teaching-learning, enhancing access to educational resources, build the capacity of learners and also help in the overall management of the education system. This definition of ICT not only encompasses hardware but also software applications including interactive digital content repository, interactive forums, learning management systems and management information systems.

In the last few decades ICT has become such an integral part of our lives that it is not just affecting the society at large but our day to day lives as well (Bhattacharjee & Deb, 2016). Among those which faced the most radical transformations due to evolving technology, is the field of Education, where ICT became an integral part of the teaching-learning processes. It is by far one of the most consequential fields to be affected by this onslaught of technology, undoubtedly affecting not only teaching, learning but research as well (Yusuf, 2005).

Over the years, the field of education has seen several paradigm changes one after another, each one fundamentally changing the way we conceptualize not only learner & learning but content knowledge, pedagogy and research as well. ICT is one such force, emerging quickly and impacting everything in its path but they distinguish themselves from other technologies and paradigm changes in one fundamental way, by their rapid evolution, defeating attempts to define a curriculum which can serve the schools for a while (Curricula for ICT in Education, 2017). ICT's popularity & widespread acceptance in all aspects of education can be largely credited to its potential of enriching the system of education by supplementing the teaching-learning process, enhancing the Quality and Accessibility of Education, cultivating a refined learning environment, increasing learning motivation by creating an engaging schooling process all of which inevitably culminates in augmenting student's scholastic performance (Kapur, 2019).

This broad national & international recognition of the influence of ICT has forced governments of many nations (including India) to come up with policies and documents acknowledging & formalizing the significance that ICT has gained in our day to day lives by making it a part of our official curriculum and pedagogy. With the convergence of technologies at this scale, it has become imperative to take a comprehensive look at all possible information and communication technologies for improving school education in the country (National Policy on ICT In School Education, 2012). Governments' increased focus on digital competences and technology in school curricula requires the teachers to accept and update their own classroom

practices (Siddiq, Scherer & Tondeur, 2016). But the limitation of the Government's approach became evident when the technology integration initiative presented, showed that it was only designed to provide support to schools in augmenting their technology infrastructure. Working to improve on this, later the government of India brought the teaching skills initiative which recognized that there was less emphasis in making use of computers in schools, unless the teachers were well-equipped with technical skills (Kapur, 2019).

2.2. ICT and 21st Skills

Effective integration of ICT in education requires 21st-century knowledge and application abilities, of skills such as critical thinking, problem-solving, collaborative and leadership, adaptability, accessing and analyzing information, curiosity and imagination (Saavedra & Opfer, 2012) which are also identified by Moersch (2011) as learning innovative skills, information-based learning, media & technology skills and life & career skills.

Lim & Oakley (2013) also endeavored to define 21st-century skills as Generic competencies, which he deems necessary for living along with competencies such as accessing information, communicating, building knowledge, problem-solving, representing ideas, creating and developing ideas, collaborating, and learning how to learn.

2.3. Integration of ICT with Education

Traditionally teaching emphasis in classrooms has always been on content but now gradually the focus has shifted towards skills and competencies, which requires a curriculum that allows accessing of a variety of knowledge, student-centered practices, problem-solving and inquiry-based activities, teachers like mentors/coaches rather than content experts (Oliver, 2002). In short, this current technological revolution has reached all social classes and its educative use by teachers has not gone unnoticed (Gamez, Fernández, Bravo & Ortiz, 2020).

The primary motivation for integrating ICT in education is this belief that it supports students in their own constructive thinking, allows them to transcend their cognitive limitations, and engages them in cognitive operations that they may not have been capable of otherwise (Salomon as cited by Lim, 2007). Keane & Keane also substantiate this claim with the conclusions of their own study stating that when ICT is integrated with education it enables students to learn lifelong, personalises learning which empowers, creates collaboration and communities to learn & communicate.

Lim (2006) studied the pedagogical practices in the ICT learning environment and came to the same conclusion that it engages students in higher-order thinking and identifies ICT tools which affect the integration of ICT with education. This study provided a set of tools for effective use of ICT including CD-ROM, Internet, data logger, and open tools like a word processor, spreadsheet, geometric sketch pen and presentation applications. According to this study, the effective learning environment includes according to this study, ICT tools which include funds allocated to schools for ICT resources, the masterplan for ICT education such as teacher-student ratio and adequate ICT resources and interview, Disciplinary rules which include brief rules to use a computer in the computer room, educational rules which include the demonstration to use ICT tools, ICT- mediated lessons, a checklist to support the use of teachers, division of labor among participants which includes teachers instead of trying to solve

a technical problem by themselves taking help from a technical assistant. Students are assigned roles as the group leader or group member. Another study asserts that ICT not only increases the attention of students but also helps them to learn better, solve complex problems, enhance communication skills & cognitive skills (Agbo, 2015). ICT helps them to become an independent learner, where they can learn on their own by exploring various resources provided by technology. In the contemporary world, ICT becomes a tool which helps the student to move from assistance learning to independent learning. There have been a number of studies apart from the ones discussed above, substantiating these same claims, not all of which could be included in the limited scope of this review.

But this widespread acknowledgement of the relevance of technological assistance in education doesn't mean that this transition has been smooth or uneventful. There have been a number of factors impeding the wholesale uptake of ICT in education across all sectors. These have included such factors as a lack of funding to support the purchase of the technology, a lack of training among established teaching practitioners, a lack of motivation and need among teachers to adopt ICT as teaching tools (Starr as cited by Oliver, 2002). Or as mentioned by Bingimlas (2009) lack of confidence, lack of competence, and lack of access to resources. "But in recent times, factors have emerged which have strengthened and encouraged moves to adopt ICTs into classrooms and learning settings. These have included a growing need to explore efficiencies in terms of program delivery, the opportunities for flexible delivery provided by ICTs (eg. Oliver & Short, 1997); the capacity of technology to provide support for customized educational programs to meet the needs of individual learners (eg. Kennedy & McNaught, 1997); and the growing use of the Internet and WWW as tools for information access and communication (eg. Oliver & Towers, 1999)" (Oliver, 2002).

2.4. Teacher ICT Competency

The process to integrate information and communication technologies (ICT), where teachers play a decisive role, is complex (Rodríguez, Almerich, Orellana & García, 2018). Several studies have been done over the years exploring what constitutes the ICT Competencies Competences of Teachers and to what extent can it be found in the schools currently.

A study done by Li, Yamaguchi, Sukhbaatar & Takada (2019) titled the 'The Influence of Teachers' Professional Development Activities on the Factors Promoting ICT Integration in Primary Schools in Mongolia' which contradicting most others, claims that six teacher level factors that are important for the ICT integration have been improved over time through professional development activities. These are professional competency in the educational use of ICT, collaboration for ICT integration, benefits on the use of ICT, autonomy to innovate, recognition as a professional, and skills and practices in the educational use of ICT. But the reverse of this conclusion has been proven through a number of other studies discussed below.

The results of the study "Primary Teachers' Technological, Pedagogical and Content Knowledge" (Vila, Andrés & Medrano, 2015) showed that teachers are more knowledgeable in the pedagogical and content fields than in technology, which means that their level of technical knowledge does not suffice to integrate ICTs into their teaching tasks. Solesa (2011) also agrees that teachers and educators do not have the ICT competencies developed as their basic knowledge of ICT acquired during their education is very poor. For many teachers as

well as policymakers the relevance of technological interventions in itself is a controversial or debatable issue to this day. As many feel torn between the claim of technology being the basis of all human evolution & survival and the belief that the incorporation of technology in a field like education will end up severing the roots of our traditional cultural values from our young generations. As supported by (Watson, 2003) which states that "In this climate of educational and societal change surrounding the introduction of ICT, the teacher often falls between two classifications - that of a conservative resistor of change, and that of a pioneer and interpreter of change". Teacher's believing in the latter may feel that the demand to use ICT is unwarranted as they are already doing a good enough job and are unclear about what this would contribute to their classrooms. Besides, using these interventions demand from them their time and a set of tools which either/ or they didn't ask for or don't know how to use (Lawrence and Veena, 2012).

But there still exists a technological gap between the progress of the society and instructional activities of the teacher in the classroom (Bhattarjee & Deb, 2016). As the teacher, as a key element in the integration process of ICT, still does not feel trusted in this process. One of the most outstanding causes of this deficit in confidence is the lack of teaching staff competence in the ICT (Suárez, Almerich, López and Aliaga, 2010).

One of the main reasons for the existence of this gap is that there still prevails the "misconception that ICTs generally refers to 'computers and computing-related activities' (Noor-ul-Amin). However, not only the current UNESCO ICT Curriculum Framework for teachers and ISTE Standards for educators but most of the preceding documents have also outlined a more inclusive and comprehensive set of standards that are deemed desirable in an ICT capable teacher. In accordance with which "launch of many professional development programs to train teachers to use ICT" (Khan & Hasan, 2013) has taken place nationwide at different levels (State & Centre). Considering the fact that it would allow teachers to gain access to new knowledge and skills, improve educational resources, overcome the traditional isolation of teachers and create individualized training opportunities (UNESCO Bangkok, 2004).

Hence, it is agreed on by most of the international and national standards that to overcome the above-mentioned gap between the nostalgia of traditional classroom practices making teachers cling to the old ways/pedagogy and the altogether natural desire/ yearning to move forward with the rapidly evolving world of pedagogy merged with technology, it's important to converge our focus on the competencies and the extent of those competencies that a teacher is able to develop pre-service or in-service which is exactly what this study is trying to do.

Catching-up with the fast pace of expectations of policymakers and other stakeholders of education regarding the technological integration of classroom learning with traditional pedagogy requires teachers to constantly adapt to new technologies and refine their competencies. Besides, the increased focus on digital competences and technology in school curricula requires the teachers to accept and update their own classroom practices. But updating teacher competencies requires teachers and teacher educators to have a clear idea of what these entail and to tackle this obstacle over the years, several well researched national & international guidelines and frameworks with extensive details of what all can be included, have been

released. Some which are discussed below along with the independent and derived studies from these well-established / prominent documents.

2.4.1 UNESCO ICT Competency Framework for Teachers

While talking about Teacher's ICT Competency in education perhaps the first landmark document that we have to acknowledge is the **UNESCO ICT Competency Framework for Teachers (UNESCO ICT CFT), Version 3 (2018)**. This document, according to the sustainable development goals for 2030, recognizes the ubiquity of Information & Communication Technology in the attainment of these goals as "...technology has the potential to provide innovative solutions to enable learners to take part in quality lifelong learning opportunities, to access information and knowledge and fully participate in society." (UNESCO ICT CFT, 2018). This framework lists 18 competencies that an educator should have, clubbed under six aspects of teacher's professional practice over three levels of teachers' pedagogical use of ICT including, Understanding ICT in Education Policy; Curriculum and Assessment; Pedagogy; Application of Digital Skills; Organization and Administration; and Teacher Professional Learning.

According to the framework, the ICTCFT is organized over three successive levels of a teacher's development in integrating ICT with pedagogy. The document provides a number of specific competencies that the experts of each of these levels should hold. But due to the limited nature and scope of this study, this review will only discuss those competencies which comecomes into the purview of this research.

In all three levels, **Knowledge Acquisition**, **Knowledge Deepening** and **Knowledge Creation** educators are expected to master various skill sets and competencies including but not limited to acquiring knowledge about using technology & basic ICT competency, enabling teachers to facilitate learning environments that are student-centered, collaborative and cooperative in nature by acquiring suitable ICT Competencies i.e., pedagogical skills etc.

These levels give a comprehensive framework which encompasses all the objectives of this study within one stage or the other. But mostly the essence of the study lies at the intersection of the knowledge acquisition level and Teacher Professional Learning, Application of Digital Skills and Pedagogical aspects.

An older version of the same document, 'UNESCO ICT competency standards for teachers (2008)', states that a teacher should enhance learning with technical support. Each subject should be taught with technology-rich experiences. A teacher should effectively use resources like digital and open educational resources, interactive computer simulations, data gathering, and assessment tools, etc.

From the above-mentioned framework (the UNESCO ICT Teacher Competency framework) emerged a study 'ICT Competency Level of Teacher in the MUST' which aimed at exploring the landscape of Mongolian teachers' ICT Competency level. The study revealed that the ICT Competency level of the respondents is in the knowledge deepening approach. On the basis of the findings, certain suggestions were put forward by the author claiming that there is a need to improve the level of competency, particularly skills in using complex and pervasive ICT tools to achieve innovative teaching and learning. Among other things, these recommendations

included that the teachers must understand the intentions of national policies and be able to contribute to the discussion of education reform policies and participate in the design, implementation, and revision of programmes intended to implement these policies, they should also know how to design ICT-based knowledge communities and use ICT to support the development of students' knowledge creation skills and their continuous, reflective learning. And lastly, they too must have the ability, motivation, inclination, encouragement and support to experiment, continuously learn and use ICT to build professional learning communities working toward creating knowledge (Khashkhuu, 2017).

2.4.2 International Society for Technology in Education (ISTE)

Another set of standards providing a comprehensive guideline for organizations/ institutes and governments all over the world for curriculum development & implementation ideas is the International Society for Technology Education (ISTE).

International Society for Technology in Education (ISTE) maps out 24 goals subsumed into 7 larger ones. These 7 goals aim to prepare an educator on the following fronts- Leader, Learner, Citizen, Collaborator, Designer, Facilitator and Analyst. Each of these categories entails certain skills and attitudes that an Educator needs to develop to gain mastery over the standards set by ISTE and successfully achieve ICT into one's teaching practice. Some of these skills demand educators to continually improve their practice by learning and exploring proven & promising practices that leverage technology to improve student learning or to facilitate learning with technology to support student achievement of the ISTE Standards for Students etc.

This study focuses mainly on comparison of educators' development on the front of **Learning & Facilitation** of teachers by evaluating a set of criteria included in an educator's quest for learning and proficiency in teaching, namely, the Use of ICT in Teaching-Learning, comparison of expertise in using Basic Computer Operations and Devices, Office and Teaching Productivity Tools, Internet and Network Application, Information and Data Management, Confidence in using ICT, Skill of Technology Operations and Concepts, Social and Ethical Values regarding the use of ICT, Pedagogical & Professional Skills and lastly, the Overall Perception of use of ICT in Teaching-Learning.

The study 'A basic model of integration of ICT by teachers: competence and use' was done with the goal of building a basic model that connects teachers' ICT technological and pedagogical competencies with the use of these technological resources by teachers. "This model explores a complex relation between competence and use. Technological competences influence pedagogical competences and personal-professional use, while pedagogical competencies influence personal-professional use and use in class. Use in class is influenced by both pedagogical competences and personal-professional use. Personal and contextual factors influenced the four dimensions of use and competence" (Rodríguez, Almerich, Orellana & García, 2018).

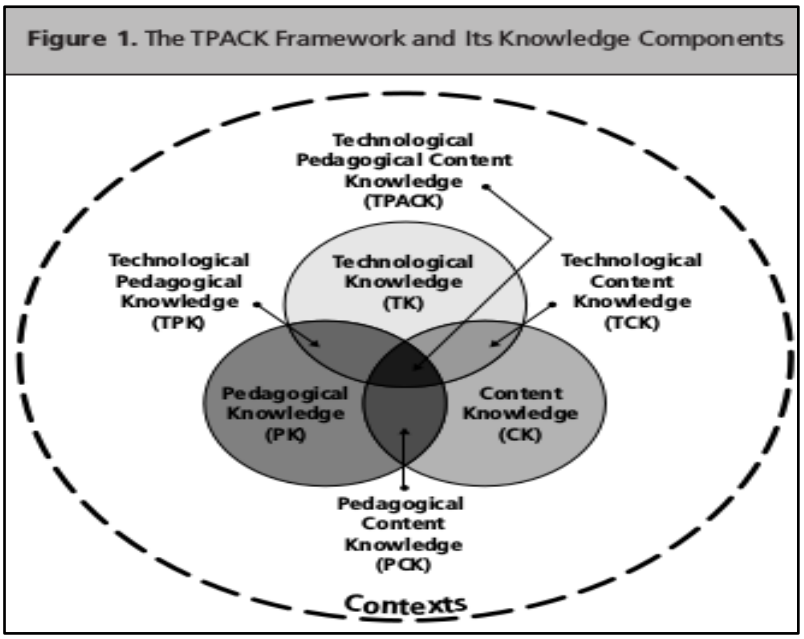
On the basis of the analysis of educators' competencies developed by these two major organizations, ISTE and UNESCO, Lawrence A.K.A. and Veena K. in their study "Improving Teacher Competency Through ICT" describes ICT competency as a set of technology standards that define proficiency in using computer technology in the classroom and grouped

it into four general domains, namely, Basic Technology Operation, Personal and Professional Use of Technology Tools, Social**,** Ethical**,** and Human Issues, and Application of Technology in Instruction.

Another research studying the same phenomenon, analyzed both policy and practice, with the aim to explore teachers' enacted digital competence was undertaken by Olofsson, Fransson & Lindberg (2019). After collecting data through interviews with teachers and classroom observations, the study concluded that teachers' adequate digital competence is flexible in meaning, determined by local contextual conditions and enacted in activities and decisions that are based on the teachers' own value frameworks.

Similarly another study 'Teaching of Relationship between the digital competencies of primary school teachers and the educational use of technology in the classroom' identified three groups of competencies on the basis of the data obtained. These 3 competencies are basic technological, pedagogic and complex technological with a major presence of the first one followed by the pedagogic competencies and finally, the complex technological competencies (D'uniam, Campos & Badia, 2014). A similar set of categories were identified as the result of another study, 'Teachers' information and communication technology competences: A structural approach', it indicated that teachers' ICT competencies form a unique set composed of two subsets, technological competences and pedagogical competences and technological competences influenced the pedagogical ones. Moreover, the study also found that personal and contextual factors have a relevant impact on the competence subsets and, hence, must be considered when designing training plans (Almerich, Orellana, Suárez & García, 2016).

This successful integration of technology with teaching stressed repeatedly by international & national frameworks and curriculum for ICT remains elusive and superficial unless we consider the Technological Pedagogical Content Knowledge (TPACK) framework of teacher training. This framework is based upon a complex interaction among three bodies of knowledge: content, pedagogy, and technology. "It is the basis of effective teaching with technology, requiring an understanding of the representation of concepts using technologies; pedagogical techniques that use technologies in constructive ways to teach content; knowledge of what makes concepts difficult or easy to learn and how technology can help redress some of the problems that students face; knowledge of students' prior knowledge and theories of epistemology, and knowledge of how technologies can be used to build on existing knowledge to develop new epistemologies or strengthen old ones" (Koehler, Mishra & Cain, 2013).



Source: What is Technological Pedagogical Content Knowledge? (Koehler, Mishra & Cain, 2013)

Husain (2010), in the study titled 'Teacher Competencies for the Use of Information Communication Technology', studied the competencies needed by teachers for the development and implementation of ICT-based education. By surveying 73 teachers on the basis of a 47 items based rating scale he concluded that teachers need to develop the competency to use ICT skills in developing and presenting information, the ability to recognize when and how to apply ICT to the solution of problems. Another finding of this study states that teachers need to develop three main pedagogical ICT competencies on a priority basis and these competencies are preparation of ICT-based learning environment, designing and creating rich & effective learning environments with the support of ICT and understanding of computer technology which can enhance student learning.

Lastly, the study listed another interesting finding that teachers need to develop two main social ICT competencies on a priority basis and these competencies are: (1) Demonstrating knowledge and skills for using technology in ethical, legal and safe ways and (2) Able to use humor and good manners during the teaching and learning process.

Most of the studies and frameworks of digital competence of teachers discussed up till now, according to Pettersson (2017), shows the trend that although research on digital competence in educational contexts has increased, knowledge on digital competence related to organizational infrastructures and strategic leadership are sparse. Moreover, And most research focuses on the specific competence needed by teachers and therefore tends to neglect the influence of broader contextual conditions in the wider school setting.

2.4.3 Teacher Education

The above-listed documents and studies only details what should comprise the specifics of a teacher's digital competence. However, these competencies can only be mastered & brought into practice when it is translated into teacher education so that the development of digitally

competent teachers can become a reality. As supported by Dagdilelis & Xinogalos (2012) as well as Botturi (2019), both of whom assert that successful integration of Digital & Media Literacy in classroom practice requires a well-organized training of teachers starting from pre-service education only. Whatever knowledge or skills that the student-teacher does exhibit is largely self-taught and, so, there is an urgent need to purposefully incorporate relational and didactic aspects of ICT integration (Fraile, Vélez & Lacambra, 2018). It's important then to ask what is really known about the use of ICT for pedagogical and didactic purposes in teacher education programmes? Evidence suggests that teacher education institutions and programmes still have a long way to go before they fully integrate digital competence into their practice.

Most of the earlier, organized, nationwide attempts to link technology with education stood in isolation from the broader teacher competencies and focussed on the development of technological skills in an educator so that they can disseminate what they have learnt. In turn, most of the teacher training institutes also ignored the competencies required to improve the integration of ICT into a teacher's professional practice. Even today, a large number of the teacher training institutes don't have the provision of ICT education and some that do, have put it in the syllabus as an elective part of the course. And even that elective is more an accreditation requirement. In general, necessary conditions for ICT integration in teaching and learning exist within the colleges, however, the pedagogical aspects of teacher preparation for ICT-based teaching are not emphasized enough (Goldstein, Waldman, Tesler, Baruch, Shonfeld, Mor, Heilweil, Zelkovitz., Zidan & Kozminsky, 2011). This lack of connect has forced the policy interventions at the in-service level to exist in the air without the ground support required to fulfill the goals of these ambitious policy mediations. And therefore, it's important to have a look at the reason for these unsuccessful attempts as well as the extent to which these have been lucrative in enriching the personal as well as professional technological literacy of educators (Lawrence and Veena, 2012).

Although there have been many education reforms regarding teachers' training policy in recent years and the number of training programs has been increased, they have not been able to satisfy teachers' needs to achieve expertise in ICT integrated subject teaching to any substantial degree (Kalogiannakis, 2010). Studies show a clear lack of knowledge among Student-Teachers about certain technological concepts essential for their future teaching work (Gómez-Trigueros, Ruiz-Bañuls & Ortega-Sánchez, 2019).

Therefore, student teachers are most likely not prepared to integrate the fostering of mandatory digital competence in their subject teaching even when they graduate. Thus digital competence is often neglected or reduced into more shallow and instrumental activities, like learning to use the computer or searching the Internet (Ottestad, Kelentrić & Guðmundsdóttir, 2014). Still, there is a general consensus among researchers and policymakers, that the professional teacher is a key figure for the successful implementation of digital technologies in schools. Many expectations have been placed upon professional teachers regarding the implementation and use of digital technologies (Engen, 2019).

Assessing the extent of Teacher Digital Competences poses a challenge seeing its multidimensional nature, therefore, it needs a multi-pronged approach along with a carefully curated instrument to accurately measure the knowledge of preservice teachers, to which end

a study was conducted aimed at designing and developing an instrument for TDC evaluation through a standard based on validated benchmark indicators. The results indicated that the test is well designed and consistent with its intended purpose (Cantabrana, Usart & Gisbert, 2019). This tool has been used in this review to get an idea of how the extent of Teacher Digital Competencies are measured and what are the criteria used for its measurement.

An increasing trend of digitalization in education has led to the proposal of a number of formalized phenomena. The most prominent among which lies at the intersection of digital competence and teacher pedagogy and is known as Pedagogical Digital Competence (PDC). Several reports, frameworks, and research projects reveal that teachers, teacher educators, and future teachers must possess a professional digital competence- a term that has been constructed and debated in a number of recent publications (Tømte, Enochsson, Kårstein & Buskqvist, 2015). The term is defined as the ability to consistently apply the attitudes, knowledge and skills required to plan and conduct, and to evaluate and revise on an ongoing basis, ICT-supported teaching, based on theory, current research and proven experience with a view to supporting students' learning in the best possible way, which can develop the more experienced a teacher becomes (From, 2017).

Tømte, Kårstein and Olsen (2013) found that the development of professional digital competence all over is weakly instituted at the management level of teacher education programmes and that most programmes lack a comprehensive approach to the development of such skills. Another study done with the aim of focussing on the integration of professional digital competence in initial teacher education programmes showed that there are weak positive correlations between positive management, management's development support, and teacher educators' digital competence, but stronger positive correlations between teacher educators' self- reported efficacy and digital competence (Instefjord & Munthe, 2017). But at the same time some remedial action research studies have successfully concluded that "..despite the limited space in the curriculum and resources available, even a short course can make a difference and enable teachers to integrate Digital & Media Literacy in their profession" (Botturi, 2019).

In an effort to answer this widely debated question, Lund, Furberg, Bakken & Engelien (2014) in their study 'What Does Professional Digital Competence Mean in Teacher Education?' tries to conceptualize what Professional Digital Competence really means in the teaching profession and what can be the consequence of its integration in teacher education. They argue the necessity of viewing PDC as comprising a deep understanding of technology, knowledge of students' learning processes, and an understanding of the specific disciplinary practices and features characterizing individual school subjects. Teacher education, on the one hand, needs to focus on the aspects of digital technologies that are generic to the teaching profession of equal importance though, is that teacher education also must be sensitive to the more specific disciplinary practices and features characterizing each individual school subject. When these two dimensions are combined and used to design and enact learning activities, we arrive at a truly integrated approach to Professional Digital Competence, where the scientific disciplines, the professional disciplines (pedagogy and subject didactics), and practices add up to a coherent whole.

However, the level of PDC that teachers have on these Learning Management Systems is not sufficient, since there is a lack of technological and pedagogical training in relation to them (Gregory et al., 2015 as cited by Gamez & López 2017). Teachers encounter significant barriers to incorporate ICT into their teaching, mainly due to lack of effective ICT training and professional development (Dong, 2018).

These studies present a bleak picture of the current state of PDC in teacher education Programs but solace can be found in the results of scarcely found studies, some of which suggests that given the right opportunities teachers actively seek to resolve demanding situations by going beyond their current PDC through engaging in diverse forms of transformative agency (Brevik, Guðmundsdóttir, Lund & Strømme, 2019).

In an attempt to gauge the reasons for the generic criticism heard commonly against teacher education that it is not fulfilling its obligation to adequately prepare teachers to utilize digital tools in the classroom, a study was done in the context of Norwegian teacher education programmes. This study, 'Guidelines and Regulations for Teaching Digital Competence in Schools and Teacher Education: A Weak Link?', according to its findings indicate that there is a weak link between the curriculum and the premises for digital competence in teacher education. Through reviewing various guiding documents of ICT in Norwegian Teacher education the study concludes that there is an obvious disparity between the terms that the curriculum sets for the education of digitally competent pupils and those that the governing documents of teacher education set for the education of digitally competent teachers. This disparity appears both in how digital competence is understood and in the degree of commitment to it (Engen, Giaever & Mifsud, 2015).

Knowledge, skills and attitude are different concepts which need to be examined together to determine the digital literacy level of an educator. A study 'Are preservice teachers really literate enough to integrate technology in their classroom practice? Determining the technology literacy level of preservice teachers' was done to determine this knowledge, skills and attitude about technology usage of preservice teachers. Which showed that Although most of the preservice teachers said they had knowledge, skills and positive attitude to use technology in teaching activities, the results revealed that they had a low level of technology literacy in terms of knowledge and skills because of the fact that they either didn't take any technology-related courses in their teacher training programs or they had such courses with insufficient contents (Dinçer, 2018).

In general, newly qualified teachers report fairly poor quality and contribution of ICT training during their teacher education. Therefore a continuous effort is needed to review the quality of Initial Teacher Education (ITE) and contribute specifically to the development of PDC and developing student teachers' ICT self-efficacy in ITE (Guðmundsdóttir & Hatlevik, 2017).

The results of a survey conducted by GRÜNWALD, MELNIKOVA, AHRENS & ZAŠČERINSKA (2018) concluded that the shortage of ICT skills is not considered as a big issue, but it is considered however an important issue to enhance trainers' and trainees' competences. Furthermore, the respondents recognize that they lack ICT skills and indicate that they would enhance their competences, mainly in improving their understanding of the use

of ICT in the evaluation of the training results and assessment of the quality of the training course .

Along with looking for the targeted remedy of this lack of enthusiasm towards ICT teaching in Teacher Education Institutes, it is necessary, for teacher training institutions to implement policies at different moments and in different areas of the Teacher Training process in order to improve the development of the Teacher Digital Competence (Silva, Usart & Lázaro-Cantabrana, 2019). Furthermore, Knowledge of ICT and how it can be integrated with pedagogy should be part of teacher training programs just like other foundational subjects, then only ICT competency will develop in teachers. Otherwise, ICT will remain an optional subject.

All the above-mentioned studies mainly deals with the question of what the current situation is in teacher education regarding ICT integration but Tondeur, Aesaert, Prestridge & Consuegra (2018), attempted an empirical study with the goal of investigating the impact of pre-service teacher's background and ICT profile in combination with the support they receive from their teacher training institution on their ICT competencies.

2.5. Factors affecting ICT competencies

There is a tendency in the current discourse around teachers, of viewing teachers as a passive block of innovation to produce & impose prescriptions for change to include the externally devised new curriculum and in-service courses to promote innovation. But the problem with this approach is that it can too easily ignore existing perceptions and experiences of teachers (Watson, 2003).

And it is unarguably agreed by a large section of educational stakeholders that to exploit the potential of technology in education to the fullest it is important for all involved (policy makers etc.) to give due consideration to all the necessary conditions and environments, directly or indirectly, related to the technology use. Having an idea of what these factors are and how they affect or obstruct the use of ICT in education may assist educators to overcome these barriers/challenges and become successful adopters in the future (Bingimlas, 2009). There have been a number of studies identifying factors that may influence teachers' decision to adopt and integrate ICT in the teaching and learning process (Lawrence & Tar, 2018). And a lot of them reached to at least one common conclusion that "the most prominent factors amongst the factors that affect the successful use of computers in the classroom is the teachers' attitudes towards computers" (Mahajan, 2016; Vogel & Boehncke, 2018; Tondeur, Aesaert, Prestridge & Consuegra, 2018; Sergis & Sampson, 2014 & Agbo, 2015).

The use of Information and communication technology (ICT) develops a powerful learning environment that helps learners to learn actively, self-directed and in a constructive way. ICT can be seen as a powerful tool to support the effective teaching-learning process. But the School teachers' lack of confidence and motivation for using ICT becomes one of the major barriers of its implementation in classrooms (Basargekar & Singhavi, 2017).

"Integration factors also affect teacher perception in different ways: for example, lack of resources (which is an external barrier) can affect teachers' confidence to integrate technology (which is an internal reason)" (Ngobeni, 2017).

According to a study, the students teachers themselves admit that the integration of technology into learning processes raised their motivation and interest in the subject (Ozdamli, 2017).

2.5.1 The motivation of teachers

Motivation is internal and external factors that foster their own performance, learning, attitude, and behavior. As such they guide other employees and increase the satisfaction, loyalty, and performance of other employees for the organization where they are working (Abu-Al-Kishk, 2006). Motivation is defined as a power that forces the individual to change their performance according to needs, sometimes management (Helal, 2009).

Motivation is the driving force behind all human efforts and it is essential to their performance (Parijat and Bagga, 2014). When applied to this study, this theory holds that if teachers possess ICT competency as their effort to perform any task by using technology, teachers will be motivated to accept and use technological aid to carry out their classroom teaching (Wei, Piaw, Kannan & Moulod, 2016).

The study titled, 'ICT use by pre-service foreign languages teachers according to gender, age and motivation' emerged with the objectives of analysing the use of ICT by future primary education teachers & of finding out whether age, gender and motivation affect their use of ICT. The results of the study confirmed that motivation constitutes an essential variable at the pedagogical digital competence level (Gámez, Lugones & Fernández, 2019).

Gasaymeh, Al-hasanat, Kraishan & Abytayeh (2017) in a quantitative study of 35 participants found motivational factors are opportunity for scholarly pursuit, Opportunity to expand program offerings, opportunity to improve my teaching, ability to reach new students that cannot attend classes on campus, greater course flexibility for students, personal motivation to use technology, opportunity to use personal research as a teaching tool, career exploration, overall job satisfaction, opportunity to develop new ideas, reduce training load, Job security, credit toward promotion and tenure, expectations by the university that faculty would use ICT, support and encouragement from university administrators, visibility for jobs at other institutions/organizations, training provided by the university, increase in salary, release time, recognitions and awards, monetary support for participation (Stipend, Overload), technical support provided by the university, grants for materials/expenses, requirement by the department, support, and encouragement from Dean or Chair, professional prestige, and status, graduate training received.

Teachers need to have positive attitudes toward the acceptance and use of technology in order to properly and effectively integrate it into their routine work (Wei, Piaw, Kannan & Moulod, 2016). This finding aligned with Albirini (2006), Demirci (2009); Teo (2008) and Pynoo & van Braak (2014) who also found that teachers' positive attitude towards ICT is the key factor for enhancing teacher acceptance and use of ICT.

2.5.2 The attitude of teachers

As several studies suggest, it is of course highly relevant for teachers to experience self-efficacy to change attitude (Boehncke & Vogel, 2018).

“Despite the existence of many programs and training projects in the field of ICT, in education, the teaching and learning process continues to be supported by traditional classroom methods. This phenomenon can be particularly observed in education degrees, even though future teachers are expected to acquire the necessary digital skills in order to carry out their work properly.” A study was undertaken in this regard by García, Fernández & Gamez (2018) to explore the different correlations between the use of ICT and their perceived level of digital competence, age and their level of motivation. The results of this study showed that future teachers have a low level of attitude of use towards ICT in the classroom.

Rather (2014) in a quantitative study of 529 teachers and principals of secondary schools from which 236 teachers and 35 principals were from Jammu and Kashmir and 38 principals and 220 teachers were from Uttar Pradesh. It states that teachers' attitude is a prerequisite for the implementation of ICT therefore policy should be framed with consideration of attitude. This study also found that Uttar Pradesh’s teachers and Principals have a more positive attitude towards ICT than teachers and principals of Jammu Kashmir.

Drent & Meelissen (as cited in Agbo 2015) & Tondeur, Aesaert, Prestridge & Consuegra (2018) also found that teachers having a positive attitude, computer experience, pedagogical approach, and personal entrepreneurship directly influence the innovative use of ICT.

Almusalam (as cited in Agbo 2015) states that teacher’s attitude has been found to be major predictors of the use of new technologies in instructional settings.

According to Inam and Lowther, (as cited in Kerckaert, Vanderlindc, Braak) attitude of teachers towards ICT includes their own perceptions of technology on student learning, achievement, classroom instructions, and learning activities. However, Sergis & Sampson (2014) emphasize that a teacher is a core actor in the ecosystem of school, an integral part of processes in school, their ICT competencies and attitude towards ICT affect their level of ICT exploitation at and therefore, influence their strategies to integrate ICT.

2.5.3 Confidence of teacher

“Adequate self-efficacy is useful for motivating individuals to engage in continued improvement” (Elstad & Christophersen, 2017). Confidence as well as the attitude – according to Blackwell, Lauricella, and Wartella (as cited by Vogel & Boehncke, 2018) – seem to be the most influential factors for teachers’ use of digital technology in primary school.

Hsu, Wang, Runco (2013) in a mixed-methodology surveyed 32 and randomly observed 15 middle school science teachers’ ICT competencies and confidence in five components: problem solving, communication and metacognition, basic ICT capabilities, analysis and production with ICTs and information and internet-related skills. This research found that teachers had high ICT literacy confidence and were quite familiar with skills but they are not as confident while practised in the classroom. Also, teachers had relatively low confidence in skills rather than ICT skills.

Karataş, Tunc, Yilmaz & Karaci (2017) conducted interviews and surveys of 427 teachers and studied their self-confidence, perception of pre-service middle school math teachers towards technological pedagogical content knowledge (TPACK). That study finds that females have a

lower score on the survey regarding TPACK related self-confidence then male. The reason behind this may be their readiness to use TPACK.

While some teachers do receive some form of ICT training in their respective teacher education programs, it is evident that such training has had minimal or no impact at all on the abilities and confidence of teachers to use ICT in their teaching. These factors that negatively influence teachers' readiness for, and confidence in using ICT; need to be dealt with by the various stakeholders (Mathevula & Uwizeyimana, 2014) in order to fully achieve ICT integration with education.

CHAPTER 3: Methodology

3.1. Introduction

This chapter explains in detail the methodology part of this research. It discusses the research design, population/sample of the study, the process of development of tools for data collection, the hypothesis on the basis of which the objectives were decided, major objectives along with the research questions and lastly, the statistical techniques used in the data analysis.

The major objectives of this study include comparing adjusted means scores of Reaction towards the overall perception of teachers regarding the use of ICT in teaching-learning, the digital competencies required for successful integration of ICT in teaching-learning as well as the pedagogical & professional skills of teachers belonging to Ajmer, Bhopal, Bhubaneswar and Mysore Demonstration Schools by considering Pre- Reaction towards Use of ICT in Teaching-Learning as the covariate. The study also aims to compare the Social & Ethical Values of Teachers and the manipulative factors affecting their use of ICT including confidence, Motivation & Attitude, in the classroom setting. To carry out this study the tool used for data collection ranges from pretest-posttest questionnaires & non-participant observations to interviews. This chapter gives a comprehensive view of the methodology followed to complete this study.

3.2. Research Design

This study is a quantitative enquiry/investigation of ICT Competency level of Teachers of Demonstration Multipurpose Schools of Ajmer, Bhopal, Bhubaneswar and Mysore. For this purpose, the researcher decided to adopt a Quasi-Experimental Research Design known as Interrupted Time Series Design which is a variant of One Group Pretest-Posttest.

A time series is a set of measurements taken at intervals over a period of time. For example, a manufacturing company might measure its workers' productivity each week for a year. In an interrupted time-series design, a time series like this one is "interrupted" by a treatment (Cook & Campbell, as cited by Rajiv S. Jhangiani & I-Chant A. Chiang, Paul C. Price, 2015).

This study followed the above-mentioned process by first administering a pretest to ascertain the level of knowledge regarding ICT and its competency to the sample selected from the population then designing and providing intervention accordingly and lastly, measuring the learning by carrying on a posttest. This whole process is considered as one cycle. Between the next cycle and the first, a period of interruption is provided to give time for the learning from the intervention to be applied in the classrooms that it is meant for. Then the whole process is repeated again after a certain interval. This project was designed to repeat this cycle five times for signs of definite improvement. And at the end of the first three cycles, the participants were supposed to compile an E-portfolio detailing whatever they have done in the intermittent period between two cycles.

3.3. Research Method

Research method is defined as "the strategies, processes or techniques utilized in the collection of data or evidence for analysis in order to uncover new information or create a better understanding of a topic" (University of New Castle Library Guides, 2019). The choice of a

research method for any study depends on a number of factors, one of which is the objective of the study.

Every research study is started with one of three objectives in mind: Theoretical, Factual or Application. Factual & Theoretical objectives contribute to a particular field of study or discipline. But the third objective i.e., instead of contributing new knowledge suggests new/real-world application or solution for practical problems as well as improvement and modification in existing practices (Singh, 2006). This type of Research Method is called Action Research which is defined as, "The process by which practitioners attempt to study their problems scientifically in order to guide, correct and evaluate their decision and action is what a number of people have called action research" (Corey as cited by Singh, 2006). This method of Research emphasizes problems here and now in a local setting. Therefore, its findings are to be evaluated in terms of local applicability, not universal validity. Its purpose is to improve school practices and at the same time to improve those who try to improve the practices i.e., Teachers (Best & Kahn, 2006).

This approach perfectly illustrates the purpose of this study as the study itself aims to diagnose the problems that teachers face in integrating ICT in their classrooms in DMS of Ajmer, Bhopal, Bhubaneswar and Mysore in order to be able to suggest & train teachers in implementing compatible strategies to deal with the current stagnation in practice.

Once the research method is chosen, the next step is the selection of appropriate research tools for data collection.

3.4. Population & Sampling

The population has been defined as any group of individuals that has one or more characteristics in common and that are of interest to the researcher by Best & Kahn (2016). It's necessary to limit the population with the desired characteristic(s) in common so that it can be distinguished from other individuals as it is impractical if not impossible to study the entire population to arrive at generalizations (Best & Kahn, 2016). In this case, the population selected was the teachers of the Demonstration Multipurpose Schools run by National Council of Educational Research & Training as they are ones who are to be provided with the targeted support needed for integration of ICT in the teaching-learning process which is the expected result of the project undertaken.

The study doesn't claim to provide recommendations and solutions of problems in practice for teachers, universally, as the problems faced in achieving the goal of technology integration differ from place to place. Hence, it would be impossible to carry out due to the sheer size and not very useful due to the diversity.

After defining the population to whom the findings of the study will be generalized, the second step in designing a project is to select a representative sample on which the study will be conducted.

"A sample is a small proportion of the population that is selected for observation and analysis.." (Best & Kahn, 2016). Representation is considered the first general rule of the sampling procedure, it means that whatever sample is selected by observing the characteristics of the sample, one should be able to make certain inferences about the characteristics of the

population from which it was drawn. This particular quality of the sample is what makes it possible to generalize the research findings for the larger population (Singh, 2006).

Most studies try to ensure that the randomness of a sample is ensured through a systematic selection/process but wherever it is not possible other systematic means are used. Like in this study, a Purposive Sampling Method which is a type of Non- Probability Sampling.

Purposive Sampling is used whenever it is not feasible to do a systematic random selection. It is done by some arbitrary method because it is known to be representative of the total population (Singh, 2006). It allows the researcher to select those participants, who will provide the richest information and those who manifest the characteristics of particular interest to the researcher (Best & Kahn, 2016).

This study employed this above-mentioned method of sampling and chose as participants those teachers amongst the population who have eagerly participated & have an active stake in ICT integrated education. Therefore, are well versed with the challenges of the field and have rich practical insights which can be used to develop a tailored program for them and their peers to update their classroom practices.

3.5. Research Process

This study was planned in five Phases, as is mentioned in the research design. According to the selected research design i.e., Interrupted Time-Series Design, these five phases were punctuated by long intervals (11-12 months), spread across five years, so that the participants get the time to test out what they have learnt in the interventions in the classroom settings that they are intended for. Since the project started in 2017, by now only three phases have been implemented.

3.5.1. Phase 1- Induction 1 Course

The first phase of the study was aimed at establishing the required infrastructure & Induction level training for teachers.

For this first, it was necessary to enquire about the state of infrastructure necessary for technology-aided education in DMS schools & to measure the ICT Competency of teachers at the beginning of the study to estimate the success level of the interventions both at the end of the study and each phase. To this end, entry-level questionnaires (Annexure 1) were administered before the training/intervention.

The questions were designed to estimate teacher’s confidence in using ICT through a range of criterion including their personal as well as professional self-efficacy regarding the use of technology, their attitudes towards ICT in professional practice and its relevance in current times, their competency through the extent of their identification with a range of hardware and software devices, the extent of their identification & recognition of a number of ethical and social issues, their pedagogical ICT Competency measured through questions judging the extent of ICT use in the classroom as well as interaction with parents and for personal use & lastly, assessment of their active efforts towards their own continuous professional improvement/development.

The answers to these questions from the participants established the extent of their knowledge related to ICT and its pedagogy which made it easier to curate and present content suitable for them rather than haphazard course creation/dispensing without considering the capabilities and requirements of the participants and by proxy the larger population.

The forum chosen for the dispensation of the course content was online through the ICT curriculum website. Each participant had to register themself in the Induction 1 Course in order to avail regular online classes being uploaded on the site. As soon as these interventions started a Whatsapp group was also formed and teachers across schools started to interact with each other. With ongoing online classes, motivated teachers started implementing what they were learning simultaneously in their classrooms along with a couple of them taking their efforts further by giving their challenges and learning the form of a proper research study and presenting papers based on them. Another few were also motivated to take up online courses from other National & International Organizations.

While these participant teachers were striving for professional growth by learning how to work with FOSS, the study with the help of the larger, supervising organization started upgrading labs with Open-Source Operating System. "Throughout the year CIET team provided technical as well as academic support to DMS teachers to WhatsApp group as well as one -to - one phone calls to enable them to complete the assignments given" (Rathnabai, 2019).

Another parallel initiative was started simultaneously with Google India aiming to conduct a pilot collaboratively with DMS Bhopal. As part of this collaboration, a Google team trained the DMS teachers of Bhopal in the use of basic tools like Google Suite for Education.

This pilot intervention helped in further tailoring the Induction-1 Course content for larger dispensation. The inputs from the participants improved the course content and evaluation materials which were afterwards shared with the states and UTs.

3.5.2. Phase 2: Refresher 1 Course

After a long incubation period, the second phase of the study was started with another entry-level questionnaire assessing the participants upon the same criterion as Phase 1. This same pretest (Annexure 2) also acted as a posttest for the first phase as it reflected if the training and implementation in the last phase has improved their confidence or attitude towards the use of ICT and whether their pedagogical and personal competency has surpassed their capabilities the year before or not.

This second phase was aimed at ICT pedagogy integration training for teachers and the implementation of ICT in education courses for students. To accomplish this goal of capacity building of teachers in developing their own e-resources and integrating it in their teaching-learning process for effective transaction of content to achieve learning outcomes 11 days training on ICT -Pedagogy integration in teaching and

learning which was a combined refresher of ICT in teaching-learning- I & digital storytelling was organized. The objectives of this course included-

- Appreciate the potential of ICT in Education
- Design appropriate instructional design

- Acquire, organize and create various e-resources.
- Appropriately integrate ICT in the educational process.
- Practice safe, ethical and legal ways of using ICT.

To achieve these above-mentioned objectives a number of mediums were used, starting with an inaugural session which introduced the participants with the prominent ideas & international development in practices of virtual Learning followed by some icebreaking activities for the purpose of familiarizing participants from different DMS with each other which would prove helpful for the next 10 days while engaging in group tasks, peer learning etc.

After these initial introductory sessions, the first session was conducted on Mobile Base Learning seeing as it is one of the most widespread and hence, an accessible digital device available making it a feasible medium of digital teaching-learning or technology-aided education.

The next discussion was on Subject-Specific Tools which later evolved into the workings of Augmented Reality Apps and how they can be used to enhance & aid students' subject-specific learning. Immediately, after which other Educational apps which could perform a similar function were also explored by the participants so as to have other options when required and develop the skill of identifying appropriate Free & Open Source learning resources. This was done with the help of peers without direct instruction in any supervisory capacity. Whatever resources that the teachers identified and also the ones they were told about in the workshop, was employed in this next session to familiarize themselves with the educational games and animations that are already available and to develop a range of e-Resources including Stop Motion Animations, Image Hotspots etc.

In between these seemingly content laden sessions lively group discussions were held and health concerns were addressed through light stretching and exercises.

In the later part of the training sessions, the participant teachers were brought up to date on current discourses on technological pedagogical content knowledge and a pre-planned card activity was done so as to give them a hands-on experience of how it can be employed in their daily teaching-learning process.

But all this technological innovation and discoveries can only operate fruitfully in the classroom, if the teacher has a clear idea of what outcome they want from which activity and what type of technological resources can be used to achieve that outcome single-mindedly. For this, there was a session planned on an evolved form of concept mapping which included how ICT can be used to aid the learning of a concept.

The last thing included in the agenda was training on how to use social media and assistive technology for interaction and a better inclusive interface for which a demonstration session was held followed by a lecture on how these technologies can break down the usual bureaucratic barriers to facilitate smooth interaction between the stakeholders.

Along with the teacher's workshop, a student intervention was running simultaneously with a combined initiative of CIET-NCERT, RIE Bhopal and Google aiming for a holistic ICT Implementation in the classroom.

Towards the end of this 11-day long training session, a group of teachers visited from Bhutan to observe and interact with the participant teachers and organizers to exchange knowledge, culminating the training.

3.5.3. Phase 3: Refresher 2 Course

This third phase of the project focuses on advanced training on ICT-pedagogy integration (online & offline) with specific attention to 21st-century skills, ICT-pedagogy integration classroom practice and the development of ICT integrated activities across subjects.

After another long implementation span, the third phase of the study was initiated. This Phase brought a change in the format of the intervention so instead of holding training workshops to achieve the above-mentioned goals, training sessions happened through the online forum where a detailed description of each activity and task were uploaded and then teachers were asked to develop and submit E-portfolios based on those activities.

Through the lessons uploaded on the website it was expected that at the end of this workshop, teachers will be able to,

- Explore various ICT tools
- Design an ICT integrated session plans
- Develop various e-content based on the need
- Plan the implementation strategies

To this end, lessons spanning from identification of key ideas, preparation of unit plans, session planning, development of Rubric i.e., evaluation, e-Content development, classroom video creation and learning management system were given and each lesson contained some tasks which the participants needed to complete within the given time and upload it on the website as E-portfolio so that it can be evaluated to assess how much the participant has learnt from the lesson.

The submission of E-portfolios concluded the third phase of the study.

3.6 Objectives

The following were the Objectives of this study:

1. To compare adjusted means scores of Reaction toward Use of ICT in Teaching-Learning of Teachers belonging to Ajmer, Bhopal, Bhubaneswar and Mysore Demonstration Schools by considering Pre- Reaction towards Use of ICT in Teaching-Learning as covariate.
2. To compare adjusted means scores of Reaction toward Basic Computer Operations and Devices of Teachers of Ajmer, Bhopal, Bhubaneswar and Mysore Demonstration Schools by considering Pre- Reaction toward Basic Computer Operations and Devices of Teachers as covariate.
3. To compare adjusted means scores of Reaction toward Office and Teaching Productivity Tools of Teachers of Ajmer, Bhopal, Bhubaneswar and Mysore Demonstration Schools by considering Pre- Reaction toward Office and Teaching Productivity Tools of Teachers as covariate.

4. To compare adjusted means scores of Reaction toward Internet and Network Application of Teachers of Ajmer, Bhopal, Bhubaneswar and Mysore Demonstration Schools by considering Pre- Reaction toward Internet and Network Application of Teachers as covariate.
5. To compare adjusted means scores of Reaction towards Information and Data Management of Teachers of Ajmer, Bhopal, Bhubaneswar and Mysore Demonstration Schools by considering Pre- Reaction toward Information and Data Management of Teachers as covariate.
6. To compare adjusted means scores of Confidence in Using ICT by Teachers belonging to Ajmer, Bhopal, Bhubaneswar and Mysore Demonstration Schools by considering Pre-Confidence in Using ICT by Teachers as covariate.
7. To compare adjusted means scores of Skill of Technology Operations and Concepts of Teachers belonging to Ajmer, Bhopal, Bhubaneswar and Mysore Demonstration Schools by considering Pre- Skill of Technology Operations and Concepts of Teachers as covariate.
8. To compare adjusted means scores of Social and Ethical Values of Teachers belonging to Ajmer, Bhopal, Bhubaneswar and Mysore Demonstration Schools by considering Pre-Social and Ethical Values of Teachers as covariate.
9. To compare adjusted means scores of Pedagogical Skills of Teachers belonging to Ajmer, Bhopal, Bhubaneswar and Mysore Demonstration Schools by considering Pre-Pedagogical Skills of Teachers as covariate.
10. To compare adjusted means scores of Professional Skills of Teachers belonging to Ajmer, Bhopal, Bhubaneswar and Mysore Demonstration Schools by considering Pre-Professional Skills of Teachers as covariate.
11. To compare adjusted means scores of Overall Perception of use of ICT in Teaching – Learning of Teachers belonging to Ajmer, Bhopal, Bhubaneswar and Mysore Demonstration Schools by considering Pre- Overall Perception of use of ICT in Teaching – Learning of Teachers as covariate.

3.7 Hypotheses

The following were the Hypotheses of this study.

1. There is no significant difference in adjusted means scores of Reaction toward Use of ICT in Teaching-Learning of Teachers belonging to Ajmer, Bhopal, Bhubaneswar and Mysore Demonstration Schools by considering Pre- Reaction towards Use of ICT in Teaching-Learning as covariate.
2. There is no significant difference in adjusted means scores of Reaction toward Basic Computer Operations and Devices of Teachers of Ajmer, Bhopal, Bhubaneswar and Mysore Demonstration Schools by considering Pre- Reaction toward Basic Computer Operations and Devices of Teachers as covariate.
3. There is no significant difference in adjusted means scores of Reaction toward Office and Teaching Productivity Tools of Teachers of Ajmer, Bhopal, Bhubaneswar and Mysore Demonstration Schools by considering Pre- Reaction toward Office and Teaching Productivity Tools of Teachers as covariate.

4. There is no significant difference in adjusted means scores of Reaction toward Internet and Network Application of Teachers of Ajmer, Bhopal, Bhubaneswar and Mysore Demonstration Schools by considering Pre- Reaction toward Internet and Network Application of Teachers as covariate.
5. There is no significant difference in adjusted means scores of Reaction towards Information and Data Management of Teachers of Ajmer, Bhopal, Bhubaneswar and Mysore Demonstration Schools by considering Pre- Reaction toward Information and Data Management of Teachers as covariate.
6. There is no significant difference in adjusted means scores of Confidence in Using ICT by Teachers belonging to Ajmer, Bhopal, Bhubaneswar and Mysore Demonstration Schools by considering Pre- Confidence in Using ICT by Teachers as covariate.
7. There is no significant difference in adjusted means scores of Skill of Technology Operations and Concepts of Teachers belonging to Ajmer, Bhopal, Bhubaneswar and Mysore Demonstration Schools by considering Pre- Skill of Technology Operations and Concepts of Teachers as covariate.
8. There is no significant difference in adjusted means scores of Social and Ethical Values of Teachers belonging to Ajmer, Bhopal, Bhubaneswar and Mysore Demonstration Schools by considering Pre- Social and Ethical Values of Teachers as covariate.
9. There is no significant difference in adjusted means scores of Pedagogical Skills of Teachers belonging to Ajmer, Bhopal, Bhubaneswar and Mysore Demonstration Schools by considering Pre- Pedagogical Skills of Teachers as covariate.
10. There is no significant difference in adjusted means scores of Professional Skills of Teachers belonging to Ajmer, Bhopal, Bhubaneswar and Mysore Demonstration Schools by considering Pre- Professional Skills of Teachers as covariate.
11. There is no significant difference in adjusted means scores of Overall Perception of use of ICT in Teaching – Learning of Teachers belonging to Ajmer, Bhopal, Bhubaneswar and Mysore Demonstration Schools by considering Pre- Overall Perception of use of ICT in Teaching – Learning of Teachers as covariate.

Chapter 4: Data Analysis and Interpretation

4.1 Analysis

4.1.1 Institution-wise Comparison of Adjusted Mean Scores of Reaction towards Use of ICT in Teaching-Learning by Considering Pre-Reaction towards Use of ICT in Teaching-Learning as Covariate of Teachers

The objective was to compare adjusted means scores of Reaction towards Use of ICT in Teaching-Learning of Teachers belonging to Ajmer, Bhopal, Bhubaneswar and Mysore Demonstration Schools by considering Pre- Reaction towards Use of ICT in Teaching-Learning as covariate. The data were analyzed with the help of One Way ANCOVA by considering Pre- Reaction towards Use of ICT in Teaching-Learning as covariate of Teachers. The results are given in Table 1.

Table 1: Summary of One Way ANCOVA of Reaction towards Use of ICT in Teaching-Learning by considering Pre- Reaction towards Use of ICT in Teaching-Learning as covariate of Teachers

Source of Variance	df	$SS_{y.x}$	$MSS_{y.x}$	$F_{y.x}$ -Value	Remark
Institutions	3	863.59	287.86	5.21	p<0.01
Error	91	5025.51	55.22		
Total	95				

From Table 1, it can be seen that the adjusted F-Value for Institutions is 5.21 which is significant at 0.01 level with df=3/91. It indicates that the adjusted mean scores of Reaction towards Use of ICT in Teaching-Learning of Teachers belonging to Ajmer, Bhopal, Bhubaneswar and Mysore Demonstration Schools differ significantly when Pre- Reaction towards Use of ICT in Teaching-Learning was considered as covariate. Thus the null hypothesis that there is no significant difference in adjusted mean scores of Reaction towards Use of ICT in Teaching-Learning of Teachers belonging to Ajmer, Bhopal, Bhubaneswar and Mysore Demonstration Schools by considering Pre- Reaction towards Use of ICT in Teaching-Learning as covariate is rejected. In order to know which Institution Teachers had significantly more favorable Reaction towards Use of ICT in Teaching-Learning, the data were further analysed with the help of t-test and the results are given in Table 2.

Table 2: Institution-wise adjusted Mean, SE, N and t-values of Reaction towards Use of ICT in Teaching-Learning by considering Pre- Reaction towards Use of ICT in Teaching-Learning as covariate

Institution	Adjusted Mean	SE	N	Bhopal	Bhubaneswar	Mysore
Ajmer	68.10	2.20	14	1.90	1.16	1.14
Bhopal	73.43	1.74	24		1.05	3.51**
Bhubaneswar	71.10	1.37	35			2.84**
Mysore	64.94	1.68	23			

**Significant at 0.01 level

From Table 2, it can be seen that the t-values of 1.90, 1.16, 1.14 and 1.05 are not significant. It reflects that the adjusted mean scores of Reaction towards Use of ICT in Teaching-Learning of Teachers from Ajmer Demonstration School do not differ significantly from those of Bhopal, Bhubaneswar and Mysore. The teachers from these Demonstration schools were found to have the same degree of favorable Reaction towards Use of ICT in Teaching-Learning. Also adjusted mean scores of Reaction towards Use of ICT in Teaching-Learning of Teachers from Bhopal Demonstration School do not differ significantly from those in Bhubaneswar. Teachers from demonstration Schools of Bhopal and Bhubaneswar were found to have the same degree of favorable Reaction towards Use of ICT in Teaching-Learning. Further the t-value of 3.51 and 2.84 are significant at 0.01 level with df=45 and 57 respectively. It shows that the adjusted mean scores of Reaction towards Use of ICT in Teaching-Learning of Mysore Demonstration School Teachers differ significantly from those of Bhopal and Bhubaneswar. Further the adjusted mean score of Reaction towards Use of ICT in Teaching-Learning of Teachers from Bhopal and Bhubaneswar is 73.43 and 71.10 respectively which is significantly higher than those of Mysore Demonstration School whose adjusted mean score of Reaction towards Use of ICT in Teaching-Learning is 64.94. So Bhopal and Bhubaneswar Demonstration Schools Teachers were found to have more favorable Reaction towards Use of ICT in Teaching-Learning than those of Mysore Demonstration School Teachers.

Reaction towards Use of ICT in Teaching-Learning of Teachers comprises four basic skills. These basic Skills were Basic Computer Operations and Devices; Office and Teaching Productivity Tools; Internet and Network Applications; and Information and Data Management. The data were analyzed separately and the results are presented in the following captions.

4.1.2 Institution-wise Comparison of Adjusted Mean Scores of Reaction Toward Basic Computer Operations and Devices by Considering Pre- Reaction Toward Basic Computer Operations and Devices of Teachers as Covariate

One of the components of Reaction towards Use of ICT in Teaching-Learning was Basic Computer Operations and Devices Reaction. So the objective was to compare adjusted means scores of Reaction toward Basic Computer Operations and Devices of Teachers of Ajmer, Bhopal, Bhubaneswar and Mysore Demonstration Schools by considering Pre- Reaction Toward Basic Computer Operations and Devices of Teachers as covariate. The data were analysed with the help of One Way ANCOVA by considering Pre- Reaction Towards Basic Computer Operations and Devices of Teachers as covariate. The results are given in Table 3.

Table 3: Summary of One Way ANCOVA of Reaction toward Basic Computer Operations and Devices by considering Pre- Reaction toward Basic Computer Operations and Devices of Teachers as covariate

Source of Variance	df	$SS_{y.x}$	$MSS_{y.x}$	$F_{y.x}$	Remark
Institutions	3	414.62	138.21	3.65	p<0.01
Error	91	3445.12	37.86		
Total	95				

From Table 3, it can be seen that the adjusted F-Value for Institutions is 3.65 which is significant at 0.01 level with df=3/91. It indicates that the adjusted mean scores of Reaction toward Basic Computer Operations and Devices of Teachers belonging to Ajmer, Bhopal, Bhubaneswar and Mysore Demonstration Schools differ significantly when Pre- Reaction toward Basic Computer Operations and Devices of Teachers was considered as covariate. Thus the null hypothesis that there is no significant difference in adjusted mean scores of Reaction toward Basic Computer Operations and Devices of Teachers belonging to Ajmer, Bhopal, Bhubaneswar and Mysore Demonstration Schools by considering Pre- Reaction toward Basic Computer Operations and Devices of Teachers as covariate is rejected. Now in order to know which Institute's adjusted mean score of Reaction toward Basic Computer Operations and Devices of Teachers is significantly different from others, the data were analysed with the help of t-test and the results are given in Table 4.

Table 4: Institution-wise adjusted Mean, SE, N and t-values of Reaction toward Basic Computer Operations and Devices by considering Pre- Reaction toward Basic Computer Operations and Devices of Teachers as covariate

Institution	Adjusted Mean	SE	N	Bhopal	Bhubaneswar	Mysore
Ajmer	31.44	1.65	14	1.43	2.80**	2.94**
Bhopal	34.41	1.26	24		1.53	1.77
Bhubaneswar	36.90	1.04	35			0.41
Mysore	37.59	1.29	23			

**Significant at 0.01 level

From Table 4, it can be seen that the t-values of 1.43, 1.53, 1.77 and 0.41 are not significant. It reflects that the adjusted mean scores of Reaction toward Basic Computer Operations and Devices of Teachers from Ajmer and Bhopal; Bhopal and Bhubaneswar; Bhopal and Mysore; and Bhubaneswar and Mysore Demonstration Schools do not differ significantly when Pre-Reaction toward Basic Computer Operations and Devices of Teachers was taken as covariate. So Teachers from Ajmer and Bhopal; Bhopal and Bhubaneswar; Bhopal and Mysore; and Bhubaneswar and Mysore Demonstration Schools were found to have the same type of Reaction toward Basic Computer Operations and Devices.

Further the t-values of 2.80 and 2.94 are significant at 0.01 level with df=47 and 35 respectively (vide Table 4). It shows that the adjusted mean scores of Reaction toward Basic Computer Operations and Devices Reaction of Teachers from Bhubaneswar and Mysore Demonstration School Teachers differ significantly from those of Ajmer. Further the adjusted mean scores of Reaction toward Basic Computer Operations and Devices Reaction of Teachers from Bhubaneswar and Mysore are 36.90 and 37.59 respectively which are significantly higher than those of Ajmer Demonstration School whose adjusted mean score of Reaction toward Basic Computer Operations and Devices is 31.44. So Bhubaneswar and Mysore Demonstration Schools Teachers were found to have significantly more favourable Reaction toward Basic Computer Operations and Devices than those of Ajmer Demonstration School.

4.1.3 Institution-wise Comparison of Adjusted Mean Scores of Reaction toward Office and Teaching Productivity Tools by Considering Pre-Reaction toward Office and Teaching Productivity Tools of Teachers as Covariate

Another component of Reaction towards Use of ICT in Teaching-Learning was Office and Teaching Productivity Tools Reaction. So the objective was to compare adjusted means scores of Reaction toward Office and Teaching Productivity Tools of Teachers of Ajmer, Bhopal, Bhubaneswar and Mysore Demonstration Schools by considering Pre- Reaction toward Office and Teaching Productivity Tools of Teachers as covariate. The data were analysed with the help of One Way ANCOVA by considering Pre- Reaction toward Office and Teaching Productivity Tools of Teachers as covariate. The results are given in Table 5.

Table 5: Summary of One Way ANCOVA of Reaction toward Office and Teaching Productivity Tools by considering Pre- Reaction toward Office and Teaching Productivity Tools of Teachers as covariate

Source of Variance	df	$SS_{y.x}$	$MSS_{y.x}$	$F_{y.x}$ -Value	Remark
Institutions	3	2240.19	746.73	5.69	p<0.01
Error	91	11937.42	131.18		
Total	95				

From Table 5, it can be seen that the adjusted F-Value for Institutions is 5.69 which is significant at 0.01 level with df=3/91. It indicates that the adjusted mean scores of Reaction toward Office and Teaching Productivity Tools of Teachers belonging to Ajmer, Bhopal, Bhubaneswar and Mysore Demonstration Schools differ significantly when Pre- Reaction toward Office and Teaching Productivity Tools of Teachers was considered as covariate. Thus the null hypothesis that there is no significant difference in adjusted mean scores of Reaction toward Office and Teaching Productivity Tools of Teachers belonging to Ajmer, Bhopal, Bhubaneswar and Mysore Demonstration Schools by considering Pre- Reaction toward Office and Teaching Productivity Tools of Teachers as covariate is rejected. Now in order to know which Institute's adjusted mean score of Reaction toward Office and Teaching Productivity Tools of Teachers is significantly different from others, the data were analysed with the help of t-test and the results are given in Table 6.

Table 6: Institution-wise adjusted Mean, SE, N and t-values Reaction toward Office and Teaching Productivity Tools by considering Pre- Reaction toward Office and Teaching Productivity Tools of Teachers as covariate

Institution	Adjusted Mean	SE	N	Bhopal	Bhubaneswar	Mysore
Ajmer	48.78	3.07	14	0.61	2.55*	3.41**
Bhopal	51.12	2.35	24		2.67*	3.25**
Bhubaneswar	58.04	1.94	35			1.31
Mysore	62.08	2.41	23			

*Significant at 0.05 level **Significant at 0.01 level

From Table 6, it can be seen that the t-values of 0.61 and 1.31 are not significant. It reflects that the adjusted mean scores of Reaction toward Office and Teaching Productivity Tools of Teachers from Ajmer and Bhopal; and Bhubaneswar and Mysore Demonstration Schools do not differ significantly when Pre- Reaction toward Office and Teaching Productivity Tools of Teachers was taken as covariate. So Teachers from Ajmer and Bhopal; and Bhubaneswar and Mysore Demonstration Schools were found to have the same type of Reaction toward Office and Teaching Productivity Tools.

Further the t-values of 2.55 and 3.41 are significant at 0.05 and 0.01 level with df=47 and 35 respectively (vide Table 6). It shows that the adjusted mean scores of Reaction toward Office and Teaching Productivity Tools of Teachers from Bhubaneswar and Mysore Demonstration School Teachers differ significantly from those of Ajmer. Further the adjusted mean scores of Reaction toward Office and Teaching Productivity Tools of Teachers from Bhubaneswar and Mysore are 58.04 and 62.08 respectively which are significantly higher than those of Ajmer Demonstration School whose adjusted mean score of Reaction toward Office and Teaching Productivity Tools is 48.78. So Bhubaneswar and Mysore Demonstration Schools Teachers were found to have significantly more favourable Reaction toward Office and Teaching Productivity Tools than those of Ajmer Demonstration School.

Further the t-values of 2.67 and 3.25 are significant at 0.05 and 0.01 level with df=57 and 45 respectively (vide Table 6). It shows that the adjusted mean scores of Reaction toward Office and Teaching Productivity Tools of Teachers from Bhubaneswar and Mysore Demonstration School Teachers differ significantly from those of Bhopal. Further the adjusted mean scores of Reaction toward Office and Teaching Productivity Tools of Teachers from Bhubaneswar and Mysore are 58.04 and 62.08 respectively which are significantly higher than those of Bhopal Demonstration School whose adjusted mean score of Reaction toward Office and Teaching Productivity Tools is 51.12. Thus Bhubaneswar and Mysore Demonstration Schools Teachers were found to have significantly more favourable Reaction toward Office and Teaching Productivity Tools than those of Bhopal Demonstration School.

4.1.4 Institution-wise Comparison of Adjusted Mean Scores of Reaction toward Internet and Network Applications by Considering Pre-Reaction toward Internet and Network Applications of Teachers as Covariate

The third component of Reaction towards Use of ICT in Teaching-Learning was Reaction toward Internet and Network Application. So the objective was to compare adjusted means scores of Reaction toward Internet and Network Application of Teachers of Ajmer, Bhopal, Bhubaneswar and Mysore Demonstration Schools by considering Pre- Reaction toward Internet and Network Application of Teachers as covariate. The data were analysed with the help of One Way ANCOVA by considering Pre- Reaction toward Internet and Network Application of Teachers as covariate. The results are given in Table 7.

Table 7: Summary of One Way ANCOVA of Reaction toward Internet and Network Application by considering Pre- Reaction toward Internet and Network Application of Teachers as covariate

Source of Variance	df	$SS_{y.x}$	$MSS_{y.x}$	$F_{y.x}$ -Value	Remark
Institutions	3	1096.27	365.42	7.67	p<0.01
Error	91	4332.52	47.61		
Total	95				

From Table 7, it can be seen that the adjusted F-Value for Institutions is 7.67 which is significant at 0.01 level with df=3/91. It indicates that the adjusted mean scores of Reaction toward Internet and Network Application of Teachers belonging to Ajmer, Bhopal, Bhubaneswar and Mysore Demonstration Schools differ significantly when Pre- Reaction toward Internet and Network Application of Teachers was considered as covariate. Thus the null hypothesis that there is no significant difference in adjusted mean scores of Reaction toward Internet and Network Application of Teachers belonging to Ajmer, Bhopal, Bhubaneswar and Mysore Demonstration Schools by considering Pre- Reaction toward Internet and Network Application of Teachers as covariate is rejected. Now in order to know which Institute's adjusted mean score of Reaction toward Internet and Network Application of Teachers is significantly different from others, the data were analysed with the help of t-test and the results are given in Table 8.

Table 8: Institution-wise adjusted Mean, SE, N and t-values Reaction toward Internet and Network Application by considering Pre- Reaction toward Internet and Network Application of Teachers as covariate

Institution	Adjusted Mean	SE	N	Bhopal	Bhubaneswar	Mysore
Ajmer	26.53	1.85	14	0.65	2.38*	2.98**
Bhopal	25.02	1.41	24		3.68**	4.10**
Bhubaneswar	31.75	1.17	35			0.85
Mysore	33.34	1.46	23			

*Significant at 0.05 level **Significant at 0.01 level

From Table 8, it can be seen that the t-values of 0.65 and 0.85 are not significant. It reflects that the adjusted mean scores of Reaction toward Internet and Network Application of Teachers from Ajmer and Bhopal; and Bhubaneswar and Mysore Demonstration Schools do not differ significantly when Pre- Reaction toward Internet and Network Application Reaction of Teachers was taken as covariate. Thus Teachers from Ajmer and Bhopal; and Bhubaneswar and Mysore Demonstration Schools were found to have the same type of Reaction toward Internet and Network Application.

Further the t-values of 2.38 and 2.98 are significant at 0.05 and 0.01 level with df=47 and 35 respectively (vide Table 8). It shows that the adjusted mean scores of Reaction toward Internet and Network Application of Teachers from Bhubaneswar and Mysore Demonstration School

Teachers differ significantly from those of Ajmer. Further the adjusted mean scores of Reaction toward Internet and Network Application of Teachers from Bhubaneswar and Mysore are 31.75 and 33.34 respectively which are significantly higher than those of Ajmer Demonstration School whose adjusted mean score of Reaction toward Internet and Network Application is 26.53. Thus Bhubaneswar and Mysore Demonstration Schools Teachers were found to have significantly more favourable Reaction toward Internet and Network Application than those of Ajmer Demonstration School.

Further the t-values of 3.68 and 4.10 are significant at 0.01 level with df=57 and 45 respectively (vide Table 8). It shows that the adjusted mean scores of Reaction toward Internet and Network Application of Teachers from Bhubaneswar and Mysore Demonstration School Teachers differ significantly from those of Bhopal. Further the adjusted mean scores of Reaction toward Internet and Network Application of Teachers from Bhubaneswar and Mysore are 31.75 and 33.34 respectively which are significantly higher than those of Bhopal Demonstration School whose adjusted mean score of Reaction toward Internet and Network Application is 25.01. Thus Bhubaneswar and Mysore Demonstration Schools Teachers were found to have significantly more favourable Reaction toward Internet and Network Application than those of Bhopal Demonstration School.

4.1.5 Institution-wise Comparison of Adjusted Mean Scores of Reaction Toward Information and Data Management by Considering Pre- Reaction Toward Information and Data Management of Teachers as Covariate

Another component of Reaction towards Use of ICT in Teaching-Learning was Reaction toward Information and Data Management. So the objective was to compare adjusted means scores of Reaction towards Information and Data Management of Teachers of Ajmer, Bhopal, Bhubaneswar and Mysore Demonstration Schools by considering Pre- Reaction toward Information and Data Management of Teachers as covariate. The data were analysed with the help of One Way ANCOVA by considering Pre- Reaction toward Information and Data Management of Teachers as covariate. The results are given in Table 9.

Table 9: Summary of One Way ANCOVA of Reaction toward Information and Data Management by considering Pre- Reaction toward Information and Data Management of Teachers as covariate

Source of Variance	df	$SS_{y.x}$	$MSS_{y.x}$	$F_{y.x}$ -Value	Remark
Institutions	3	232.28	77.43	4.06	p<0.01
Error	91	1736.75	19.08		
Total	95				

From Table 9, it can be seen that the adjusted F-Value for Institutions is 4.06 which is significant at 0.01 level with df=3/91. It indicates that the adjusted mean scores of Reaction toward Information and Data Management of Teachers belonging to Ajmer, Bhopal, Bhubaneswar and Mysore Demonstration Schools differ significantly when Pre- Reaction toward Information and Data Management of Teachers was considered as covariate. Thus the null hypothesis that there is no significant difference in adjusted mean scores of Reaction toward Information and Data Management of Teachers belonging to Ajmer, Bhopal,

Bhubaneswar and Mysore Demonstration Schools by considering Pre- Reaction toward Information and Data Management of Teachers as covariate is rejected. Now in order to know which Institute's adjusted mean score of Reaction toward Information and Data Management of Teachers is significantly different from others, the data were analysed with the help of t-test and the results are given in Table 10.

Table 10: Institution-wise adjusted Mean, SE, N and t-values of Reaction toward Information and Data Management by considering Pre- Reaction toward Information and Data Management of Teachers as covariate

Institution	Adjusted Mean	SE	N	Bhopal	Bhubaneswar	Mysore
Ajmer	14.32	1.17	14	0.36	2.38*	2.58*
Bhopal	14.86	0.90	24		2.36*	2.56*
Bhubaneswar	17.60	0.74	35			0.48
Mysore	18.17	0.92	23			

*Significant at 0.05 level

From Table 10, it can be seen that the t-values of 0.36 and 0.48 are not significant. It reflects that the adjusted mean scores of Reaction toward Information and Data Management of Teachers from Ajmer and Bhopal; and Bhubaneswar and Mysore Demonstration Schools do not differ significantly when Pre- Reaction toward Information and Data Management of Teachers was taken as covariate. Thus Teachers from Ajmer and Bhopal; and Bhubaneswar and Mysore Demonstration Schools were found to have the same type of Reaction toward Information and Data Management.

Further the t-values of 2.38 and 2.58 are significant at 0.05 level with df=47 and 35 respectively (vide Table 10). It shows that the adjusted mean scores of Reaction toward Information and Data Management of Teachers from Bhubaneswar and Mysore Demonstration School Teachers differ significantly from those of Ajmer. Further the adjusted mean scores of Reaction toward Information and Data Management of Teachers from Bhubaneswar and Mysore are 17.60 and 18.17 respectively which are significantly higher than those of Ajmer Demonstration School whose adjusted mean score of Reaction toward Internet and Network Application is 14.32. Thus Bhubaneswar and Mysore Demonstration Schools Teachers were found to have significantly more favourable Reaction toward Information and Data Management than those of Ajmer Demonstration School.

Further the t-values of 2.36 and 2.56 are significant at 0.05 level with df=57 and 45 respectively (vide Table 10). It shows that the adjusted mean scores of Reaction toward Information and Data Management of Teachers from Bhubaneswar and Mysore Demonstration School Teachers differ significantly from those of Bhopal. Further the adjusted mean scores of Reaction toward Information and Data Management of Teachers from Bhubaneswar and Mysore are 17.60 and 18.17 respectively which are significantly higher than those of Bhopal Demonstration School whose mean score of Reaction toward Information and Data Management is 14.86. Thus Bhubaneswar and Mysore Demonstration Schools Teachers were

found to have significantly more favourable Reaction to Reaction toward Information and Data Management than those of Bhopal Demonstration School.

4.1.6 Institution-wise Comparison of Adjusted Mean Scores of Confidence in Using ICT By Considering Pre- Confidence in Using ICT By Teachers as Covariate

The objective was to compare adjusted means scores of Confidence in Using ICT by Teachers belonging to Ajmer, Bhopal, Bhubaneswar and Mysore Demonstration Schools by considering Pre- Confidence in Using ICT by Teachers as covariate. The data were analysed with the help of One Way ANCOVA by considering Pre- Confidence in Using ICT by Teachers as covariate. The results are given in Table 11.

Table 11: Summary of One Way ANCOVA of Confidence in Using ICT by considering Pre- Confidence in Using ICT by Teachers as covariate

Source of Variance	df	$SS_{y.x}$	$MSS_{y.x}$	$F_{y.x}$ -Value
Institutions	3	155.74	51.91	1.54
Error	91	3071.81	33.76	
Total	95			

From Table 11, it can be seen that the adjusted F-Value for Institutions is 1.54 which is not significant. It indicates that the adjusted mean scores of Confidence in Using ICT by Teachers belonging to Ajmer, Bhopal, Bhubaneswar and Mysore Demonstration Schools did not differ significantly when Pre- Confidence in Using ICT by Teachers was considered as covariate. Thus the null hypothesis that there is no significant difference in adjusted mean scores of Confidence in Using ICT by Teachers belonging to Ajmer, Bhopal, Bhubaneswar and Mysore Demonstration Schools by considering Pre- Confidence in Using ICT by Teachers as covariate is not rejected. It may, therefore, be said that Demonstration Schools Teachers of Ajmer, Bhopal, Bhubaneswar and Mysore were found to have low Confidence in Using ICT.

4.1.7 Institution-wise Comparison of Adjusted Mean Scores of Skill of Technology Operations and Concepts by Considering Pre- Skill of Technology Operations and Concepts of Teachers as Covariate

The objective was to compare adjusted means scores of Skill of Technology Operations and Concepts of Teachers belonging to Ajmer, Bhopal, Bhubaneswar and Mysore Demonstration Schools by considering Pre- Skill of Technology Operations and Concepts of Teachers as covariate. The data were analysed with the help of One Way ANCOVA by considering Pre-Skill of Technology Operations and Concepts of Teachers as covariate. The results are given in Table 12.

Table 12: Summary of One Way ANCOVA of Skill of Technology Operations and Concepts by considering Pre-Skill of Technology Operations and Concepts of Teachers as covariate

Source of Variance	df	$SS_{y.x}$	$MSS_{y.x}$	$F_{y.x}$ -Value	Remark
Institutions	3	14349.05	4783.02	6.30	$p<0.01$
Error	91	69038.91	758.67		
Total	95				

From Table 12, it can be seen that the adjusted F-Value for Institutions is 6.30 which is significant at 0.01 level with df=3/91. It indicates that the adjusted mean scores of Skill of Technology Operations and Concepts of Teachers belonging to Ajmer, Bhopal, Bhubaneswar and Mysore Demonstration Schools differ significantly when Pre- Skill of Technology Operations and Concepts of Teachers was considered as covariate. Thus the null hypothesis that there is no significant difference in adjusted mean scores of Skill of Technology Operations and Concepts of Teachers belonging to Ajmer, Bhopal, Bhubaneswar and Mysore Demonstration Schools by considering Pre- Skill of Technology Operations and Concepts of Teachers as covariate is rejected. In order to know which Institution Teachers had significantly better Skill of Technology Operations and Concepts, the data were further analysed with the help of t-test and the results are given in Table 13.

Table 13: Institution-wise adjusted Mean, SE, N and t-values of Skill of Technology Operations and Concepts by considering Pre- Skill of Technology Operations and Concepts of Teachers as covariate

Institution	Adjusted Mean	SE	N	Bhopal	Bhubaneswar	Mysore
Ajmer	121.58	7.38	14	0.25	2.66**	3.42**
Bhopal	123.92	5.63	24		2.85**	3.48**
Bhubaneswar	144.77	4.66	35			0.97
Mysore	152.00	5.79	23			

**Significant at 0.01 level

From Table 13, it can be seen that the t-values of 0.25 and 0.97 are not significant. It reflects that the adjusted mean scores of Skill of Technology Operations and Concepts of Teachers from Ajmer and Bhopal Demonstration Schools do not differ significantly. Also adjusted mean scores of Skill of Technology Operations and Concepts of Teachers from Bhubaneswar and Mysore do not differ significantly. Further adjusted mean score of Skill of Technology Operations and Concepts of Teachers from Ajmer Demonstration School is 121.58 which is significantly lower than those of Bhubaneswar and Mysore Demonstration Schools whose adjusted mean scores of Skill of Technology Operations and Concepts of Teachers are 144.77 and 152.00 respectively. Thus, Teachers from Demonstration Schools of Bhubaneswar and Mysore were found to have significantly better Skill of Technology Operations and Concepts as compared to those of Ajmer Demonstration School.

Further the t-values of 2.85 and 3.48 are significant at 0.01 level with df=57 and 45 respectively (vide Table 13). It shows that the adjusted mean scores of Skill of Technology Operations and Concepts of Teachers from Bhubaneswar and Mysore Demonstration School Teachers differ significantly from those of Bhopal. Further the adjusted mean scores of Skill of Technology Operations and Concepts of Teachers from Bhubaneswar and Mysore are 144.77 and 152.00 respectively which are significantly higher than those of Bhopal Demonstration School whose adjusted mean score of Skill of Technology Operations and Concepts is 123.92. So Bhubaneswar and Mysore Demonstration Schools Teachers were found

to have significantly better Skill of Technology Operations and Concepts than those of Bhopal Demonstration School Teachers.

4.1.8 Institution-wise Comparison of Adjusted Mean Scores of Social and Ethical Values by Considering Pre- Social and Ethical Values of Teachers as Covariate

The objective was to compare adjusted means scores of Social and Ethical Values of Teachers belonging to Ajmer, Bhopal, Bhubaneswar and Mysore Demonstration Schools by considering Pre- Social and Ethical Values of Teachers as covariate. The data were analysed with the help of One Way ANCOVA by considering Pre- Social and Ethical Values of Teachers as covariate. The results are given in Table 14.

Table 14: Summary of One Way ANCOVA of Social and Ethical Values by considering Pre- Social and Ethical Values of Teachers as covariate

Source of Variance	df	$SS_{y.x}$	$MSS_{y.x}$	$F_{y.x}$ -Value
Institutions	3	1285.59	428.53	2.25
Error	91	17300.50	190.11	
Total	95			

From Table 14, it can be seen that the adjusted F-Value for Institutions is 2.25 which is not significant. It indicates that the adjusted mean scores of Social and Ethical Values of Teachers belonging to Ajmer, Bhopal, Bhubaneswar and Mysore Demonstration Schools did not differ significantly when Pre- Social and Ethical Values of Teachers was considered as covariate. Thus the null hypothesis that there is no significant difference in adjusted mean scores of Social and Ethical Values of Teachers belonging to Ajmer, Bhopal, Bhubaneswar and Mysore Demonstration Schools by considering Pre- Social and Ethical Values of Teachers as covariate is not rejected. It may, therefore, be said that Demonstration Schools Teachers of Ajmer, Bhopal, Bhubaneswar and Mysore were found to have average Social and Ethical Values when the groups were matched statistically with respect to Pre- Social and Ethical Values of Teachers.

4.1.9 Institution-wise Comparison of Adjusted Mean Scores of Pedagogical Skills by Considering Pre- Pedagogical Skills of Teachers as Covariate

The objective was to compare adjusted means scores of Pedagogical Skills of Teachers belonging to Ajmer, Bhopal, Bhubaneswar and Mysore Demonstration Schools by considering Pre- Pedagogical Skills of Teachers as covariate. The data were analysed with the help of One Way ANCOVA by considering Pre- Pedagogical Skills of Teachers as covariate. The results are given in Table 15.

Table 15: Summary of One Way ANCOVA of Pedagogical Skills by considering Pre- Pedagogical Skills of Teachers as covariate

Source of Variance	df	$SS_{y.x}$	$MSS_{y.x}$	$F_{y.x}$ -Value	Remark
Institutions	3	1375.39	458.46	4.99	$p<0.01$
Error	91	8360.89	91.88		
Total	95				

From Table 15, it can be seen that the adjusted F-Value for Institutions is 4.99 which is significant at the 0.01 level with df=3/91. It indicates that the adjusted mean scores of Pedagogical Skills of Teachers belonging to Ajmer, Bhopal, Bhubaneswar and Mysore Demonstration Schools differ significantly when Pre- Pedagogical Skills of Teachers was considered as a covariate. Thus the null hypothesis that there is no significant difference in adjusted mean scores of Pedagogical Skills of Teachers belonging to Ajmer, Bhopal, Bhubaneswar and Mysore Demonstration Schools by considering Pre- Pedagogical Skills of Teachers as covariate is rejected. In order to know which Institute Teachers had significantly higher Pedagogical Skills, the data were further analysed with the help of t-test and the results are given in Table 16.

Table 16: Institution-wise adjusted Mean, SE, N and t-values of Pedagogical Skills of Teachers by considering Pre- Pedagogical Skills of Teachers as covariate

Institution	Adjusted Mean	SE	N	Bhopal	Bhubaneswar	Mysore
Ajmer	38.28	2.57	14	0.51	1.40	2.63*
Bhopal	36.64	1.96	24		2.32*	3.63**
Bhubaneswar	42.53	1.62	35			1.69
Mysore	46.92	2.04	23			

*Significant at the 0.05 level **Significant at the 0.01 level

From Table 16, it can be seen that the t-values of 0.51, 1.40 and 1.69 are not significant. It reflects that the adjusted mean scores of Pedagogical Skills of Teachers from Demonstration Schools of Ajmer and Bhopal; Ajmer and Bhubaneswar; and Bhubaneswar and Mysore do not differ significantly. It means that Teachers from Ajmer and Bhopal; Ajmer and Bhubaneswar; and Bhubaneswar and Mysore were found to have Pedagogical Skills to the same degree. Further adjusted mean scores of Pedagogical Skills of Teachers from Ajmer Demonstration School is 38.28 which is significantly lower than those of Mysore Demonstration School Teachers whose adjusted mean scores of Pedagogical Skills of Teachers is 46.92. Thus, Teachers from Demonstration School of Mysore were found to have significantly better Pedagogical Skills as compared to those of Ajmer Demonstration School.

The t-value for Ajmer and Mysore Institutes is 2.63 which is significant at the 0.05 level with df=35 (vide Table 16). It shows that the adjusted mean scores of Pedagogical Skills of Teachers from Bhopal and Mysore Demonstration Schools differ significantly. Further the adjusted mean scores of Pedagogical Skills of Teachers from Mysore is 46.92 which is significantly higher than those of Bhopal Demonstration School whose adjusted mean score of Pedagogical Skills is 36.64. It may, therefore, be said that Mysore Demonstration School Teachers were found to have significantly better Pedagogical Skills than those of Bhopal Demonstration School Teachers.

Further the t-values of 2.32 and 3.63 are significant at the 0.05 and 0.01 level with df=57 and 45 respectively (vide Table 16). It shows that the adjusted mean scores of Pedagogical Skills of Teachers from Bhubaneswar and Mysore Demonstration School Teachers differ significantly from those of Bhopal. Further the adjusted mean scores of Pedagogical Skills of

Teachers from Bhubaneswar and Mysore are 42.53 and 46.92 respectively which are significantly higher than those of Bhopal Demonstration School whose adjusted mean score of Pedagogical Skills is 36.64. So Bhubaneswar and Mysore Demonstration Schools Teachers were found to have significantly better Pedagogical Skills than those of Bhopal Demonstration School Teachers.

4.1.10 Institution-wise Comparison of Adjusted Mean Scores of Professional Skills by Considering Pre- Professional Skills of Teachers as Covariate

The objective was to compare adjusted means scores of Professional Skills of Teachers belonging to Ajmer, Bhopal, Bhubaneswar and Mysore Demonstration Schools by considering Pre- Professional Skills of Teachers as covariate. The data were analysed with the help of One Way ANCOVA by considering Pre- Professional Skills of Teachers as covariate. The results are given in Table 17.

Table 17: Summary of One Way ANCOVA of Professional Skills by considering Pre-Professional Skills of Teachers as covariate

Source of Variance	df	$SS_{y.x}$	$MSS_{y.x}$	$F_{y.x}$ -Value
Institutions	3	398.07	132.69	1.78
Error	91	6775.70	74.46	
Total	95			

From Table 17, it can be seen that the adjusted F-Value for Institutions is 1.78 which is not significant. It indicates that the adjusted mean scores of Professional Skills of Teachers belonging to Ajmer, Bhopal, Bhubaneswar and Mysore Demonstration Schools did not differ significantly when Pre- Professional Skills of Teachers was considered as covariate. Thus the null hypothesis that there is no significant difference in adjusted mean scores of Professional Skills of Teachers belonging to Ajmer, Bhopal, Bhubaneswar and Mysore Demonstration Schools by considering Pre- Professional Skills of Teachers as covariate is not rejected. It may, therefore, be said that Teachers from demonstration schools of Ajmer, Bhopal, Bhubaneswar and Mysore were found to have Professional Skills to the same extent when pre- Professional Skills was considered as covariate.

4.1.11 Institution-wise Comparison of Adjusted Mean Scores of Overall Perception of Use of ICT In Teaching- Learning by Considering Pre-overall Perception of Use of ICT In Teaching- Learning of Teachers as Covariate

The objective was to compare adjusted means scores of Overall Perception of use of ICT in Teaching – Learning of Teachers belonging to Ajmer, Bhopal, Bhubaneswar and Mysore Demonstration Schools by considering Pre- Overall Perception of use of ICT in Teaching – Learning of Teachers as covariate. The data were analysed with the help of One Way ANCOVA by considering Pre- Overall Perception of use of ICT in Teaching – Learning of Teachers as covariate. The results are given in Table 18.

Table 18: Summary of One Way ANCOVA of Overall Perception of use of ICT in Teaching – Learning by considering Pre- Overall Perception of use of ICT in Teaching – Learning of Teachers as covariate

Source of Variance	df	$SS_{y.x}$	$MSS_{y.x}$	$F_{y.x}$ -Value	Remark
Institutions	3	28406.49	9468.83	3.18	p<0.05
Error	91	270968.38	2977.67		
Total	95				

From Table 18, it can be seen that the adjusted F-Value for Institutions is 3.18 which is significant at 0.05 level with df=3/91. It indicates that the adjusted mean scores of Overall Perception of use of ICT in Teaching – Learning of Teachers belonging to Ajmer, Bhopal, Bhubaneswar and Mysore Demonstration Schools differ significantly when Pre- Overall Perception of use of ICT in Teaching – Learning of Teachers was considered as covariate. Thus the null hypothesis that there is no significant difference in adjusted mean scores of Overall Perception of use of ICT in Teaching – Learning of Teachers belonging to Ajmer, Bhopal, Bhubaneswar and Mysore Demonstration Schools by considering Pre- Overall Perception of use of ICT in Teaching – Learning of Teachers as covariate is rejected. In order to know which groups adjusted the mean score of Overall Perception of use of ICT in Teaching – Learning is significantly higher than the other, the data were further analysed with the help of t-test and the results are given in Table 19.

Table 19: Institution-wise adjusted Mean, SE, N and t-values of Overall Perception of use of ICT in Teaching – Learning of Teachers by considering Pre- Overall Perception of use of ICT in Teaching – Learning of Teachers as covariate

Institution	Adjusted Mean	SE	N	Bhopal	Bhubaneswar	Mysore
Ajmer	346.39	14.70	14	0.34	1.76	2.58*
Bhopal	352.77	11.25	24		1.66	2.59*
Bhubaneswar	376.99	9.22	35			1.19
Mysore	394.77	11.65	23			

*Significant at 0.05 level

From Table 19, it can be seen that the t-values of 0.34, 1.76, 1.66 and 1.19 are not significant. It reflects that the adjusted mean scores of Overall Perception of use of ICT in Teaching – Learning of Teachers from Demonstration Schools of Ajmer and Bhopal; Ajmer and Bhubaneswar; and Bhopal and Bhubaneswar and Bhubaneswar and Mysore do not differ significantly. It means that Teachers from Ajmer and Bhopal; Ajmer and Bhubaneswar; and Bhopal and Bhubaneswar and Bhubaneswar and Mysore were found to have Overall Perception of use of ICT in Teaching – Learning to the same degree. Further adjusted mean scores of Overall Perception of use of ICT in Teaching – Learning of Teachers from Ajmer Demonstration School is 346.39 which is significantly lower than those of Mysore Demonstration School Teachers who's adjusted mean scores of Overall Perception of use of ICT in Teaching – Learning of Teachers is 394.77. Thus, Teachers from Demonstration School

of Mysore were found to have significantly better Overall Perception of use of ICT in Teaching – Learning as compared to those of Ajmer Demonstration School.

The t-value for Bhopal and Mysore Institutes is 2.59 which is significant at 0.05 level with df=45 (vide Table 19). It shows that the adjusted mean scores of Overall Perception of use of ICT in Teaching – Learning of Teachers from Bhopal and Mysore Demonstration Schools differ significantly. Further the adjusted mean scores of Overall Perception of use of ICT in Teaching – Learning of Teachers from Mysore is 394.77 which is significantly higher than those of Bhopal Demonstration School whose adjusted mean score of Overall Perception of use of ICT in Teaching – Learning is 352.77. It may, therefore, be said that Mysore Demonstration School Teachers were found to have significantly better Overall Perception of use of ICT in Teaching – Learning than those of Bhopal Demonstration School Teachers.

4.2 Findings of the study

The following were the findings of this study.

1. The teachers from Ajmer Demonstration School did not differ significantly from those of Bhopal, Bhubaneswar and Mysore. Teachers from these Demonstration schools were found to have a slightly favourable Reaction towards Use of ICT in Teaching-Learning. Further Bhopal and Bhubaneswar Demonstration Schools Teachers were found to have more favorable Reaction towards Use of ICT in Teaching-Learning than those of Mysore Demonstration School Teachers.
2. Teachers from Ajmer and Bhopal; Bhopal and Bhubaneswar; Bhopal and Mysore; and Bhubaneswar and Mysore Demonstration Schools were found to have the same type of Reaction toward Basic Computer Operations and Devices. Also Bhubaneswar and Mysore Demonstration Schools Teachers were found to have significantly more favourable Reaction toward Basic Computer Operations and Devices than those of Ajmer Demonstration School.
3. Teachers from Ajmer and Bhopal; and Bhubaneswar and Mysore Demonstration Schools were found to have the same type of Reaction toward Office and Teaching Productivity Tools. Bhubaneswar and Mysore Demonstration Schools Teachers were found to have significantly more favourable Reaction toward Office and Teaching Productivity Tools than those of Ajmer Demonstration School. Bhubaneswar and Mysore Demonstration Schools Teachers were found to have significantly more favourable Reaction toward Office and Teaching Productivity Tools than those of Bhopal Demonstration School.
4. Teachers from Ajmer and Bhopal; and Bhubaneswar and Mysore Demonstration Schools were found to have the same type of Reaction toward Internet and Network Application. Bhubaneswar and Mysore Demonstration Schools Teachers were found to have significantly more favourable Reaction toward Internet and Network Application than those of Ajmer Demonstration School. Bhubaneswar and Mysore Demonstration Schools Teachers were found to have significantly more favourable Reaction toward Internet and Network Application than those of Bhopal Demonstration School.
5. Teachers from Ajmer and Bhopal; and Bhubaneswar and Mysore Demonstration Schools were found to have the same type of Reaction toward Information and Data Management. Bhubaneswar and Mysore Demonstration Schools Teachers were found to have

significantly more favourable Reaction toward Information and Data Management than those of Ajmer Demonstration School. Bhubaneswar and Mysore Demonstration Schools Teachers were found to have significantly more favourable Reaction to Reaction toward Information and Data Management than those of Bhopal Demonstration School.

6. Demonstration Schools Teachers of Ajmer, Bhopal, Bhubaneswar and Mysore were found to have low Confidence in Using ICT.
7. Teachers from Ajmer and Bhopal as well as Bhubaneswar and Mysore Demonstration Schools did not differ significantly in respect of Skill of Technology Operations and Concepts. Teachers from Demonstration Schools of Bhubaneswar and Mysore were found to have significantly better Skill of Technology Operations and Concepts as compared to those of Ajmer Demonstration School. Also Bhubaneswar and Mysore Demonstration Schools Teachers were found to have significantly better Skill of Technology Operations and Concepts than those of Bhopal Demonstration School Teachers.
8. Demonstration Schools Teachers of Ajmer, Bhopal, Bhubaneswar and Mysore were found to have average Social and Ethical Values when the groups were matched statistically with respect to Pre- Social and Ethical Values of Teachers.
9. Teachers from Ajmer and Bhopal Demonstration Schools; Ajmer and Bhubaneswar; and Bhubaneswar and Mysore were found to have Pedagogical Skills to the same extent. Teachers from Demonstration School of Mysore were found to have significantly better Pedagogical Skills as compared to those of Ajmer Demonstration School. Mysore Demonstration School Teachers were found to have significantly better Pedagogical Skills than those of Bhopal Demonstration School Teachers. Finally Bhubaneswar and Mysore Demonstration Schools Teachers were found to have significantly better Pedagogical Skills than those of Bhopal Demonstration School Teachers.
10. Teachers from demonstration schools of Ajmer, Bhopal, Bhubaneswar and Mysore were found to have Professional Skills to the same extent when pre- Professional Skills was considered as covariate.
11. Teachers from Ajmer and Bhopal; Ajmer and Bhubaneswar; and Bhopal and Bhubaneswar and Bhubaneswar and Mysore were found to have Overall Perception of use of ICT in Teaching – Learning to the same degree. Teachers from Demonstration School of Mysore were found to have significantly better Overall Perception of use of ICT in Teaching – Learning as compared to those of Ajmer and Bhopal Demonstration Schools.

4.3. Conclusion

"We need technology in every classroom and in every student and teacher's hand, because it is the pen and paper of our time, and it is the lens through which we experience much of our world." ~ David Warlick

As David Warlick predicted, technology has indeed become the pen and paper of the contemporary world, one cannot deny its significance in school education. National Curriculum Framework (2005) as the leading document/guideline for school education in India emphasizes the role that a teacher plays in facilitating any idea or concept in the classroom lending strength

to the claim that the full potential of using ICT in education can only be attained when teachers have that competency to use ICT in their teaching-learning processes. We live in a technologically fast changing world. We are already witnessing some of the significant social and economic consequences of ICT and its impact on education. One of the strategies to be adopted in this regard is the production of teachers who have developed competencies for the successful instructional use of ICT in education. The teachers are called 21st century teachers who will possess the technological, pedagogical, didactical and social competencies in them and they will shape the future personality of their pupil. To develop 21st-century skills among students ICT becomes a great resource, but this is only possible when teachers are using ICT smartly and have conviction in the positive usage of ICT in education. ICT competency can be developed through positive attitude building, which can be possible initially through pre-service programs. Teacher preparation should not be based on training for "Computer Literacy" but should prepare teachers for using technologies to construct, represent and share knowledge in real life authentic contexts. Research shows that teachers tend to teach the way that they were taught (Ball, 1990, Lortie, 1975). Factors like infrastructure, encouragement to use ICT, selection of pedagogical skills, social and ethical values, skills of data management majorly affect the teachers' ICT competency, whereas the effect of regional difference on teachers' ICT competency is less evident. Therefore, these factors should be considered while designing ICT curriculum for teacher training program. For developing teachers' ICT competency, educationists, policymakers, schools, universities need to give proper training to teachers during pre-service and in-service programs, so that teachers can become confident enough to merge ICT skills with their pedagogy and create a digital classroom, where education will be accessible for all students. CT should be a compulsory course in all teacher preparation institutions.

References

Agbo I. (2015). Factors Influencing the Use of Information and Communication Technology (ICT) in Teaching and Learning Computer Studies in Ohaukwu Local Government Area of Ebonyi State-Nigeria. Journal of Education and Practice, v6 n7 p71-86 2015.

Almerich G., Orellana N., Suárez J. M. & Díaz García M. (2016). *Teachers' information and communication technology competences: A structural approach.* Computers & Education. 100. 10.1016/j.compedu.2016.05.002.

Almerich G., Orellana N., Suárez J. M. & Díaz García M. (2016). *Teachers' information and communication technology competences: A structural approach.* Computers & Education. 100. 10.1016/j.compedu.2016.05.002.

Amin S. (2013). An effective use of ICT for education and learning by drawing on worldwide knowledge, research and experience: ICT as a change agent for education (A Literature review). Scholarly Journal of Education Vol. 2(4), pp. 38-45, April 2013. 42. 38-45.

Basargekar P. & Singhavi C. (2017). *Factors Affecting Teachers' Perceived Proficiency in Using ICT in the Classroom.* IAFOR Journal of Education. 5. 10.22492/ije.5.2.03.

Bhattacharjee B. and Deb K. (2016). *Role of ICT in 21st Century's Teacher Education* International. Journal of Education and Information Studies.ISSN 2277-3169 Volume 6, Number 1.

Bingimlas K. (2009). *Barriers to the Successful Integration of ICT in Teaching and Learning Environments: A Review of the Literature.* Eurasia Journal of Mathematics Science & Technology Education. 5. 235-245. 10.12973/ejmste/75275.

Botturi, L. (2019). *Digital and media literacy in pre-service teacher education: A case study from Switzerland*. Nordic Journal of Digital Literacy. 14. 147-163. 10.18261/issn.1891-943x-2019-03-04-05.

Brevik L. M., Guðmundsdóttir G. B., Lund A. & Strømme T. A. (2019). *Transformative agency in teacher education: Fostering professional digital competence.* Teaching and Teacher Education. 86. 10.1016/j.tate.2019.07.005.

Cantabrana J. L. L., Usart M. & Gisbert M. (2019). *Assessing Teacher Digital Competence: the Construction of an Instrument for Measuring the Knowledge of Pre-Service Teachers.* Journal of New Approaches in Educational Research. 8. 73-78. 10.7821/naer .2019.1.370.

Dagdilelis V. & Xinogalos S. (2012). *Preparing Teachers for Teaching Informatics: Theoretical Considerations and Practical Implications.* ACM International Conference Proceeding Series. 10.1145/2481449.2481468.

Dinçer, S. (2018). Are preservice teachers really literate enough to integrate technology in their classroom practice? Determining the technology literacy level of preservice teachers.

Education and Information Technologies. 23. 2699-2718. 10.1007/s10639-018-9737-z.

Dong C. (2018). *'Young children nowadays are very smart in ICT' – preschool teachers' perceptions of ICT use.* International Journal of Early Years Education. 1-14. 10.1080/09669760.2018.1506318.

Elstad E. & Christophersen K.. (2017). Perceptions of Digital Competency among Student Teachers: Contributing to the Development of Student Teachers' Instructional Self-Efficacy in Technology-Rich Classrooms. Education Sciences. 7. 27. 10.3390/educsci7010027.

Engen B., Giaever T. & Mifsud L. (2015). Guidelines and Regulations for Teaching Digital Competence in Schools and Teacher Education: A Weak Link?. Nordic Journal of Digital Literacy. 2015. 172-186.

Engen, B. (2019). Understanding social and cultural aspects of teachers' digital competencies. Comunicar. 27. 10.3916/C61-2019-01.

From J. (2017). *Pedagogical Digital Competence—Between Values, Knowledge and Skills.* Higher Education Studies. 7. 43. 10.5539/hes.v7n2p43.

Gasaymeh A., Hasanat H., Kraishan O. & Abutayeh K. (2017). Motivational Factors Affecting the Integration of Information and Communication Technology (ICT) in Education by Faculty Members: A Developing Country Perspective. International Journal of Education,9(3), 168-182

Goldstein O., Waldman N., Tesler B., Forkosh A. B., Shonfeld M., Mor N., Heilweil I., Zelkovitz Z., Zidan W. & Kozminsky, Lea. (2011). *The current state of pre-service teachers training for ICT based teaching in Israel: 2008-2009.*

Gómez-Trigueros I. M., Ruiz-Bañuls M. & Ortega-Sánchez D. (2019). Digital Literacy of Teachers in Training: Moving from ICTs (Information and Communication Technologies) to LKTs (Learning and Knowledge Technologies). Education Sciences. 9. 274. 10.3390/educsci9040274.

Gregory S., Scutter S., Jacka L., McDonald M., Farley H. & Newman C. (2015). Barriers and Enablers to the Use of Virtual Worlds in Higher Education: An Exploration of Educator Perceptions, Attitudes and Experiences. Educational Technology & Society. 18. 3-12.

Gruenwald N., Melnikova J., Ahrens A. & Zascerinska J. (2018). *Adult educators' ICT competence and ways for its development.*

Guðmundsdóttir G. & Hatlevik O. (2017). *Newly qualified teachers' professional digital competence: implications for teacher education.* European Journal of Teacher Education. 1-17. 10.1080/02619768.2017.1416085.

Guillen-Gamez F. & Fernández-López M. (2017). A Study About Professional Training And The Use That High School Teachers Do of ICT And The Virtual MOODLE Platform. 226-232. 10.21125/iceri.2017.0105.

Guillen-Gamez F. D., Fernández M. M., Bravo J. & Escribano-Ortiz D. (2020). *Analysis of Teachers' Pedagogical Digital Competence: Identification of Factors Predicting Their Acquisition.* Technology, Knowledge and Learning. 10.1007/s10758-019-09432-7.

Guillen-Gamez F. D., Lugones A. & Fernández M. M. (2019). ICT use by pre-service foreign languages teachers according to gender, age and motivation ICT use by pre-service foreign languages teachers according to gender, age and motivation. Cogent Education. 10.1080/2331186X.2019.1574693.

Guillen-Gamez F., Fernández M. & García, F. J. (2018). *A Study on the Actual Use of Digital Competence in the Practicum of Education Degree.* Technology, Knowledge and Learning. 10.1007/s10758-018-9390-z.

Hsu H., Wang S & Runco L. (2013). Middle School Science Teachers' Confidence and Pedagogical Practice of New Literacies. Springer, 314-324.

Husain N. (2010). Teacher Competencies for the Use of Information Communication Technology. Journal of Indian Education. Vol. XXXVI.

Instefjord E. & Munthe E. (2017). Educating digitally competent teachers: A study of integration of professional digital competence in teacher education. Teaching and Teacher Education. 67. 37-45. 10.1016/j.tate.2017.05.016.

John W. Best & James V. K. (2016). Research in Education Tenth Edition. Pearson; 10 edition.

Kalogiannakis M. (2010). *Training with ICT for ICT from the trainee's perspective. A local ICT teacher training experience.* Education and Information Technologies. 15. 3-17. 10.1007/s10639-008-9079-3.

Kapur, R. (2019). The Significance of ICT in Education.

Karataş I., Tunc M.P., Yılmaz N. & Karaci G. (2017). An investigation of technological pedagogical content knowledge, self-confidence, and perception of pre-service middle school mathematics teachers towards instructional technologies. Educational Technology and Society. 20. 122-132.

Khan, M. S. & Hasan M. (2013). Introducing ICT into Teacher-Training Programs: Problems in Bangladesh. Journal of education and practice. 4.

Khashkhuu A. (2017). ICT Competency Level of Teacher in the MUST.

Koehler M., Mishra P. & Cain W. (2013). *What is Technological Pedagogical Content Knowledge (TPACK)?.* Journal of Education. 193. 13-19. 10.1177/002205741319300303.

Lawrence A. S. A. & Veena K. (2012). *Improving Teacher Competency Through ICT.* ICTE solutions.

Lawrence J. & Tar U. (2018). *Factors that influence teachers' adoption and integration of ICT in teaching/learning process.* Educational Media International. 55. 1-27. 10.1080/09523987.2018.1439712.

Li S., Yamaguchi S., Sukhbaatar J. & Jun-ichi T. (2019). The Influence of Teachers' Professional Development Activities on the Factors Promoting ICT Integration in Primary Schools in Mongolia. Education Sciences. 9. 78. 10.3390/educsci9020078.

Lim C. P. (2007). Effective integration of ICT in Singapore schools: Pedagogical and policy implications. ERA 2010. 55. 10.1007/s11423-006-9025-2.

Lim, C. P., Oakley G., & Tay L. Y. (2013). *Information and Communication Technologies (ICT) in Primary Education.* SensePublishers. Rotterdam. 978-94-6209-086-6

Lund A., Furberg A., Bakken J. & Engelien K. (2014). *What Does Professional Digital Competence Mean in Teacher Education?.* Nordic Journal of Digital Literacy. 2014. 281-299.

Mahajan G. (2016). Attitude of Teachers towards the use of Technology in Teaching. *Educational Quest- An International Journal of Education and Applied Social Sciences.* 7. 141. 10.5958/2230-7311.2016.00031.3.

Marci-Boehncke G. & Vogel T. (2018). Digital Literacy And Inclusion: The Impact of Theory And Practice in Teachers' Education. 6872-6879. 10.21125/inted.2018.1618.

Mathevula, M. D. & Uwizeyimana D. E. (2014). *The Challenges Facing the Integration of ICT in Teaching and Learning Activities in South African Rural Secondary Schools.* Mediterranean Journal of Social Sciences, 5(20), 1087. Retrieved from http://www.richtmann.org/journal/index.php/mjss/article/view/3840

Melnikova, J. & Zascerinska, J. & Gruenwald, N. & Ahrens, A. (2019). *Adult Educators' ICT Competence in Latvia, Lithuania And Germany: Theoretical Framework. Individual. Society. State.* Proceedings of the International Student and Teacher Scientific and Practical Conference. 52. 10.17770/iss2018.4252.

Ministry of Human Resource and Development (2012). *National Policy on Information and Communication Technology (ICT) In School Education.* Department of School Education and Literacy Ministry of Human Resource Development Government of India.

Moersch, C. (2011). *Turning Up the H.E.A.T. on Student Learning: Assessing 21st Century Skills in Classrooms Today.* Educational Technology, 51(3), 43-46. Retrieved February 6, 2020, from www.jstor.org/stable/44430007

Napal M., Peñalva A. & Lacambra A. (2018). *Development of Digital Competence in Secondary Education Teachers' Training.* Education Sciences. 8. 104. 10.3390/educsci8030104.

Ngobeni, V. (2017). *Teachers' reasons for and against ICT integration into teaching and learning: a mixed methods approach.* Wits School of Education, Faculty of Humanities University of the Witwatersrand in fulfillment of the requirements for the Masters' Degree Johannesburg

Oliver R. (2002). The role of ICT in higher education for the 21st century: ICT as a change agent for education.

Olofsson, A. D., Fransson G. & Lindberg J. O. (2019). A study of the use of digital technology and its conditions with a view to understanding what 'adequate digital competence' may mean in a national policy initiative. Educational Studies. 1-17. 10.1080/03055698.2019.1651694.

Ottestad G., Kelentrić M. & Guðmundsdóttir G. (2014). *Professional Digital Competence in Teacher Education.* Nordic Journal of Digital Literacy. 9. 243-249.

Ozdamli F. (2017). *Attitudes and opinions of special education candidate teachers regarding digital technology.* World Journal on Educational Technology: Current Issues. 9. 191. 10.18844/wjet.v9i4.2581.

Pettersson F. (2017). *On the issues of digital competence in educational contexts – a review of literature.* Education and Information Technologies. 1-17. 10.1007/s10639-017-9649-3.

Rathnabai A. (2019). Development of Model for ICT Integrated School system. NCERT, New Delhi.

Research Methods: What are research methods?. (2019) The University of Newcastle.

Roig-Vila R., Mengual-Andres S. & Quinto Medrano P. (2015). *Primary Teachers' Technological, Pedagogical and Content Knowledge.* Comunicar. 23.10.3916/C45-2015-16.

Sergis S. & Sampson D. (2014). *From Teachers' to Schools' ICT Competence Profiles.* 10.1007/978-3-319-02264-2_19.

Siddiq F., Scherer R. & Tondeur J. (2015). Teachers' Emphasis on Developing Students' Digital Information and Communication Skills (TEDDICS): A New Construct in 21st Century Education. Computers & Education. 92-93. 10.1016/j.compedu.2015.10.006.

Silva J., Usart M. & Lázaro-Cantabrana J. (2019). *Teacher's digital competence among final year Pedagogy students in Chile and Uruguay.* Comunicar. 27. 10.3916/C61-2019-03.

Solesa D. & Soleša-Grijak D. (2011). *ICT competences of teachers and educators.* Odgojne Znanosti. 13.

Suárez J. M., Almerich G., López B. & Aliaga F. (2010). Competencies in ICT of teachers and their relation to the use of the technological resources Las competencias en TIC del profesorado y su relación con el uso de los recursos tecnológicos Competências em TIC dos professores e sua relação com o uso de recursos tecnológicos. Education Policy Analysis Archives. 18. 10.14507/epaa.v18n10.2010.

Suárez J. M., Almerich G., Orellana N. & Díaz García M. I. (2018). *A basic model of integration of ICT by teachers: competence and use.* Educational Technology Research and Development. 66. 10.1007/s11423-018-9591-0.

Tømte C., Enochsson A., Kårstein A. & Buskqvist U. (2015). *Educating online student teachers to master professional digital competence: The TPACK-framework goes online.* Computers & Education. 84. 26–35. 10.1016/j.compedu.2015.01.005.

Tondeur J., Aesaert K., Prestridge S. & Consuegra E. (2018). *A multilevel analysis of what matters in the training of pre-service teacher's ICT competencies.* Computers & Education. 122. 10.1016/j.compedu.2018.03.002.

United Nations Educational Scientific and Cultural Organization (UNESCO). (2008). *ICT competency standards for teachers.* CI.2007/WS/19.

Vargas-D'uniam J., Chumpitaz Campos L., Suárez-Díaz G. & Badia A. (2014). Teaching of Relationship between the digital competencies of primary school teachers and the educational use of technology in the classroom. Profesorado. 18. 361-376.

Watson D. (2003). *The Teacher - A Forgotten Stakeholder?*. 29-38. 10.1007/978-0-387-35701-0_3.

Yogesh K. S. (2006). *Fundamentals of Research Methodology and Statistics.* New Age International (P) Limited, Publishers.

Annexure-I

Questionnaire for Teachers

1. What is your email address?
2. What is your name?
3. What is your mobile number?
4. What is your institute name?
5. Which district are you from?
6. Level of teaching
   i. Primary level
   ii. Upper primary
   iii. Secondary
   iv. Higher secondary
   v. Administrator
7. Listed below are some statements concerning confidence in using ICT in the teaching-learning process. Please indicate the degree of confidence to each of the statement below by selecting the appropriate option.

   Note:
   1 Not confident
   2 Very less confident
   3 Less confident
   4 confident
   5 Highly confident

	1	2	3	4	5
I can handle all ICT tools					
I can use ICT for my personal and professional purposes					
I can use ICT effectively in teaching					
I can evaluate ICT tools					
I can select the appropriate ICT tool to use in my teaching					
I can design ICT-enhanced learning activities for my students					
I can prepare learning material using ICT					
I can give appropriate answers about ICT whenever questions are asked by students					

I can solve the problems that arise when using ICT in the teaching-learning process					
I can teach my students to use ICT					

8. Please indicate your reaction to each of the following statements by checking the option that represents your level of agreement or disagreement with it. Make sure to respond to every statement.Note:
   1 Strongly disagree
   2 Disagree
   3 Neutral
   4 Agree
   5 Strongly agree

	1	2	3	4	5
ICT enhances students' learning					
ICT provides better learning experiences					
ICT gives an opportunity to learn more.					
I have a phobia for ICT equipment.					
I need to work harder if I have to use ICT.					
I learn more from ICT than I do from books.					
ICT is useful in the dissemination of information.					
I won't have anything to do with ICT.					
Teaching with ICT tool offers real advantages over traditional methods of instruction					
Technology cannot improve the quality of students learning					
Using ICT in the classroom would make the subject matter more interesting					
ICT can not address the needs of the school system.					
It would be hard for me to learn to use the ICT for teaching					

Class time is too limited for use of ICT					
Use of ICT complicates my task in the classroom					
Everyone can easily learn to handle ICT equipments					
ICT has proved to be an effective learning tool					
There are other social issues that need to be addressed before using ICT in education					
Use of ICT tools encourage unethical practices					

9. Mark the extent of your identification with the following statements based on the scale below

   Note:
   1 Don't know
   2 Know very little but can't perform
   3 Can perform only with guidance
   4 Can perform with some guidance
   5 Can perform independently

	1	2	3	4	5
Identify and define the functions of the main components (i.e. monitor, CPU, keyboard, mouse) of the computer					
Identify and define the functions of computer peripherals (i.e. printer, scanner, modem, digital camera, speaker, etc.)					
Properly connect main components, configure peripherals and install drivers when required					
Configure computer settings of various software and hardware					
Understand the basic functions of the operating system					
Organize and manage computer files, folders and directories					

Use storage devices (i.e. hard disk, diskette, CD, flash memory, etc.) for storing and sharing computer files. Create back-ups of important files					
Protect the computer from virus, spyware, adware, malware, hackers etc.					
Use online and offline help facilities for troubleshooting, maintenance and update of applications"					
Locate and run appropriate teaching productivity tools					
Use a word processor to enter and edit text and images					
Format text, control margins, layout and tables					
Print, store and retrieve text documents from a word processor					
Use a spreadsheet to enter data, sort data and format cells into tables					
Make computation, use formula and create graphs using spreadsheets					
Print and store data tables using a spreadsheet application					
Use a presentation package to add text and sequence a presentation					
Enhance presentations by adding sound, customizing animation and inserting images					
Print presentation handouts and store slide presentations					
Make effective class presentations using the slides and LCD projector					
To acquire digital images and other media from web sites, CD, flash drives, etc.					
Crop, scale, colour correct and enhance digital images					

Play various media files using appropriate media players					
Stitch together video footages and soundtracks and add simple enhancements - transitions, titles, etc.					
Attach and configure scanners, cameras, cell phones and acquire digital images					
Store digital images using optical media (CD, DVD, flash disk) and online Repositories					
Connect to the internet via dial-up or LAN					
Configure and use Web Browsers and Help applications					
Send and receive emails with attachments, manage emails and use LAN and Web-based mail servers					
Use synchronous and asynchronous web-based communication tools like instant messengers, voice and teleconferencing					
Use the web camera to communicate on the internet					
Connect and use shared printers, shared folders and other devices within a network					
Use search engines, web directories and bookmarks					
Download and install relevant applications including freeware, shareware, updates, patches, viewers and support applications					
Create resources using web authoring tools					
Use search engines, directories, crawlers and agents to locate information sources					
Search and collect textual and non-textual information from online and offline sources					

Store and organize collected information using directories, drives, or databases					
Distribute, share, publish and print information via print or web					
Acknowledge information sources – online and offline					

10. Mark the extent of your identification with the following statements based on the scale below.

Note:
1 Don't know
2 Know very little but can't perform
3 Can perform only with guidance
4 Can perform with some guidance
5 Can perform independently

	1	2	3	4	5
Understand the legal implications of Software Licenses and Fair Use					
Understand and explain the basic concepts of Intellectual Property Rights					
Differentiate and identify the Copyright, Trademark, Patent of various products					
Detect plagiarism in student work					
Appropriately acknowledge sources used in own work					
Be an Anti Piracy advocate for all products with IPR like music, data, video and software					
Advocate the responsible use of various technologies like computers, cell phones, etc.					
Show respect for privacy and cyber etiquette, phone etiquette and similar use of technology					
Demonstrate proper handling of computer devices and the use of applications					

Monitor how students use the computer specifically on software, hardware, computer games, and internet activities					
Maintain a clean and orderly learning environment for students					
Promote and implement rules and regulations on properly using computers					
Accurately report malfunctions and problems with computer software and hardware					
Design class activities to minimize the effect on students being disadvantaged or left-out					
Help minimize the effects of the digital divide by providing access to digital materials for all students					
Prepare lessons and activities appropriate to the level of learning and cultural background of the student					
Adapt activities using specialized hardware and software for physically disadvantaged student					

11. Mark the extent of your identification with the following statements based on the scale below

    Note:
    1 Don’t know
    2 Know very little but can't perform
    3 Can perform only with guidance
    4 Can perform with some guidance
    5 Can perform independently

	1	2	3	4	5
Use appropriately presentations, videos, audio, interacts, subject-specific tools etc in the classroom					
Identify, select, and evaluate ICT resources and resources that support instruction					

Use various synchronous and asynchronous communication tools (email, chat, whiteboards, forum, blogs) to facilitate cooperative learning and exchange of ideas and information					
Connect various hardware available in the classroom (connecting mobile to a projector, TV to a projector, mobile to TV etc)					
Explore the use of electronic assessment tools like online testing, submission of projects via email or online facilities					
Design rubrics for assessing student performance in the use of various technologies					
Use electronic means of administering quizzes and examinations					
Analyze assessment data using spreadsheets and statistical applications					
Use emails, group sites, blogs, etc. for disseminating information directly to students, colleagues and parents					
Use emails, group sites, blogs, etc. to collect information and feedback directly from students, colleagues and parents					
Set up online databases or repositories of student works					
Teach students to use various tools for the report and class Presentations					
Make students use databases, spreadsheets, concept mapping tools and communication tools, etc.					
Encourage students to do data analysis, problem-solving, decision making and exchange of ideas					

12. Mark the extent of your identification with the following statements based on the scale below

Note:

1 Don’t know
2 Know very little but can't perform
3 Can perform only with guidance
4 Can perform with some guidance
5 Can perform independently

	1	2	3	4	5
Identify educational sites and portals suitable to their subject area					
Join online communities, subscribe to relevant mailing lists and online journals					
Review new and existing software for education					
Recommend useful and credible websites to colleagues					
Conduct research on the use of technology in the classroom					
Follow online tutorials or online courses					
Actively participate in online forums and discussions					
Publish (formal /informal) research on the use of ICT in education					
Share lesson plans, worksheets, templates and teaching materials through various ways like website, course portals, repositories etc					
Decide the ICT requirements for a classroom					
Contribute to implementation of ICT programmes at various					