AN INVESTIGATION OF FACULTY COMPETENCE TOWARDS TECHNOLOGY INTEGRATION AT HIGHER EDUCATION LEVEL

By

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NATIONAL UNIVERSITY OF MODERN LANGUAGES, ISLAMABAD

February, 2023

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M.Phil. PMAS Arid Agriculture University, Rawalpindi, 2017

A THESIS SUBMITTED IN THE PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF

DOCTOR OF PHILOSOPHY

IN EDUCATION

To
Department of Educational Sciences

FACULTY OF SOCIAL SCIENCES

NATIONAL UNIVERSITY OF MODERN LANGUAGES, ISLAMABAD

February 2023

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ABSTRACT

Thesis Title: An Investigation of Faculty Competence towards Technology Integration at Higher Education Level

The current study was conducted to investigate the technology integration competencies of university teachers on the basis of conceptual framework which unifies Substitution, Augmentation, Modification and Redefinition (SAMR) model and Bloom's revised taxonomy. Major objectives of the study were to examine the faculty perceptions regarding their competence towards technology integration at higher education level with reference to SAMR model in the backdrop of Bloom's taxonomy, to diagnose the differences in faculty competence towards technology integration at higher education level on the basis of sector, gender, qualification, experience, designation, disciplines and age, to explore the views of heads regarding faculty competence towards technology integration, and to propose a model for technology integration on the basis of research. Mixed method approach and convergent parallel design was used to conduct the study. Targeted population contained 4233 faculty members and 380 heads of Social Sciences and Management Sciences, teaching in 32 public and private sector universities of Punjab. For indicating appropriate representation to each strata, 14% of both sectors were selected for the sample from faculty members. Therefore, the sample consisted 593 teaching faculty (358 public sector and 235 private sector). For qualitative sample the researcher selected 30 heads from both public and private universities (13 heads from public sector and 17 heads from private sector). A self-developed questionnaire based on SAMR model and Bloom's revised taxonomy, a standardized checklists and semi-structured interview were utilized to collect the information from university teachers and heads of departments. The alpha reliability of the technology integration scale was 0.79. Findings revealed that higher education teachers were practicing technology integration. The study indicated that most of the respondents were practicing ICT learning activities at the middle levels of the SAMR model. Study also found differences in technology integration on the basis of sector, gender, qualification, experience, designation, faculties, age. The quantitative responses indicated that teachers in social sciences were practicing the technology integration at augmentation level of the SAMR model but in few cases they used modification level. In management sciences teachers were found practicing and utilizing the ICT tools at augmentation and modification level. The major themes emerged from questions were teachers' understanding of SAMR model and greater learning opportunities at higher levels of SAMR model. Study recommended that faculty Competence may be elevated from enhancement towards transformation through increase in digital knowledge, skill and attitude by periodic trainings, rewards, incentives and exposure towards more rich, technological and digitized environment. This may help towards attitude formation which is highest level of Bloom's taxonomy as well. The study also proposed a model for technology integration for HEIs in Pakistan. The model is flexible enough to cope with changes and reforms in HEIs. The phases of the model are interlinked and feedback from stakeholders directly goes back to the system in the form of opinions and suggestions to effectively incorporate technology.

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LIST OF ABBREVIATIONS

Abbreviation	Terms
ANOVA	Analysis of Variance
d.f	Degree of Freedom
Diff.	Difference
EdTech	Educational Technology
EFA	Exploratory Factor Analysis
EFA	Education for All
EFL	English Foreign Language
ESL	English as a Second Language
F	Value of ANOVA
H	Hypotheses
HEC	Higher Education Commission
HEIs	Higher Education Institutions
ICT	Information and Communication Technologies
LMS	Learning Management System
MS	Management Sciences
N	Number
NETP	National Educational Technology Plan
OECD	Organization for Economic Co-operation and Development
PD	Professional Development
Q	Questions
SAMR	Substitution, Augmentation, Modification & Redefinition
SD	Standard Deviation
Sig.	Significance
SPSS	Statistical Package for Social Sciences
SS	Social Sciences
STEM	Science, Technology Engineering, and Mathematics
t	Independent t-test value
TAM	Technology Acceptance Model
TI	Technology Integration
TRA	Theory of Reasoned Action
ZPD	Zone of Proximal Development

LIST OF APPENDICES

ACKNOWLEDGEMENTS

First of all I am really thankful to Allah Almighty (SWT), who gave me capability to complete this dissertation. Then I would like to thank our Holy Prophet, Muhammad (PBUH) whose teachings enabled us to recognize our Creator.

I would like to extend my sincerest gratitude to my esteemed supervisor Dr. Wajeeha Aurangzeb, for her unwavering support and encouragement throughout my research journey. Her expertise, knowledge, and endless support have been invaluable to me, and I am forever grateful for her commitment to my success.

I am grateful to Prof. Dr. Khalid Sultan (Dean, Faculty of Social Sciences) for his unwavering support, encouragement and guidance. I am deeply grateful for the invaluable role the Dean has played for fostering an environment where every student and faculty member feel valued and respected.

I would also extend my gratitude to all my teachers for their motivation, guidance and cooperation. I am immensely grateful to my parents, who have always been my source of inspiration and encouragement throughout my life. Their unwavering support and love has been the foundation of my academic journey, and I am truly thankful for their sacrifices and dedication. I would also like to express my heartfelt thanks to my brothers and sisters for their encouragement and support throughout my academic pursuits.

Finally, I would like to thank my class fellows and friends. Your unwavering support and encouragement have been a constant source of comfort, and I am grateful for your presence in my life.

Zia Ur Rehman

Dedication

I dedicated this humble effort, the fruit of my thoughts and study to my affectionate Parents and Teachers.

CHAPTER 1

INTRODUCTION

Technology has an impact on our daily lives. As a result of COVID-19, the major source of classroom teaching has become watching online content, revising a paper, and editing a research paper etc. According to the Teaching with Technology strategy, "great teachers motivate students to completely participate and produce their best work" (Heintzelman, 2018). Educators who have had a well-versed education are able to create possibilities for their pupils in the classroom. This includes completing school online, applying for jobs, starting a company, producing visuals, and even making music. It depends on the individual's requirements and desires. Teachers are able to provide these chances to their students, so expanding their access to opportunities. If the instructors are eager and capable, these technological opportunities will arise in the classroom. There may be obstacles preventing instructors from offering these possibilities. Hew & Cheung (2012) indicated that internal and external barriers are the most prevalent obstacles that might hinder technology integration in the classroom. The internal hurdles include instructors' self-perceptions, beliefs, and confidence in bringing technology into the classroom (Spencer, 2019).

Utilizing the SAMR model is one approach for educators to consider their technology integration (Puentedura, 2018). SAMR is a technique to introduce a different perspective on the usage of technology in the classroom. Utilizing the SAMR paradigm would affect the professional development of educators. In addition, it will raise understanding of the many sorts of technology and help teachers improve their own instruction, "which will influence their students" (Rafiq, Hussain, & Abbas, 2020). There have been major shifts in teachers' views on technology, according to research. Muratie, &

Ceka (2017) reported that throughout the course of their study, conventional instructors' perceptions of technology shifted; teachers began to consider technology as more than a tool for increasing learning.

Recent study has demonstrated that technology is bringing significant change to schools. Due to technological progress, the function of the teacher is one of these alterations (Mushtaq, 2015). According to Onyema et al. (2020), the pros and cons of technology use in the classroom have been revised (p. 1). "As the use of technology increases, instructors are adapting to how it influences education. Onyema et al. (2020) continued by stating that modern education necessitates significant technology integration, and that instructors must develop methods to employ digital tools in the classroom (p. 1).

Changes in technology usage are beginning to demonstrate that educators are unprepared to incorporate technology (Wasilko, 2020). There are issues that may cause instructors to struggle with the incorporation of technology in the classroom. Perry (2018) claimed that instructors' lack of confidence and ability in integrating technology into the learning process are factors in the classroom's lack of technology utilization. 55% of participants in a 2019 research cited a lack of familiarity with technology as a reason for not utilizing it (Maxey, & Norman, 2019). According to the research of Jenkins (2021), the link between computers and student achievement depends on the teachers. Various approaches of technology integration in the learning process have been offered by research studies, and instructors can profit according to their particular educational culture (Horgan, 2019). When instructors have witnessed the wonderful effects that technology can have, they naturally utilize technology more.

Lack of experience with technology may account for the ineffective use of technology (Guggemos, & Seufert, 2021). Despite the availability of gear and software, many educators prefer traditional teaching methods (Eze, 2016). In many classes, teachers depend largely on textbooks and pay little attention to students' specific needs (Camelia, & Ferris, 2011). In this period, the function of the instructor has gotten more intricate. In addition to being able to offer good teaching, they are now expected to master the digital skills of technology integration and play a key role as subject specialist and technology scholar (Cotton, 2021).

Technology is an ever-evolving tool, with daily developments resulting in faster and simpler ways to accomplish things. While technology can be used for entertainment, it can also be utilized to learn new ideas and information. Teachers have had the option over the past two decades to move from a lecture-style classroom to a more technological approach reliant on technology in the instruction (Asad et al., 2020). Technology is increasingly progressing in education, with numerous online applications and tools becoming increasingly common and prevalent in the daily lives of higher education students (Sawyer, 2017).

As technology tools become more accessible in higher education, teachers are encouraged to incorporate technology into their daily lectures. Furthermore, teachers are responsible for educating learners for the future with technology-readiness abilities by making technology accessible, routine, transparent, and supportive in assisting students in achieving learning goals and becoming global citizens (Muratie & Ceka, 2017).

The purpose of this research is to determine teachers’ technology integration in public and private sector universities of Pakistan; it measures faculty competence towards technology integration concerning to SAMR Model and Bloom’s Taxonomy; find out the differences in faculty competence toward technology integration at higher education level based on demographics; explore the challenges of technology integration at higher education level; propose a model for technology integration based on research gaps in the public and private sector.

Research studies indicated that for some teachers level of technology utilization is marginal or fundamental, while others' level of integration is adequate and technology usage is effortless. Many possible reasons involved in the difference between technology integration and its effects on teaching and learning, including the socioeconomic status of the learner, infrastructure, finances, accessibility, the role of management, teachers' beliefs, self-efficacy and attitudes, and professional training etc. The key factor of technology integration is the knowledge and understanding of the association between content, pedagogy, and the appropriate technology. In most cases, teachers are unaware of the adequate and essential framework that helps create instructional activities with suitable technology. During instruction, when teachers face challenges and barriers to technology integration, they become less willing and less confident to integrate technology during the instructional process. It also decreases the chances of their using that particular technology in the future. Thus, it leads to teachers' resistance to technology integration during instruction or the preparation of instructional material. Technology-related workshops, training, and professional development are essential and significant factors supporting teachers using ICT during instruction. Teachers in higher education need continuous support from IT specialists and professional development opportunities to help with their technology integration competencies and overcome the integration challenges (Hilton, 2016).

More importantly, higher education students must be aware of using technologies to access the relevant information using online resources such as e-books, academic journals, research papers, and educational websites to gather information on various topics. Technology has the potential to enhance the learning experience by making it more interactive and engaging. Students can use various tools and software to create multimedia presentations, collaborate with peers (Anastasiades, & Zaranis, 2016).

According to Wright (2017), possibilities presented by the recent growth of technology in education have been mostly neglected. While technology has profoundly revolutionized many aspects of our society, for instance, in politics, economics, entertainment, commerce, and the workplace, it has been mostly overlooked and frequently inconsistently applied in education (Maryellen, 2017). Massive amounts of money are spent on constructing data systems to assess and monitor student understanding of prescribed learning material, as well as ranking universities and teachers, instead of creating engaging learning possibilities. Rather than being utilized to foster knowledge creation, technology is frequently employed to conceal drill and kill practices as meaningful content (Bruton, 2018).

Guggemos, & Seufert (2021) believe that there is an excessive focus on technology integration instead of technology-enabled learning. They assert that regardless of how many technology-related skills and resources we provide, without an equal emphasis on the teaching process, the professional training and tools have little to no effect on the technology integration of teachers and the interaction their learners have with technology. How technology tools are employed determines their classification because they possess a wide variety of overlapping qualities. Depending on incorporating an instructional tool at any time, the tool may be characterized as one of three or four different things. Furthermore, a tool or application may offer various options, but if a teacher decides not to utilize them, the technology is defined as fundamental. The emphasis may shift from encouraging digital tools and integration to empowering teachers in developing technology-based learning, asserting content-based pedagogy followed by considering all the tools a teacher might integrate, to enhance student learning.

Hammett (2018) enlightened the development of the SAMR model, as Puentedura (2014) introduced it to inspire educators by improving the quality of classroom instruction through implementation technology. Four levels lay under this model: Substitution, Augmentation, Modification, and Redefinition.

1.1 Rationale of the Study

Teachers in higher education have consistent access to instructional technology and professional development opportunities related to the various new and modern educational trends. Not all higher education teachers are actively engaged in learning and applying them. The study's objective was to investigate how Pakistani higher education teachers now enable the use of instructional technology in their teaching process. It is crucial to understand how instructors utilize the technology available to them in order to determine which teachers use technology to enhance the critical thinking, communication, collaboration, and higher-order thinking abilities of the learners, as well as to investigate the elements that contribute to technology integration. Furthermore, it is critical to discover how other teachers are integrating technology into their instruction and what problems are preventing effective technology integration (Green, 2016; Horgan, 2019; Jati 2018). To this goal, teachers completed a survey guided by the SAMR model, and heads were interviewed for an in-depth view of teachers' technology integration competencies. Heads' views of technology integration, the effects of professional development, the types of technologies, the transformation of instructional practices, challenges they have faced in technology integration and the types of training required for meaningful technology integration are all covered in the interview questions.

Technology integration in higher educational settings creates more opportunities for teaching and learning environments. In this modern era, the majority of students possess digital gadgets such as smartphones. Teachers in higher education can transform learning through technology integration. Instructional technology provides multiple ways to disseminate learning and provide suitable teaching methods. Educators can be provided with more ways with instructional technology because ICT provides a connected, situated and personalized nature of learning opportunities. Curriculum developers and policymakers should ascertain to organize instructional tasks which correspond with higher levels of the SAMR model (i.e., modification and redefinition). The teaching and learning tasks that modify and redefine the existing learning tasks have a more significant effect on technology integration (Bradley, 2020; Cotten, 2021; Spencer, 2019).

Keeping in view the status of technology integration in Pakistan, it gets clear that teachers at all levels need to update their teaching methodologies for both face-to-face and online learning. Before the pandemic, students and teachers were unfamiliar with the concepts and demands of virtual learning. Therefore, teachers need some advanced methodologies to handle the instruction adequately. The SAMR Model (Puetendura, 2014), is a framework for integrating technology in education. In substitution phase, technology is used as a direct substitute for traditional classroom tools. This can include things like using an e-book instead of a printed textbook. In augmentation phase, technology is used to improve the learning experience in a way that was not possible before. For example, an online discussion forum etc. In modification, technology is used to significantly redesign the learning experience. For example, students may use a collaborative document to contribute to a group project in real-time. In redefinition, technology is used to completely transform the learning experience. For example, virtual reality can allow students to explore historical events and scientific concepts. (Guggemos & Seufert, 2021).

Activities that can be transformed are modified, augmented, and substituted by using ICT, which is used in place of traditional tools (Sroka, 2020). In comparison, many examples are being provided by research in favor of the positive use of substitution and augmentation in learning the use of ICTs. Hockly (2016) mentioned learning activities related to modification and redefinition levels of the framework of the SAMR, which can modify learning. According to higher levels of the SAMR framework, it is defined that learning through these technologies with a complete perspective is realized (Turayev, 2018;

Wasilko, 2020).

There is minimal research demonstrating the technology-related competencies of higher education teachers. Most research focused on secondary and intermediate level teachers or the professional development of higher education faculty. Further study is indeed required in this field to determine the extent to which teachers are using digital resources in their teaching at the higher education level. There is also a gap in research regarding investigation of teachers' competency in technology integration particularly in higher education institutions, the challenges and barriers that educators face while integrating technology, and how to overcome those obstacles (Patton, 2015; Humes, 2017; Pfaffe, 2017; Foremming, 2020). Absence of concrete recommendations for professional development programs to enhance technology integration in higher education in Pakistan (Abbasi, 2014) and lack of clear and consistent framework for faculty competence in TI (Dullien, 2017; Golzar, 2019; Fallatah, 2019; James, 2020). GoP (2018) also mentioned the gap of availability of adequate data for international agencies to indicate the ICT ranking of Pakistan. The ranking benchmark included infrastructure, skill readiness, affordability, socio-economic effect as well as business and innovation environment.

1.2 Statement of the Problem

In recent era, tremendous attention has been paid to teachers' technology integration in the classroom, emphasizing the constant strive to improve the quality of teaching. This has led to a shift from teaching strategies to more in-depth knowledge of technology. This research was initiated to explore teachers' technology integration competencies at the university (public and private) level. To achieve the goals related to instruction using technology, the SAMR model can be combined with Bloom's revised taxonomy in a way that taxonomy tasks move from lower order thinking skills to upper order thinking skills and SAMR model tasks move from its lower to upper competency. This integration of

SAMR and Bloom assists teachers in analyzing what content, pedagogy, and technology might look like in teaching, which associates higher order thinking skills. Bloom's taxonomy is widely used to plan instruction at every level of teaching. The SAMR model and Bloom's revised taxonomy added weight to the assessment process of the faculty's technology integration. Furthermore, building a framework after unifying both concepts may guide teachers of HEIs to choose and integrate appropriate technology to enhance student learning effectively. Therefore, the current study was initiated to explore the perceptions of faculty regarding technology integration competencies and to explore the differences in faculty competence based on demographic variables. The study also tends to explore the views of heads regarding technology integration and propose a suitable model for technology integration for Pakistani HEIs.

1.3 Theoretical Base

In the last three eras integration of technology has improved. However, instructional technology is intended to use in educational institutions for two purposes: to learn and use computers to create basic skills (Jenkins, 2021; Kilty, 2019).

Maxey & Norman (2019) stated that in constructive theory, tools are given to students for constructing their knowledge. According to this theory, teachers should accept the idea of learners' knowledge, which they will construct, gain and interpret. This operational procedure lets learners get a sense of their world.

Constructivists oppose the 'systematic process' of learning presented by many educationists. The constructive approach suggests nothing systematic about the learning process and knowledge construction. Instead, constructivists believe that knowledge is socially created, and every person has different social experiences, which result in various social realities (McClain, 2019).

Amick (2019) described that in each aspect of society and culture, digital technology had a significant effect on many eras. Due to computers, it becomes easy to access the bulk of information and to process the acquired information immediately. Technologies also made communication effortless over long and remote distances. Recently, technology can be found in living rooms, museums, arcades, and shopping malls. In addition, children can easily control and manipulate digital tools and technology-based environments.

The SAMR Model presents different instances of activities that adjust under four classifications of this model: substitution, augmentation, modification, and redefinition. The model provides a framework for curriculum designers and teachers to create adequate instructional experiences which support technology integration. Puentedura (2014) defines the use of the framework of the SAMR together with the definition of ICT. Various instructional activities are being evaluated in this study which is in use nowadays. In addition to the theoretical framework, the instructional activities associated with technology integration were evaluated to assess teachers' technology integration competencies.

When using technology in the classroom, the educator needs to keep in mind various aspects. Guernsey & Levine (2015) mentioned that educators significantly influence the quality of technology used in educational settings. While integrating technology, the willingness and commitment of a teacher should be on priority. Mainly, teachers need to concentrate on two changes: firstly, teachers should learn the use of technology, and secondly, teachers must change the way of teaching (Hammett, 2018).

1.3.1 Vygotsky's Philosophy of Social Constructivism and Technology

In education, learning theories are getting more critical, introducing computers specifically a wide range in the classrooms. For example, Horgan (2019) stated that teachers who got training could practice with computers by sitting alone at the back of the classroom or engaging students in drilling and practice. Many others proposed that in educating teachers, they need computer training and a connection between training and students' learning processes.

Vygotsky's ideas are examined by considering teacher education and technology. Ideas such as scaffolding and immediate development areas are broadly used to develop the software and sources related to technology. Vygotsky was directed to his work due to his profound interest in children, particularly those with specific needs. Vygotsky’s philosophy is very relevant because technology effectively develops higher-order thinking skills, including decision-making, drawing conclusions, analyzing and interpreting information, and problem-solving. Vygotsky has put stress on thinking rather than intelligence. Thinking is a source of building knowledge that requires different methods of inspiring and enriching learners’ thinking. In Vygotsky’s comprehensive research, such aspects play a significant role e.g., history, creativity, humanism and philosophy, as it was an interdisciplinary approach like its understanding is artistic, caring vision. In its acceptance of the paradox of human learning, it is philosophical. As he is called the Mozart of psychology, he gained that high and noble tide at every moment (Martin, 2016; Onyema et al. 2020).

Social constructivism suggests that learners are active participants in the creation of their own learning and knowledge. It suggests that knowledge develops form how learners interacts with peers and teachers, society and culture at large. Students depend upon peers and teachers to help create their knowledge, and seeking knowledge this way enable them to construct their own ideas. Social constructivism comes from Vygotsky and also connected to cognitive constructivism with added elements of peer influence and society (Schreiber & Valle, 2013).

The learning is more obviously linked with individual needs of the learners. Peng et al. (2009) stated that constructivism improves the instructional process by enabling learners to represent authentic and realistic learning. Teachers those design course units and teach pupils with a constructive manner enhance chances to deal with broader range of pupils’ individual differences. Constructivism enables engaging learning process and reduces the gaps in the knowledge of teachers and learners who use technology in the classroom. Resnick (1989) further stated that the actual logic of constructivism can be taken as theory of meaning making and learning, and people involve can build their own knowledge on the basis of interaction between existing knowledge, ideas and believes. During a national survey of technology usage, Becker and Riel (1999) found that teachers with constructive approach towards instruction were more likely to integrate technology in the classroom.

In a constructivist classroom, teachers adjust their teaching to match the learners' level of understanding. Therefore, teacher must have the understanding of students and their preexisting knowledge. In this environment teacher is facilitator than instructor to create the collaborative environment. It also enables shared authority and shared knowledge between teachers and students. Various research studies has employed social constructivism to support their ideas on collaborative learning and technology usage (Guilherme, 2015; Hanson, 2015; Pillay & Reynold, 2014; Awan & Ali, 2013). It is evident that investigation through constructivism may provide teachers with more information about curriculum development using technology integration. Problem-solving and critical thinking increases as learners start to contribute to the instructional process (Keengwe, Onchwari, & Agamba, 2013). Therefore the constructivism requires teachers to use nontraditional methods of instruction to facilitate learning and to provide clear understanding of technology-based instructional tools. (McDowell, 2013) mentioned that constructivism is a progressive teaching method that emphases on the needs of the learner to take control of their knowledge and participate in their learning which also aligns effectively with technology integration.

Vygotsky however didn't proposed any stages of development within social constructivism. But the key components of constructivist learning are problem-based learning and collaboration. Furthermore, Vygotsky emphasized on social interaction, the more knowledgeable others (MKO), zone of proximal development (ZPD) and scaffolding. These ideas are widely used in software development and other technical advances, because philosophy plays greater role while proposing and developing any form of technology. Vygotsky graded thinking as the origin of knowledge. He further emphasized on individual differences and needs as well as social learning.

In the modern world social interaction is more dependent on technology. Vygotsky mentioned that parents, peers, teachers, social context and language are the tools for any culture. It is significant that we accept electronic forms of cultural tools. The isolating uses of technology are against the concept of social constructivism. Therefore, it is essential for technology to connect society and bring people together.

1.3.2 Constructivism and Instructional Technology:

Watkins (2014) argued that use of technology is effective in developing higher-level thinking skills including decision making, drawing conclusions, judging information, analyzing and problem solving. Technology integration emphasizes of personalized learning and learner-centered instruction. Technology also provides means to influence the following research-based instructional activities:

- Accessing resources and means to align with students' proximal zone of development (Vygotsky, 1978) in relationship to language, content and skill.
- Scaffolding instruction to support cognitive abilities of the learners.
- Providing learners the ownership in their learning (i.e. students can learn in different ways and within different time frames)
- Providing learning options to allow students to maximize their cognitive abilities.
- Enabling collaboration and learning beyond traditional methods of instruction.
- Expanding learning opportunities in culturally and socially contexts.

- Empowering learners to take their decisions while learning e.g. choosing and adjusting with their own learning style.
- Increasing motivation and evolving meaningful habits such as willingness to work.
- Enhancing compatibility of learning targets and personal interests.
- Diversity through learners' choice of technology tools, solutions, projects and demonstration of knowledge.

1.3.3 Bloom's Revised Taxonomy

According to the revised version of Bloom's Taxonomy, there are six cognitive learning levels: remembering, understanding, applying, analyzing, evaluating, and creating (Anderson, & Krathwohl, 2001).

In the development of the learning outcomes process, these levels can be helpful, and certain verbs are mainly suitable for each level. However, these levels are not suitable for other verbs, which are helpful at multiple levels. For instance, a student might list proteins or participles to show to create some connectivity to learn these terms. However, the learner may not show the clarifying protein folding or distinctive between active and passive participles (Anderson, & Krathwohl, 2001).

1.3.4 Vygotsky's ZPD and Bloom's Revised Taxonomy

Sideeg (2016) informed that to make instructional practices and assessment more useful and valid the learning outcomes must be linked with Vygotsky's (1978) zone of proximal development. Vygotsky in ZPD emphasized the role of guidance and encouragement in developing learners' skills, when teacher leads the learner to perform actions or tasks. Therefore, proceeding from known to unknown we can link Remembering and Understanding with knowledge phase, apply and analyze with ZPD and evaluate and create to explore what is unknown.

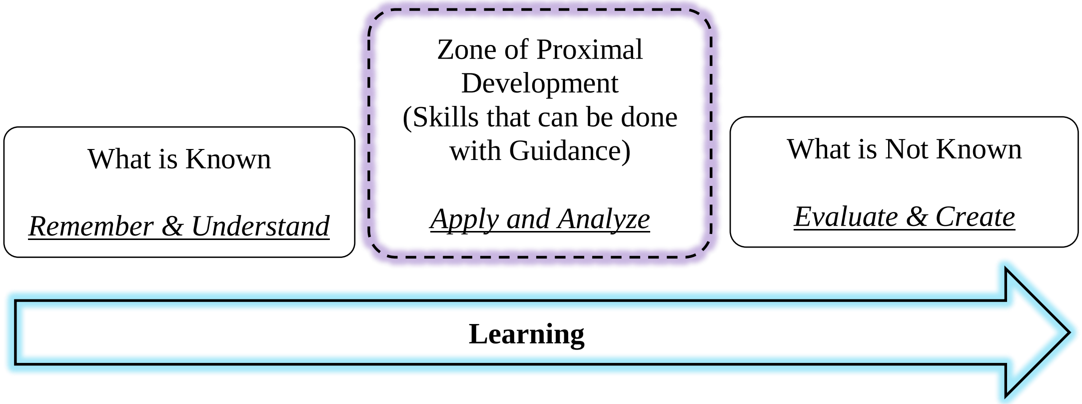

Figure 1: Vygotsky's ZPD and Bloom's Revised Taxonomy

1.4 Conceptual Framework of the Study

Instructional technology can help improve student learning outcomes by providing access to a wide range of learning resources and opportunities, including online courses, virtual labs, and collaborative learning tools. It can also help faculty members develop more effective teaching strategies to make learning more engaging and interactive. In addition, instructional technology can help increase student engagement and participation in class, promote self-directed learning, and provide personalized learning experiences.

The study adopted a framework originally described by Puentedura (2014), wherein the architecture of the learning process, as planned by the teacher, reflects learning through technology. While dealing with educational technology, for teachers, the task handling sometimes appears intimidating. Occasionally, it will be tough but SAMR model can help teachers by frequently substituting technology to enhance the learning process. The process also helps teachers transform the learning process to achieve desired goals (Puentedura, 2014). To achieve the goals related to instruction using technology, the SAMR model can be combined with Bloom's revised taxonomy in a way that taxonomy tasks move from lower to the upper level, and SAMR model technology-based tasks repeatedly move from its lower level to upper level. The coupling of The SAMR Model and Bloom's Revised Taxonomy is presented as a conceptual framework for this study.

The first three levels of Bloom's taxonomy, i.e., remembering, understanding and applying, can be associated with the lower two levels of SAMR model, also called the enhancement phase. Whereas the upper levels of Bloom's taxonomy i.e. analyzing, evaluating, and creating, can be associated with the upper two levels of SAMR model, also called the transformation phase.

As a result, within each group, a similar order proceeds. For example, Substitution level tasks are associated with "Remembering" tasks. Substitution and augmentation level tasks are associated with "Understanding" tasks and so on. The coupling of the concept is presented in figure 1. The study took account of all levels of SAMR model (Puentendura, 2014), based on six areas of the teachers' competency in revised Bloom's taxonomy (Anderson, & Krathwohl, 2001).

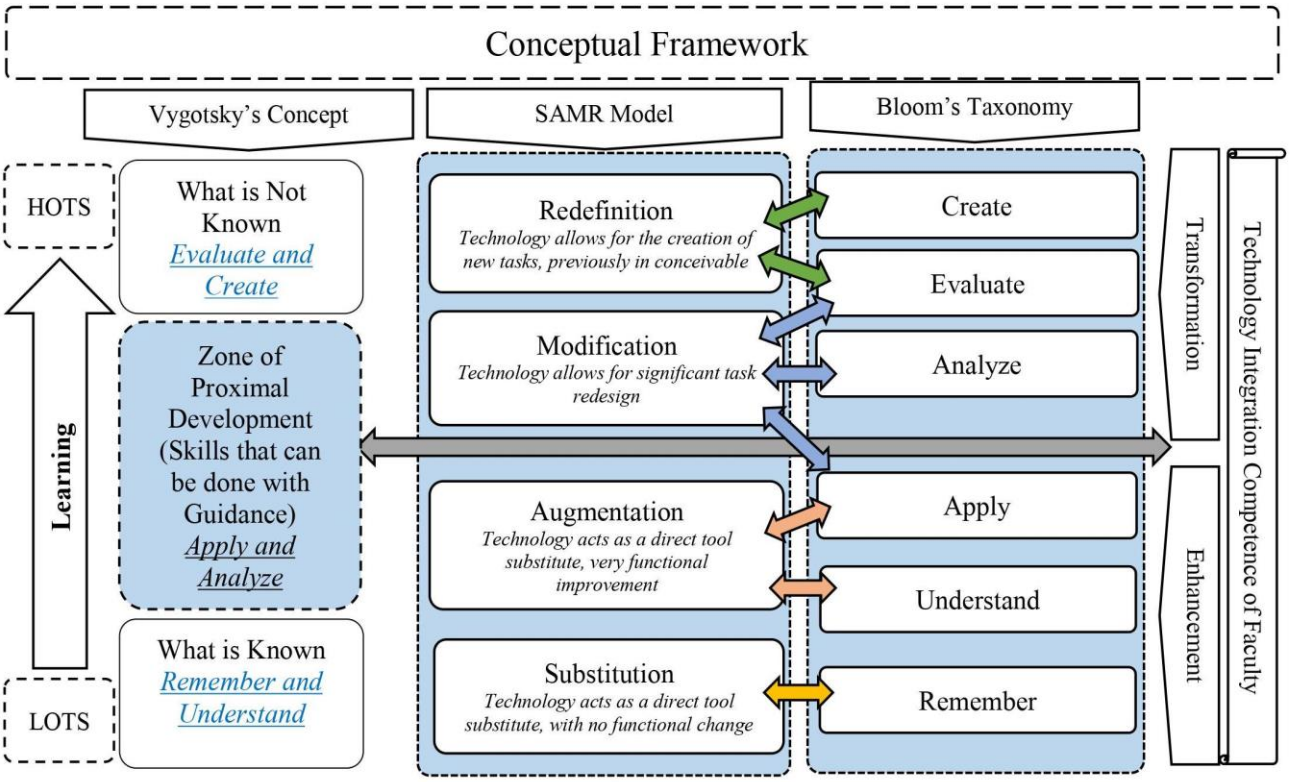

Figure 2: Conceptual Framework of Study

1.5 Objectives of the Study

1. To examine the faculty perceptions regarding their competence towards technology integration at higher education level with reference to SAMR model in the backdrop of Bloom's taxonomy.
2. To identify the differences in faculty competence towards technology integration at higher education level based on sector, gender, qualifications, experience, designations, disciplines, and ages.
3. To explore the views of heads regarding faculty competence towards technology integration.
4. To propose a model for technology integration based on gaps identified through research.

1.6 Research Questions

1. What are the faculty perceptions regarding their competence towards technology integration with respect to SAMR Model and Bloom's Taxonomy?
2. Does a statistical difference exist between survey scores of university teachers?

1.7 Null Hypotheses

H_{01} There are no statistical differences among teachers' technology integration while comparing <u>Sectors</u>.

H_{01a} There are no statistical differences among teachers with reference to *'Substitution'* in the backdrop of '*Remembering*'.

H_{01b} There are no statistical differences among teachers in connection with *'Augmentation'* in the backdrop of *'Understanding'* and *'Applying'*.

H_{01c} There are no statistical differences among teachers in connection with

'Modification' in the backdrop of *'Applying', 'Analyzing'* and *'Evaluating'*.

H_{01d} There are no statistical differences among teachers in connection with *'Redefinition'* in the backdrop of '*Evaluating'* and '*Creating*'.

H_{02} **There are no statistically significant differences among teachers' technology integration while comparing <u>Gender</u>.**

H_{02a} There are no statistical differences among teachers with reference to *'Substitution'* in the backdrop of '*Remembering*'.

H_{02b} There are no statistical differences among teachers in connection with *'Augmentation'* in the backdrop of *'Understanding'* and *'Applying'*.

H_{02c} There are no statistical differences among teachers in connection with *'Modification'* in the backdrop of *'Applying', 'Analyzing'* and *'Evaluating'*.

H_{02d} There are no statistical differences among teachers in connection with *'Redefinition'* in the backdrop of '*Evaluating'* and '*Creating*'.

H_{03} **There are no statistically significant differences among teachers' technology integration while comparing <u>Qualifications</u>.**

H_{03a} There are no statistical differences among teachers with reference to *'Substitution'* in the backdrop of '*Remembering*'.

H_{03b} There are no statistical differences among teachers in connection with *'Augmentation'* in the backdrop of *'Understanding'* and *'Applying'*.

H_{03c} There are no statistical differences among teachers in connection with *'Modification'* in the backdrop of *'Applying', 'Analyzing'* and *'Evaluating'*.

H_{03d} There are no statistical differences among teachers in connection with *'Redefinition'* in the backdrop of '*Evaluating'* and '*Creating*'.

H_{04} There are no statistically significant differences among teachers' technology integration while comparing Teaching Experience.

H_{04a} There are no statistical differences among teachers with reference to *'Substitution'* in the backdrop of '*Remembering*'.

H_{04b} There are no statistical differences among teachers in connection with *'Augmentation'* in the backdrop of *'Understanding'* and *'Applying'*.

H_{04c} There are no statistical differences among teachers in connection with *'Modification'* in the backdrop of *'Applying', 'Analyzing'* and *'Evaluating'*.

H_{04d} There are no statistical differences among teachers in connection with *'Redefinition'* in the backdrop of '*Evaluating'* and '*Creating*'.

H_{05} There are no statistically significant differences among teachers' technology integration while comparing Designations.

H_{05a} There are no statistical differences among teachers with reference to *'Substitution'* in the backdrop of '*Remembering*'.

H_{05b} There are no statistical differences among teachers in connection with *'Augmentation'* in the backdrop of *'Understanding'* and *'Applying'*.

H_{05c} There are no statistical differences among teachers in connection with *'Modification'* in the backdrop of *'Applying', 'Analyzing'* and *'Evaluating'*.

H_{05d} There are no statistical differences among teachers in connection with *'Redefinition'* in the backdrop of '*Evaluating'* and '*Creating*'.

H_{06} There are no statistically significant differences among teachers' technology integration while comparing Disciplines.

H_{06a} There are no statistical differences among teachers with reference to

'Substitution' in the backdrop of '*Remembering*'.

H_{06b} There are no statistical differences among teachers in connection with *'Augmentation'* in the backdrop of *'Understanding'* and *'Applying'*.

H_{06c} There are no statistical differences among teachers in connection with *'Modification'* in the backdrop of *'Applying', 'Analyzing'* and *'Evaluating'*.

H_{06d} There are no statistical differences among teachers in connection with *'Redefinition'* in the backdrop of '*Evaluating'* and '*Creating*'.

H_{07} There are no statistically significant differences among teachers' technology integration while comparing Age.

H_{07a} There are no statistical differences among teachers with reference to *'Substitution'* in the backdrop of '*Remembering*'.

H_{07b} There are no statistical differences among teachers in connection with *'Augmentation'* in the backdrop of *'Understanding'* and *'Applying'*.

H_{07c} There are no statistical differences among teachers in connection with *'Modification'* in the backdrop of *'Applying', 'Analyzing'* and *'Evaluating'*.

H_{07d} There are no statistical differences among teachers in connection with *'Redefinition'* in the backdrop of '*Evaluating'* and '*Creating*'.

1.8 Significance of the Study

Teachers and instructional designers must keep their focus on the use of ICTs in the improvement of learning. In this study, different activities which are based on ICT (applications and tools) were evaluated in connection with the framework of the study. Therefore, for the guidance of administrators in making technology-related policy decisions, the findings of this study will be used to fulfill the stakeholders' requirements and offer guidelines for teachers. The ICT strategies that are modified and redefined will have the flexibility to be integrated into the classroom.

This study intended to evaluate the faculty competence towards technologies recently being in practice by higher education educators as well as the instructional activities following the SAMR model and Bloom's taxonomy. The study's findings will guide the administrators working on the front line of making policy decisions regarding technology usage in the subject matter to serve all stakeholders best and provide faculty members awareness of instructional strategies that correspond with the modification and redefinition level of the SAMR model. Recommendations were made to support faculty competencies that provide transformative learning opportunities rather than merely enhancing student learning.

The present study explores the competencies of Pakistani teachers regarding technology integration in the classroom. The study presents the actual scenario of technology integration and contributes to the technology-related professional training of teachers in higher education. This study was conducted to shed light on different aspects of technology integration and their importance by comparing teachers' demographic variables. The study will assist higher institutions in enhancing plans and approaches for technology-assisted learning environments. Teachers can assess and evaluate their competencies in a better way. It will help teachers to recognize and improve their technology integration practices to make the teaching and learning process more effective, particularly to enhance their competencies in relation to professional standards. The study will be helpful for the teacher trainers, policymakers and curriculum developers to understand the need of higher education teachers by keeping in view both the pre-service and in-service levels.

The study can play an essential role in enhancing the teachers' technology integration in the classroom. The study carefully explores the technology integration competencies and their knowledge about modern digital tools. It provides SAMR model awareness to teachers and administrators that can help in teachers' professional development. The study may provide critical future implications and guidelines for researchers to explore more about the phenomenon of technology integration by adding other variables. The study may also provide guidelines for policymakers and curriculum developers to design professional development courses for teachers while adding technology integration as a significant and contributing variable. According to the online HEC repository of dissertations, very few studies were conducted to assess the teachers' technology integration in Pakistan. However, around the world, we see many instances where researchers focused on teachers' technology integration and use of digital tools at all levels from Kindergarten to higher education. This study would provide meaningful information to technology trainers and future researchers working in the field of higher education.

1.9 Methodology

1.9.1 Approach

A mixed method approach was used to analyze the data using statistical techniques.

1.9.2 Design

The study used a convergent parallel design. This design is based on the parallel process of data collection and analysis. This design required the researcher to collect and analyze quantitative and qualitative data simultaneously. In the second phase, the results were compared and the researcher proceeded toward interpretation (Creswell & Creswell, 2017).

1.9.3 Population

The study was delimited to two disciplines (Social Sciences and Management Sciences). The researcher has selected 32 universities in Punjab as the targeted population contained 4233 faculty members and 380 heads of Social Sciences, and Management Sciences, teaching in 32 public and private sector universities of Punjab (HEC, 2021). The population was divided into two major strata, i.e., public and private sector universities. From thirty-two universities in Punjab, sixteen were affiliated with the public sector while the other sixteen universities were affiliated with the private sector of Punjab.

1.9.4 Sample

Teachers and heads working in public and private sector universities of Punjab were considered as two major strata for the selection of the sample.

A stratified random sampling technique was used in the study to attain a sample. The number of public institution teachers was 2554 and private sector teachers were 1679, 14% of both strata were taken as quantitative samples. Five hundred ninety-three questionnaires along with a faculty response checklist were distributed among faculty working in universities of Punjab following the criteria suggested by Cohen, Manion & Morrison (2013) and from them only 552 teachers returned the questionnaire and checklist to the researcher and the return rate was thus 95%.

For the qualitative phase, the total number of public sector heads was 245, and private sector heads were 135. From both strata, 30 heads were taken as a qualitative sample, following the criteria suggested by Creswell & Creswell (2017). Interviews were conducted with a response rate of 100%.

1.9.5 Research Instruments

For measuring the faculty competence towards technology integration, Puentedura’s model of SAMR, parallel to Bloom’s revised taxonomy by Anderson & Krathwohl, was used to construct a five-point questionnaire that has a broad theoretical base. The SAMR model can be used parallel to Bloom’s revised taxonomy since both share parallel cognitive levels.

Secondly, a standardized checklist by Pfaffe (2017) was used to closely evaluate the teaching practices of faculty members at each level of SAMR Model.

Thirdly, a semi-structured interview was developed for heads of departments. The purpose of this interview was to evaluate how teachers integrate technology into their lectures and how much the teaching practices are aligned with Puentedura's SAMR framework.

1.9.5.1 Demographic Variables

The study is based on the demographic information of the respondents. The questionnaire included the information related to the respondents' demographic information. Such as sector of institution (public or private), gender, qualification, teaching experience, designation, disciplines and age.

1.9.6 Pilot Testing

Construct validity of the questionnaire was assessed through factor analysis. For this purpose, the component analysis was used with Varimax Rotation which facilitates maximum factor loading. Two additional tests, the Kaiser–Meyer–Olkin (KMO) and Bartlett's Test of Sphericity, were run for the sustainability of the factor analysis. Item under each construct was tested and items with a value less than 0.4 were eliminated (Appendix, M).

The pilot testing of the checklist, questionnaire, and semi-structured interview were conducted on a sample of 60 respondents taken from 2 universities in Punjab (1 Public and 1 Private), from which 36 public sector and 24 private sector teachers along with 4 heads of departments were taken. A panel of educationists verified the validity of both quantitative and qualitative instruments. The suggestions and comments from the panel were incorporated to improve and updated the instruments. The questionnaire was found reliable as the Cronbach's Alpha Coefficient was 0.79.

1.9.7 Data Collection

The quantitative data was collected through a validated and expertly reviewed checklist and questionnaire. The data for the checklist and questionnaire was collected online because most quantitative and qualitative respondents were working online due to COVID-19-related restrictions applied by the provincial government. The researcher collected the qualitative data in three phases. The first was to visit the Heads of the department personally. In the second phase, the researcher conducted phone interviews using the Call Recorder application. In the third phase, the researcher created a Google Form with a permission letter, detail of the study and open-ended questions about the interview. The link was forwarded via email to the targeted respondents (Heads of the departments) only.

Table 1.1

Objectives with respective Statistical Techniques

The following table depicts the study objectives and their associated analysis.

S#	Research Objectives	Analysis
1	To examine the faculty competence towards the technology integration at higher education level with reference to SAMR model in the backdrop of Bloom's taxonomy.	Frequency, Percentage, Mean & Standard Deviation
2	To find out the differences in faculty competence towards technology integration at higher education level based on sector, gender, qualification, experience, designation, disciplines and age.	Independent t-test, ANOVA, Post Hoc
3	To explore the views of heads regarding faculty competence towards technology integration.	Thematic Analysis
4	To propose a model for technology integration based on research.	Gaps identified through research

1.9.8 Data Analysis

After the data collection, the data were analyzed using descriptive and inferential statistics compared to the research objectives. Mean score, standard deviation, t-test, and analysis of variance were calculated to analyze the results. MS Excel and IBM SPSS 22nd version were used for statistical analysis. 5% level of significance was used to test the hypotheses. Recommendations were made on the basis of conclusions drawn from the study.

1.10 Delimitations

The study was delimited to the following:

1. The faculty of social sciences and management sciences.
2. The department of Education, Islamic Studies, Pak Studies, Psychology, Sociology, criminology, humanities, anthropology political science, media and communication studies, international relations, philosophy, geography, environmental studies, economics, management sciences etc.
3. Heads of departments from selected faculties (Qualitative).
4. Regular faculty members of selected faculties (Quantitative).
5. Puentedura’s (2014) SAMR Model and Bloom’s Revised Taxonomy (Anderson, & Krathwohl, 2001).

1.11 Ethical Consideration

To assure the authenticity of the current study, the researcher used methodologies and processes successfully developed and deployed by previously published studies in reputable journals and institutions. Which involved the previously discussed pattern of carrying out the research in a location familiar to the researcher, employing data collection instruments with significant levels of reliability and validity, monitoring activities through quality checks of data collection methods such as interview protocols to address ethical concerns, and integrating multiple data sources such as checklists and questionnaire to increase the credibility of the results (Creswell, 2018; Ghafouri & Ofoghi, 2016; Mertler, 2017).

1.12 Operational Definitions

i. **Technology Integration:** Technology integration relates to the faculty's perceptions of utilizing technology to promote the students' learning experience. It focuses on integrating various technologies in face-to-face and online learning environment. The ultimate purpose is to engage students in the learning process actively.

ii. **SAMR Model:** The SAMR Model, developed by Ruben Puentedura, describes the substitution and augmentation of learning via technology as an enhancing impact. In comparison, the modification or redefinition of an instructional activity via technology has a transformational impact on the learners.

iii. **Substitution:** The Substitution level is where the incorporation of digital tools begins. This phase utilizes digital tools to emulate instructional practices. For instance, a scholar reading an online journal on a digital device such as a laptop or tablet rather than a printed book is an instance of substitution. A learner may use both ways to highlight the relevant text, give feedback, and bookmark articles.

iv. **Augmentation:** Augmentation phase is the second phase of technological incorporation. Throughout this phase, digital tools are utilized to modify an instructional practice somewhat, but the instructional goals remain unchanged.

v. **Modification:** Modification happens when digital tools are utilized to alter the functionality of particular instructional practice. Modification entails learners' participation and innovation while also enhancing students' comprehension of the material.

vi. **Redefinition:** This happens when many modes of technology integration are employed to synthesize new instructional activities. This phase requires skills including teamwork, creativity, communication, and critical reasoning.

vii. **Enhancement:** The enhancement stage is regarded as the fundamental stage of the technology usage paradigm. The initial two phases, i.e., substitution and augmentation of the SAMR framework, are indicated as the Enhancement stages. Enhancement levels of SAMR are associated with the three lower levels of Bloom's taxonomy i.e. Remember, Understand, Apply.

viii. **Transformation:** The upper two phases of learning, Modification, and Redefinition are recognized to be as transformational stages of instructional practices. During the transformation phase, teachers utilize digital gadgets to enhance not just the effectiveness of educational practice but also to drastically alter its functionality, hence enhancing the students' achievement. Additionally, if digital tools require major job reformation or involve task reshaping, digital tools act as a transformational factor.

ix. **Revised Bloom's Taxonomy:** Anderson & Krathwohl (2001) expanded and improved Bloom's taxonomy to reflect 21st-century relevance for teachers and students. The changes they made to Bloom's taxonomy may seem modest, but they have a profound effect on how individuals employ the taxonomy. A revised version consists of six levels of cognitive learning which are remembering, understanding, applying, analyzing, evaluating, and creating.

x. **Remembering:** Remembering requires recalling or identifying information. When memory is utilized to construct or recall concepts, information, or facts or to recall previous knowledge, this is known as remembering. For example, memorizing historical dates, formulas, or vocabulary words.

xi. **Understanding:** Understanding requires generating information from several forms of operations, such as textual or graphic signals, or activities such as analyzing, illustrating, categorizing, synthesizing, explaining, comparing, and inferring. For example, Explaining the main idea of a story, summarizing a chapter in a textbook, or translating a word from one language to another.

xii. **Applying:** Applying includes performing or implementing a procedure. Applying refers to scenarios in which acquired knowledge is implemented through simulations, interviews, presentations, or models. For example, Solving a math problem, applying scientific concepts to a real-world scenario, or using a historical event to support an argument.

xiii. **Analyzing:** Analyzing includes separating concepts or materials into components, discovering how the components relate to or interact, and deciding how the parts relate to a larger structure or goal. This cognitive function includes Comparing and contrasting two different pieces of literature, evaluating the reliability of sources, or identifying cause-and-effect relationships. Analyzing can be illustrated by using questionnaires, diagrams, or other graphical representations.

xiv. **Evaluating:** Evaluating includes forming conclusions based on principles and criteria through examining and criticizing. Recommendations, critiques, and reports are instances of the outcomes that can be produced to represent evaluation procedures. For example, assessing the validity of an argument, comparing two solutions to a problem, or making decisions based on ethical considerations.

xv. **Creating:** Creating includes combining aspects into a cohesive or functioning whole; rearranging elements into a new context or shape through planning, generating, or producing. In order to create a new component, pattern or format, users must recombine or recombine pieces in novel ways, hence generating a new component or pattern. For example, writing a research paper, designing a new product, or creating a new strategy for solving a complex issue.

Summary

The present study was expected to identify the technology integration competencies of faculty members at the university level. This chapter presented the basic concepts of technology integration. The chapter also presented objectives, hypotheses, significance, methodology and operational definitions of related terms. The next chapter will describe a detailed review of related literature in the form of related theories and models of technology integration.

CHAPTER 2

REVIEW OF RELATED LITERATURE

This section provides context for the research by reflecting on educational technology usage, outlining 21st-century abilities, and discussing instructors' technology integration competencies at higher education level. A discourse on the influence of technology will include a detailed explanation of perceived limitations and recognized concerns, as well as a discussion of teachers' philosophy contextualized by an examination of technology-assisted instructional practice. Additionally, the section reviews established practices and considers prospective models of usage for a technology-enabled instructional environment.

In the Global competitiveness index, Pakistan is ranked 131 out of 141 countries in ICT adoption, which is indicated as the third pillar in the Global Competitiveness Report. At the same time, the overall score is 110 out of 141 (World Economic Forum, 2020). In comparison, Human Development Report ranked Pakistan at 154 out of 189 (UNDP, 2020). Sachs et al. (2021) informed that Pakistan is ranked 129 on SDG index with a score of 57.7, indicating a 74.5% literacy rate among learners ages 15 to 24. The SDG4.a indicates building and upgrading the educational facilities to provide an effective and inclusive learning environment for all, indicating the importance of ICT in GoP (2018) as the goal of accelerated digitization eco system in the country. The UNESCO report on the SDG-4 Gap analysis of Pakistan indicated that only higher education is focused on HEC Vision 2025, not provincial education. The recommendations were to enhance the collaboration with private sector sponsors to support underprivileged students across the country (UNESCO, 2017).

2.1 Technology in Education

Education is heavily reliant on technology. The importance of Technology in teaching is pervasive, permeating the fields of educational leadership, pedagogy, teaching, evaluation, and educational environment. Gray & Lewis (2020) informed that the desktop computer's invention is now intimately tied to the concept of educational technologies. In publicly available information, the recent educational statistics disclose per capita learner access to technology under four years old. Students' availability of modern digital technology and internet connection rose by just 15% and 16%, respectively, during the decade up to 2017. According to the PSLM (2020), Pakistanis are 68% unlikely to have a complementary or comparable high-speed internet connection at home, and the nation falls short of the average with regard to Internet access across south Asian countries (GoP, 2020). GoP (2018), primarily focuses on assisting ministry of education to ensure quality ICT education and bridging the academia industry gap to ensure the relevance of ICT education. This confirms that the educational system demonstrates neither readiness nor progress toward increasing utilization of technology in education, just taking the education sector as the focus.

The growing variety and accessibility of technology in the classroom of higher education do not correlate with an effect on students' academic achievement (Cuban, 2010). The rapid pace of technical innovation, investigators have shown, is not directly tied to changes in strategies or results (Halverson & Smith, 2010). With changing technology amid the Economic Depression over the previous decade, the net outcome is that teachers continue to have access to digital technology, as opposed to cost prohibitive one to one access for students, underpinning updated and predicted educational theories (Kilty, 2019; Halverson & Smith, 2010). According to instructors, computers and digital projectors have become routine in most higher education classes, but not in every core course. This discrepancy is determined by the degree to which finance allocation to higher education in Pakistan is aligned with HEC vision 2025 (GoP, 2017).

Murray & Olcese (2011) explored that student usage of technology outside the university has risen significantly over the past decade, as seen by the pervasive spread of cell phones, smart tablets, and other portable devices. However, learner accessibility to computer instructional practices has not kept pace. Several national projects have concentrated on simulating developing technology implementation – many on the one-to-one scale – but data shows that the software engineering required for effective deployment has not kept pace with the hardware's promise.

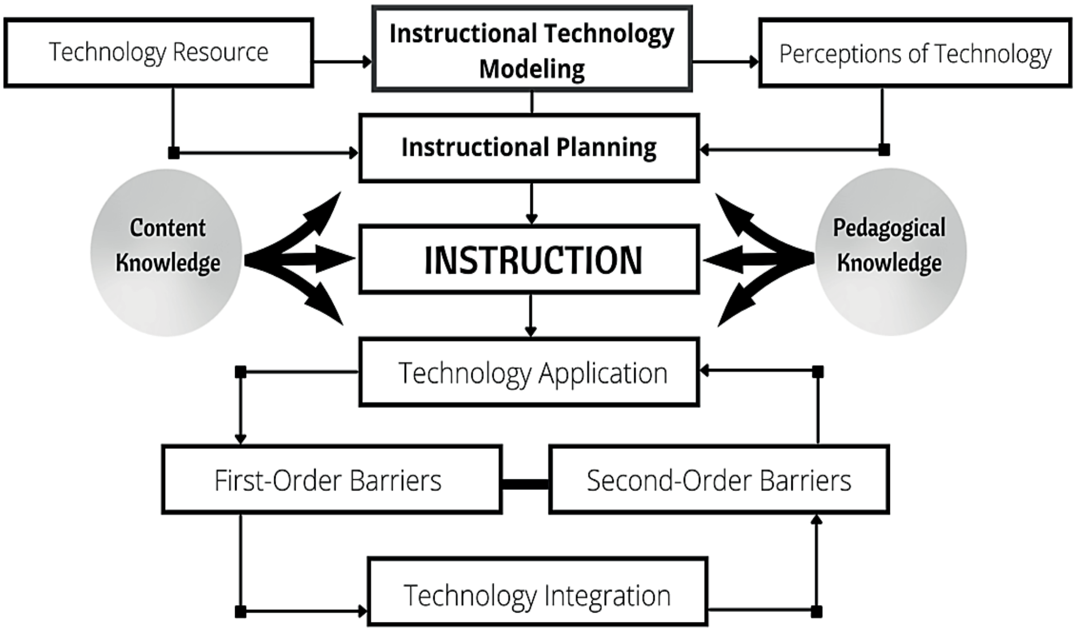

Figure 3: Process of Technology Integration (Cotton, 2021)

2.2 Background of Technology Integration

Ever since the developments and progress in the areas of industrialization and space technology, educators at all levels have sought to achieve every available instrument, from audio devices, radio, TVs to computers and real-time gadgets, in order to reinvent and improve the instructional process and extend learning possibilities for learners. This has prompted educators to rethink teaching approaches and reimagine how digital tools are employed in instructional settings (Doshmanziari & Mostafavi, 2017). Learners often use technology to generate and innovate their concepts, while others use it to replace materials like books and workbooks. This enormous range makes defining technology integration and utilization more challenging at higher education levels (Carver, 2016; Schrum, Galizio, & Ledesma, 2011). Technology usage can be defined as the use of digital devices by teachers and students to increase efficiency or to substitute traditional methods of instruction, the use of digital tools to supplement traditional instruction, or even utilizing technology and digital tools to comprehensively analyze the performance of a learner carrying out a task or engage in any instructional activity (Birisci & Kul, 2019; Ertmer & Ottenbreit-Leftwich, 2010).

In addition to primary themes of technology integration, the major concept of technology integration is explored in detail throughout a range of subtopics, including the impact of instructional technology, Models of instructional technology, the advantages and barriers of technology on educational processes, and research measures of technology integration. Impact of instructional technology discusses the educational effects of incorporating technology into educational methods, and broader applications (Hulon, 2015). The section on models of technology integration discusses effective models for development in technology integration, including shifting teachers' practices and acknowledging teachers' perceptions of technology usage, as well as establishing an association between teachers' skills and their technology utilization. The section on the advantages and barriers of technology to the instructional process synthesizes research publications, progress in instructional technology and students' use of technology inside and outside educational settings, custom software/applications in curriculum and higher education areas, and instructional theories covering the technology integration. Finally, the section on empirical evidence on technology integration concludes with a summary of research describing the extent to which technology is integrated into diverse educational contexts.

2.3 The Evolution of Technology Integration

The term "technology" may have a variety of meanings for various interpreters, based on the situation in which it is articulated and how individuals' activities and practices have impacted their perspectives. In daily life, technology is employed to improve the efficiency of human activities. Almost every characteristic of contemporary human survival growth and well-being is impacted by technology, from modes of communication to transport, enjoyment to daily life comforts, talents to adoration practices, Reformation to civic engagement, and political movements and health organizations to commercialism (Fu, 2013). Furthermore, the impact of digital media on public and private sector institutions has been under investigation in recent decades due to the failure and success of digital tools to deliver on its objective of improving educational success and job preparedness on a large and systematic scale (Lin et al., 2013).

The influence of current technological advancements on higher education has been explored and recorded by researchers on the subject of educational technology (Culp et al., 2005). In higher education institutions, using digital tools has increased the productivity of the instructional process. Along with increasing efficiency, digital media has grown in the higher education sector to make the instructional process more exciting and meaningful. It has altered and revolutionized higher education levels in a previously unimaginable manner (Bataller, 2018; Heintzelman, 2018; Samsonova, 2017).

2.4 Continuum of Technology Integrated Learning

A well-known continuum of technology-based content delivery methods serves as the practical foundation for delineating appropriate educational methodologies. The preceding research studies focused on synchronous educational settings in which a teacher promotes and encourages synchronized and simultaneous learning activities. In comparison, an asynchronous educational setting, defined by computer-based and technology-mediated instructional methods, arose throughout the previous decade. Stepanian, (2017) classified seven distinct types of online education based on their delivery method, all of which remain mainly relevant in today's educational settings. While James's (2020) study focuses on the students' educational period (public and private institutions of grades 6-12), Watson, *et al*. (2011) provided a directional and operational analysis of systems in multiple ways such as comprehensive learning (part-time or full-time), reach (online programs that facilitate students across regional campuses and remote locations), and delivery (technology-based content delivery), type (face to face to completely virtual with technology-based curriculum).

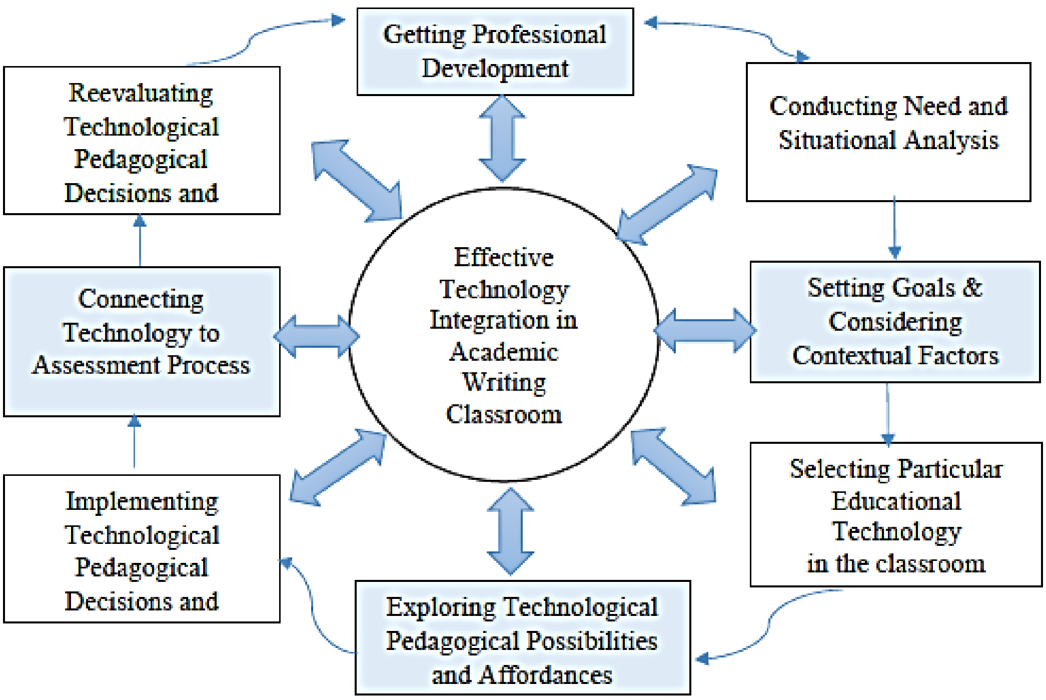

Figure 4: Technology Integration in Academic Process (Golzar, 2019)

The continuum in this study can be defined as the method of instruction that can be completely online, fully face-to-face, and face-to-face cum online (blended). The educational technology facilitates the professional development opportunities for the teachers through conducting situational analysis, setting appropriate goals, indicating the suitable technology in the classroom, exploration of technology-based instructional possibilities, implementing technology-based instructional decisions, integrating technology in the assessment process and revaluing the technology-based instructional decisions as well as combining the professional development (Golzar, 2019).

2.4.1 Completely Face to Face

The technology-related face-to-face instructional environment is fundamentally a standard classroom setting where a learning management system is regarded crucial element of the instructional method. Learning management systems (LMS), such as Canvas, Moodle, Mindflash, Skyprep, Litmos, ProProfs, etc., arrange instructional activities, simultaneously share materials, host evaluations and host discussion opportunities. In contrast to the online, asynchronous setting, an LMS-supported face-to-face learning environment encourages more robust synchronization of educational tasks among teachers and learners as the formal classroom is the primary site of content access (Vargas, 2017).

2.4.2 Online Learning

Often students who enroll in technology-related courses do it entirely online and in a possibly remote geographical region. Additionally, various research studies find increased demand from higher education learners. However, intermediate-level institutions remain few and generally incompatible owing to a scheme of studies and applicability to diverse student demographics (Hew & Cheung, 2012; Vance, 2012). The entirely online/virtual learning environment enables the student to choose their own pace of instruction totally - particularly in comparison to other students, resulting in asynchronous learning. The asynchronous, virtual learning environment is built on a learner-centered instructional environment far higher than previous technology-related approaches (Allen & Seaman, 2010). While most current studies focus on higher education students, other researchers believe that the most crucial component in completing online courses is the students' intrinsic motives rather than cognitive abilities. Learners' performance in a virtual teaching climate incorporating technology has received mixed evaluations regarding educational outcomes. The asynchronous continuity of the system has not consistently provided outcomes that meet interestingly excellent standards (Galy, Downey, & Johnson, 2011).

2.4.3 Online & Face-to-Face Learning (Blended)

Watson, *et al*. (2011) described blended instruction as a process in which learners get access to coursework online while maintaining consistent attendance in a traditional classroom environment for that particular course. Blended learning enables and supports the greater involvement of technology in the instructional process. The same is the case with a solely virtual learning environment. A considerable amount of research demonstrates a reasonable association between the hybrid teaching mode and increased students’ self-efficacy. In a research study, Shea & Bidjerano (2010) identified self-efficacy as a dependent component of students’ academic achievement in hybrid instruction. According to Keengwe and Kang (2013), the blended instruction frameworks are very effective when combined with other instructional models and frameworks such as inquiry-based instruction and problem-based instruction, both of the frameworks put greater preference on students’ cooperation and collaboration.

2.4.4 Learning Management System

The asynchronous instructional activities can continuously challenge the availability of suitable hardware and software to keep the LMS up and running. The institution that provides online learning facilities may deal with this challenge more often (Foley, 2017). Winterhalder (2017) indicated that the compatibility of the hardware is one of the various factors that can become a limitation in the transformation of instruction through technology. Furthermore, the research studies reported that instructors are either seldom or non-users of digital tools, which in most cases is invalid. Multiple research studies in this area identified teachers' hardware and software proficiency as the barrier to progress in integrating technology as an instructional component (Murray & Olcese, 2011).

Numerous research studies attributed the advent of learning management software as a crucial element of advancement to the concept of technology having transformational qualities within the asynchronous spectrum of technology-based learning. Although initially praised for boosting the instruction with which homework, projects, and assignments were collected, and learners' results were shared, the LMS now serves as a powerful platform for communication and collaboration. Apart from facilitating effective communication, there is a developing and mostly unknown concept that the characteristics of the LMS software might effectively organize self-regulatory activities, hence increasing the learners' self-efficacy in an online learning environment (Kretschmann, 2015). The assumption that LMS favorably targeted students' motivation has been confirmed regarding the motivational characteristics of formative evaluation in higher education (Li, Hung, & Chang, 2010). Though research evidence suggested that the independence linked with asynchronous learning (virtual/online/hybrid) opportunities motivates learners, it certainly appears that the self-assessment component of the LMS alone can assist in learners' academic achievement and motivational level at higher education and any level of education (Cauley & McMillan, 2010).

2.5 Bloom’s Impact on Technology Integration

Benjamin Bloom is widely acknowledged as one of the most influential educational researchers of the past fifty years. The advancement of technology was not the primary focus of Bloom, but his popular findings on one-to-one instruction and Mastery Learning (Bloom, 1984) have inspired the perspective of tech innovators as they sought a technology framework that could replicate the effective instruction provided by a one-to-one instructor. The most successful configuration for learning, according to Bloom (1984), was when one qualified tutor was allocated to no more than three learners during a particular instructional session. (Bloom, 1984) compared a control group of 30 learners to a one-to-one teaching class using the standard deviation found that one-to-one coached learners scored higher than 98% of the conventional class students. 30 students were taught the content in a Blended Learning settings in the third configuration of the research. The Mastery Learning students scored, on average, above 84% of the traditional control sample, but even the Blended Learning students missed the mark of the advantages achieved by the one-to-one teaching environment. Since Bloom's discovery of the advantages of the one-on-one tutor, numerous experiments have been conducted to explore instructional methodologies and technological breakthroughs that build on what was gained in the "2 Sigma Problem" study (Bloom, 1984). The desire for more personalized education prompted teachers, scholars, and software developers to create new tutoring methods and applications. The "2 Sigma Problem" (Bloom, 1984) study had a significant impact on the development of educational technology approaches for interactive learning instruments. In an attempt to leverage on a virtual environment of a one-on-one method of tutoring referred to as model tracing methodology, innovative technology was implemented in response to Bloom's research (Cotten, 2021; Reigeluth, 2016). Bloom's revised taxonomy (Anderson, & Krathwohl, 2001) and technology integration are closely related as technology can be used to support and enhance all the levels of the taxonomy. At the Remembering level, technology can be used to help students recall information and facts, such as through flashcards or online quizzes. At the Understanding level, technology can be used to help students comprehend and explain concepts, such as through multimedia presentations or interactive simulations. At the Applying level, technology can be used to help students apply knowledge and skills to solve problems or complete tasks, such as through virtual labs or games that simulate real-world scenarios. At the Analyzing level, technology can be used to help students analyze and evaluate information, such as through data visualization tools or online discussions. At the Evaluating level, technology can be used to help students make judgments and form opinions, such as through online debates or peer review tools. At the Creating level, technology can be used to help students design and produce original content, such as through video production or coding projects. Churches (2010) also used Bloom's Revised Taxonomy to explain a scale relating to higher-order thinking skills in order to further clarify methods for measuring student involvement in the technology classroom.

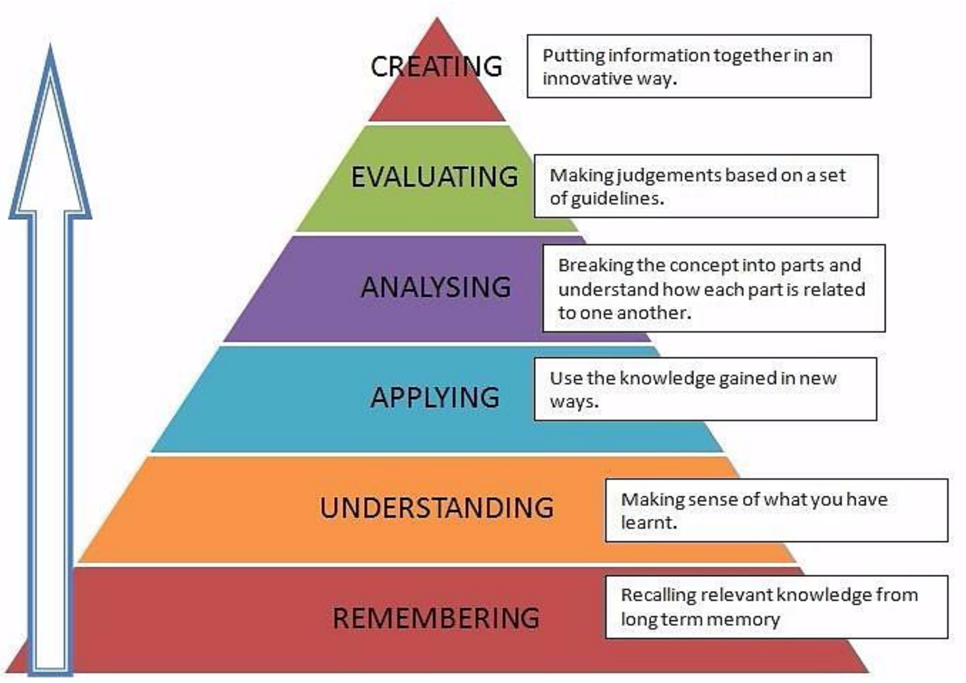

Figure 5: Bloom's Revised Taxonomy (Anderson, & Krathwohl, 2001)

1.6 SAMR Model

According to SAMR Model technology is divided into four major categories that can be used in learning activities:

- Substitution: A substitute is provided by the technology for other activities of learning with no basic change.
- Augmentation: A substitute is provided by technology for other activities of learning with basic developments.
- Modification: The learning activity is permitted to be reformed by the technology.
- Redefinition: Those tasks that couldn't be done without technology, are allowed by the technology to be created.

Therefore, the framework divides integration of technology into four categories which include substitution, augmentation, modification, and redefinition. The term substitution relates to instructors' interaction with technology at the basic level, when technology is employed to accomplish the same instructional activities those were carried out with absence of technology. For instance, a teacher may utilize the functionality of MS PowerPoint so that learners may simply manage content about a specific subject on successive slides. The term augmentation refers to the second stage of the model. The learner adds extra levels of refinement at this phase. For instance, a learner augments a PowerPoint presentation with graphics, motions, and word art effects in addition to the typed content, which indicates the enhancement of the content. The steps of modification and redefinition indicate that this paradigm has reached to content transformation. Audio and video aids are considered as distinguishing characteristics of this modification level of the paradigm. For instance, an educator may utilize the software that enables learners to upload particular video files or create their own voiceover to enhance their comprehension of the topic. Learners build objects that could not be made using any other instructional medium except a digital tool during the final step of the paradigm. For instance, learners in a classroom may be divided into small groups and assigned to analyze a part of textbook content. The instructor next guide each group to create an animated representation of the analyzed material of textbook assignment using an internet based animation application. Along with the motion and graphic, learners record their own voiceover to demonstrate their understanding. The development of students during the redefinition stage is the summit of both the SAMR model and Bloom's revised taxonomy (Puentedura, 2018).

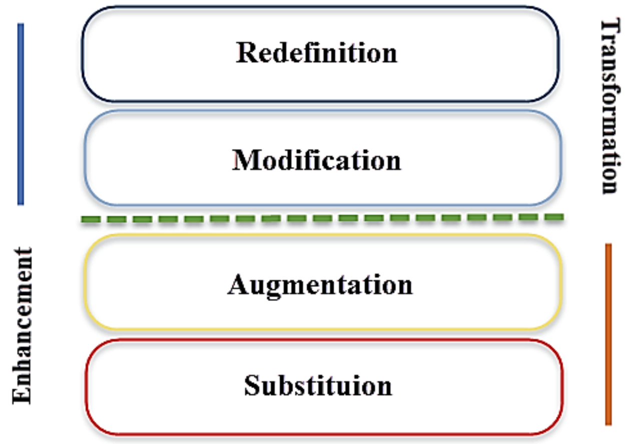

Figure 6: Model of SAMR (Puentedura, 2014)

2.7 Integration of SAMR Model and Bloom's Revised Taxonomy

Although the present effect of digital tools in higher education institutions continues and it happens to make the instructional process more meaningful, it will later have a demonstrable impact on current instructional systems. The most notable effect of digital tools on the educational climate is how it has evolved from supporting the instructional process in a more effective, interesting, and applicable way to transforming the instructional process. The term "transformation" refers to a significant change in style, shape, or operation. The capacity of educational technology incorporation to revolutionize teachers' instruction and learners' knowledge acquisition is exceptional in the sense that it enables teachers to become a mentor of instruction and learners to become creators of their mental processes and understanding (Prensky, 2012). Mishra & Koehler (2006) developed a conceptual paradigm to promote educational technology's transformative features. The SAMR framework are composed similarly to Bloom's revised taxonomy in relation to the context and levels of cognitive learning. Numerous empirical investigations have reported that the degrees of incorporation in digital tools achieved via the SAMR Model corresponds to the characteristics of Bloom's revised Taxonomy (Boll, 2015; Savignano, 2017).

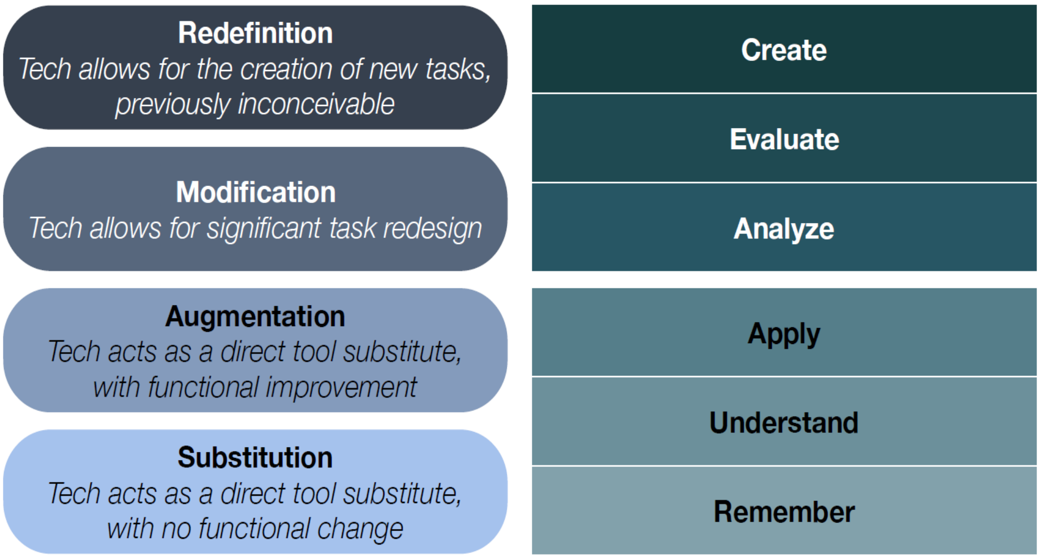

Figure 7: SAMR Model and Bloom's Revised Taxonomy (Puentedura, 2014)

2.8 21st Century Skills

Chris Dede, a contributory writer to the Digital Teaching Platform and National Educational Technology Plan and a Harvard Professor specializing in 21st-century expertise, based the definition of 21st-century learning skills on an assertion by James (2020) that robots are now capable of performing the 20th-century abilities of infrequent cognitive activities and manual handling in the organizations. On the other hand, the previously indicated abilities, when combined with reasonable technology awareness and reasonable communication capabilities, will appear to be essential in the twenty-first century (Clarke-Midura & Dede, 2010). Based on the ideas outlined above, the National Educational Technology Plan (NETP) asks for a concerted effort to address the areas of a learner-centered curriculum, effective teaching that fosters freedom in education, and technology-based evaluation.

The latest acceptance of and conformity to the Common Core Standards mandates a move toward technology-enhanced education, evaluation, and content creation (Presby, 2017). One of the emerging Common Core Standards' primary directives is for all learners to be proficient in 21st-century competencies (Adams Jr, 2010; Cuban, 2013). The standards' emphasis on creative writing enables students to acquire the 21st-century ability of efficient and good communication in a technology-rich environment. Interestingly, the sustaining imperative to revolutionize the instructional process through computers and digital technology was first articulated in NEP 1998. Further drafted in the scope of the Draft National Education Policy, the Roadmap for NEP 2017 provides a shared vision for an integrated learning model that emphasizes both technical proficiency and an improvement in the cognition of instruction (GoP, 2017). The digital Pakistan policy (GoP, 2018), focused on proposing necessary policy framework to enable sustainable IT environment and laws regarding information protection. The policy promotes the availability of high quality ICT services for the citizens for their economic well-being and quality of life. The policy also focused on the achievement of sustainable development goals, socio economic development through mass adoption of innovative applications and emerging digital technologies. The key components of policy for education sector covered four SDGs (GoP, 2018). The HEC and PIEAS also collaborate to implement science, technology, engineering, and mathematics (STEM), which has also become a keystone of the current government to validate the educational reforms.

2.9 Impact of Technology

Although the desirable influence of technology-mediated instruction on the learning environment is largely accepted as productive and beneficial, however, the underlying procedures and strategies are subject to debate. Whereas a variety of research designs, from experimental to relationship studies, demonstrate considerable effects of technology on learners' academic achievement, even compared to relatively technologically under-privileged groups, the differences in educational practices, the student's access to digital tools, and content variation all affect the process to consolidate research findings. The influence of digital technology on the instructional process extends into the domain of teachers' professional growth and development, where the deployment of teaching methodologies corresponds with both the quantity and quality of accessible digital tools (McCusker & Gunaydin, 2015).

2.9.1 Technology and Student Motivation

The favorable characteristics of educational technology for the instructional process are centered on measurable increases in learners' academic accomplishment, with little research evidence on the process linking these two variables. Amick (2019) provided a self-evident paradigm called Expectancy Value Theory linked to learners' motivation for ages 12 to 24 years, a time predominantly defined as adolescence. According to Bataller (2018), the cognitive paradigm is connected to learners' motivation in a way that enables the concept that learners keep the choice to involve in cognitive processes, resulting in a set of behavioral patterns (basically a constructivist concept) formulated on the insight that what is acquired will be valuable and beneficial (Li & Wang, 2012). Research studies in a variety of STEM-related fields demonstrate the evolution of the active learners' lens, which is encouraged by the quantitatively obtained value of the gained ability and information (Li et al., 2010). Similar to how learning outcomes have been proven to be an effective source of intrinsic motivation for learners, asynchronous instruction has been recognized as possessing the same motivational characteristics by learners (Li et al., 2010; Samuels, 2010; Wang, 2012). Consequently, these theories as much as adequately account for often seen learners' interest in digital devices, both as a result of novel contact with a novel object and as a result of a reported tendency for educational scenarios that include technology in the instructional procedure (Clayton, Blumberg, & Auld, 2010; Cauley & McMillan, 2010). The tendency has been addressed from various perspectives, such as the conceptual framework of game theory, learner-controlled accessibility to formative assessment, and an enhanced learning performance viewpoint associated with the flipped learning approach (Newman, Deyoe, Connor, & Lamendola, 2014).

2.9.2 Technology and Curricular Access

Besides the well-known linkage and relationship of motivating factors, instructional technology facilitates access to course contents. According to Keengwe, Schnellert, & Mills (2012), there is a statistically significant relationship between one-to-one students in digital learning settings and higher content availability. Warschauer and Matuchniak (2010) presented a more comprehensive review of technology and curricular availability. The investigators precisely concluded that stock availability of digital tools and devices in campus laboratories or regular access to portable mobile devices at home was adequate for teaching methods prior to the reasonable and adequate availability of core courses of instruction. However, digital libraries, repositories, and database access to research students are mandatory for post-graduate programs. Additionally, the same investigators discovered that learners had a significant statistical willingness and enthusiasm for technology-mediated education, a choice associated with a potential advantage from the availability of suitable and course-associated software. Additionally, other empirical evidence support Cuban's (2010) argument that the increasing availability of educational technology is insufficient to enhance teaching and learning because the major constraint for an increase in quantifiable learner's achievement is the teachers' instructional practices, i.e. teachers' instructional activities and strategies associated with technology integration.

2.9.3 Technology and Instruction

In various research studies, the consideration of technology's effect on instruction at the higher education level has been centered on increased learners' involvement, initiative, communication, collaboration, and the broader availability of digital tools and instructional material. A new area of study is comparing the effectiveness of technology-mediated teaching in contrast with the teacher-centered didactic teaching process. However, Lei (2010) discovered a correlation between innovative usage of educational technology and learners' underlying cognitive patterns, regardless of instructional material. In addition to the argument over how software such as learning management systems arrange asynchronous integration, collaboration, and communication, educational technology has influenced how students learn in technology-based instruction. While a review of the related literature reveals comparable qualitative results, there is a lack of studies that adopt, at the very least, a quasi-experimental model or any other suitable framework capable of producing generalizability in conclusions relative to educational technology and instructional reforms through technology (Lei, 2010).

2.9.4 Technology and Assessment

Aside from considering technology-associated policies and interconnected student skills, accountability and assessment are the motivating forces to integrate technology at the higher education level meaningfully. While the National Testing Service (NTS) has employed technology-based testing for the last decade, in the context of the Graduate

Assessment Test (GAT), the testing deployment has accelerated the reforms of all states to computer-based assessment. Higher education Pakistan committed in GoP (2017) to enhancing technology-based higher education facilities through the Partnership for Pakistan Education and Research Network (PERN III) (GoP, 2017). The significant features of ICT integration were; to provide technology equipment, develop the education sector's capacity, integrate the best instructional activities in technology-related programs, develop harmonizing procedures to technology in higher education and use technology to reinforce quality in the instructional process. Given that both partnerships are composed of all states and the funding is based on federal and provincial ministries, the deployment of testing systems and various partnerships has been primarily acknowledged as a responsibility of the Federal Government. All states have recognized the partnerships in the previous five years, while in some cases, publicly acknowledged their examination of alternative choices, including the Pakistan Testing Service (supported by the different groups of colleges) and an Allied Testing Service (ATS). Given the explicit link between the Policy Standards and the preparedness of higher education institutions, It cannot be ignored that the appeal of potential state collaborations with testing systems such as PPSC and FPSC to offer reliable testing systems to successfully deploy Central Superior Service (CSS) examination system. According to Cuban (2013), the major hindrance to implementing a technology-based reform - in light of past experiences of technology-mediated instruction initiatives - will depend on curriculum developers' awareness that instructional outcomes will almost certainly be dependent on known practices of quality teaching to acquire broader reforms (Cuban, 2013; Chingos, 2013).

From a broader policy perspective, it is necessary to maintain policy consistency with instructional objectives while guaranteeing that future transformations of instructional policy may reflect and adapt to the adequate description of evolving instructional technology. According to Cuban (2013), the abilities required for the twenty-first century are both technologies dependent and complicated in terms of cognition, collaboration, and communication. The researchers clarify this assumption by noting that responsibilities demanding cognitive abilities and physical or psychomotor activities are increasingly being performed by robots in favor of those requiring meaningful collaboration, communication and critical thinking. The technology that seems accessible in the classroom evolves the stimulation and expansion of workplace competencies and requirements (Clarke-Midura & Dede, 2010). In light of the qualitative aspects of the required capabilities and the growing need of technology, scholars have indicated the necessity for effective policies and standards that adapts to both evolving instructional outcomes and the digital devices and media required to accomplish these results (Machado, & Chung, 2015).

2.9.5 Teacher Ideology

Realizing that the determining factor for reform is the instructor's educational ideas and, therefore their practice - the accompanying movement toward incorporating digital technologies in the teaching is linked to a growing understanding of what constitutes good instructional practices. Whereas experiential/didactic teaching continues to dominate the current instructional system, the impact of digital tools on teaching seems to be driving the current shift toward a constructivist approach.

Seymour Papert, a colleague and collaborator of Jean Piaget predicted the influence of information and communication technology on the instructional system in the 80s. Seymour believed that the pervasive availability of digital tools would herald a revolution in the educational school of thought, characterized by learner-driven digital library availability to information, in which instruction would appear an exclusive act (Khan, 2010). Anyone with a suitable web or broadband connection has connectivity to infinite repositories of knowledge. Most of those databases are organized for educational reasons.

The Melinda and Bill Gates Foundation awarded the Khan Academy approx. $1.5 million in funding in 2010 expanded the availability of the Khan Academy's already readily accessible online information (Papert, 1980). The fulfillment of Seymour's forecast and vision, shown by the Khan Academy's popularity and widely acknowledged promise, heralds a shift in k-12 computer-based education (Khan, 2010).

The constructivist learning approach of Montessori and Dewey, combined with Vygotsky's research on identifying the significance of scaffolding instructional activities of learning just ahead of students' level of expertise, is considered the authenticity of the constructivism instructional approach. In contrast to Montessori and Dewey's early revelations and experiments, computer-based learning shifts the burden for organizing instructional practices away from the instructor and onto the learner. Although Vygotsky refers to this defined zone of optimum instruction as a Zone of Proximal Development (ZPD), the value of a ZPD to the learner (besides the obvious merits of optimum student learning) represents the apparent increase in the urge for learning (Vygotsky, 1978).

This foundation is significant because it explains the discrepancy between present experiential/ didactic instructional practice and the constructivism approach (previously indicated), which seems to contextualize progressive and successful technology-integrated education. A modern constructivism philosophy of instruction is characterized by a learner-centered technique in which pupils provide instances and practices of desirable learning via teacher-guided critical thinking practices. Keengwe, Onchwari, & Agamba (2013) discussed the value and methods of constructivism philosophy in the technologically enhanced classroom. More precisely, the studies indicated that when learners have chances for effective teamwork and coordination with other learners and have access to the expertise of the instructor as a mentor of instruction rather than a possessor of information, technology-aided education enables learners to take control of their instruction (Keengwe, Onchwari, & Agamba, 2013; Keengwe & Onchwari, 2011).

Keengwe et al. (2013) correctly identified the intrinsic interpersonal nature of instruction in an artistic or constructivist setting. Modern forms of technology-aided education, which will be periodically reviewed in this literature, cover the spectrum of interpersonal relationships from more communicative to almost isolating, with interpersonal relationships defined by asynchronous communication on web-based platforms. Ertmer et al. (2012) and associates indicated that instructors' ideas regarding teaching and learning are a crucial aspect of a learner's instructional process. Additionally, if an instructor does not fully embrace and apply the constructivist approach in instruction, as mentioned previously, the instructor is more likely to make minor operational modifications to the instructional procedure, rather than substantive remodelling that represents the complete adoption of an artistic/constructivist concept.

2.10 Promising Models and Practices of Technology Integration

The literature addressing potential educational approaches is mainly based on but not limited to the model of Puentedura (2014), i.e., SAMR model, and the paradigm of Anderson et al., 2001 is the updated Bloom's Classification. Where innovation and synthesis were amongst the most significant levels of the thinking process, the emerging behaviors connected with effective utilization of educational technology specifically assist this degree of the thinking process.

The forthcoming literature will be divided into nine parts grounded on a comparison of suitable technology integration frameworks that encourage increased levels of thinking versus those that emphasize the accessibility of digital tools and learners' involvement. Reasonably, this twofold approach to the phenomenon eliminates appropriate behaviors and cognitive frameworks. On the other hand, spontaneous couplings of both practices and contexts, which will be discussed in the coming sections of related literature and research, will support contextualizing the research. Educational technology usage may be generally categorized according to whether it is primarily used by an educator or a learner for achieving the goals of delivering the relevant subject matter (Maxey & Norman, 2019).

2.10.1 The SAMR Model

The SAMR Model, presented by Doctor Ruben Puentedura, specifies the efficacy of technological instruments in the instructional procedure. According to the SAMR Model, instructional practices in which digital tools work as a replacement for supplements a non-digital enhanced method are said to be improved by digital tools. In contrast, the SAMR framework states that if digital tools require major job reformation or involve task reshaping, digital tools act as a transformational factor.

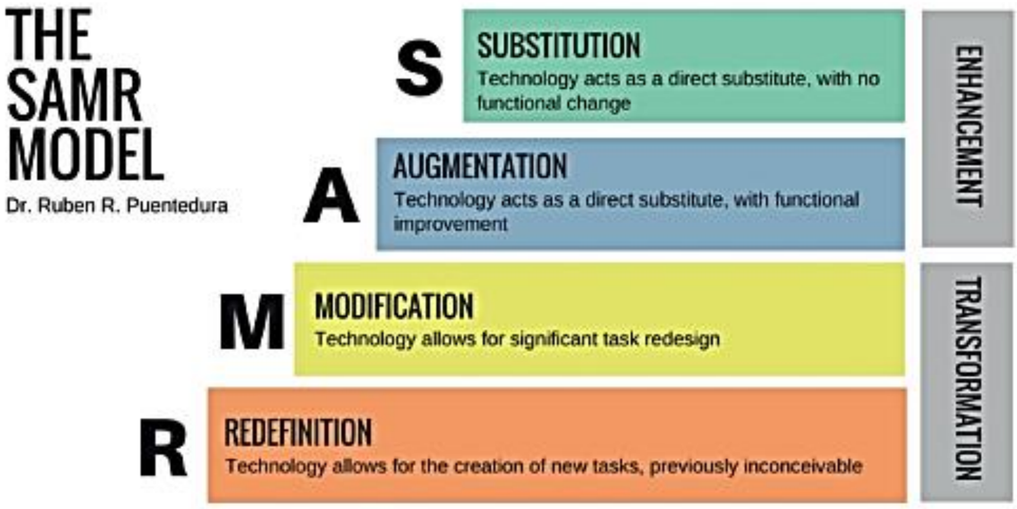

Figure 8: SAMR Model Stages (Puentedura, 2014)

Puentedura (2014) proposes that the SAMR model for educators' incorporation and utilization of digital tools may eventually change or redesign instructional goals. The author informed that if a technological gadget just replaces whatever can already be performed using conventional means such as pencil and paper etc., the digital gadget may not always be utilized meaningfully. SAMR corresponds with hierarchic phases following Bloom's revised Taxonomy, throughout which substitution or augmentation practices may be utilized to improve the instructional goals, and modification or redefinition level practices would be utilized to reform instruction at upper phases. Whenever SMAR is used in accordance with learners' instructional objectives, this integrated framework develops 21st-century learning abilities, including teamwork, creativity, communication, and critical reasoning (Terada, 2020).

Calvert (2015) strongly recommended SAMR model when combined with the co-teaching instructional method for various reasons. Co-teaching has been shown to improve education, mainly when concepts and techniques are introduced in genuine and real-life circumstances. This is a time-efficient method for incorporating digital tools into all aspects of instruction, which may benefit higher education students (Zielezinski & Darling-Hammond, 2016). Green (2014), on the other hand, advised educators against using this paradigm to shape educational views. Green suggested that SAMR model may be utilized in combination with student-centered teaching that emphasizes the procedure of meaningful knowledge creation. Creating a balanced digital climate is a complex but necessary effort. Terada (2020) mentioned that SAMR framework could assist instructors in conceptualizing revolutionary methods to incorporate digital tools inside and outside the educational settings. Although many instructors already employ SAMR. The study of Hamilton, Rosenberg, & Akcaoglu (2016) proposed more mixed method research on SAMR's effect in dynamic, student-centered environments owing to the model's inflexibility and the changing integrative procedure required. SAMR may be used in conjunction with Bloom's revised Taxonomy to enhance the teaching and learning process.

Puentedura introduced a methodology of technology-assisted instruction called Substitution, Augmentation, Modification, and Redefinition (SAMR). Additionally, it refers to the number of digital tools utilized while assessing instructors' level of technology usage or selecting suitable tools for educational objectives (Puentedura, 2014). The framework carefully classifies technology use according to its effectiveness. It is a substitute for a non-digital resource against various ways of generating new information, comparable to Bloom's revised Taxonomy categories (Anderson & Krathwohl, 2001). Educators are mostly aware of and increasingly refer to Bloom's Taxonomy instruction objectives to increase educational outcomes. Whereas the SAMR approach is not very dynamic, it may be utilized to assess instructional goals and content to determine the extent to which instructors integrate digital technology. Educators may use the framework to determine which activities can be replaced by digital technology to expose learners to complex cognitive abilities (Hamilton, Rosenberg & Akcaoglu, 2016).

2.10.1.1 Significance of SAMR Model

The SAMR framework is an extremely valuable platform that was created to support instructors in identifying how they utilize digital tools throughout the instructional process in higher education. It comprises four distinct phases of technological incorporation, each of which is separated into two distinct stages. The blending and incorporation of digital gadgets proceed from top to bottom level, and instructors may remain at a level that is appropriate for the content and instruction. The Substitution level is where incorporation of digital tools begins since it is the model's initial phase. This phase utilizes digital tools to emulate instructional practices. A scholar reading an online journal on a digital device such as a laptop or tablet rather than a printed book is an instance of substitution level. A learner may use both ways to highlight the relevant text, give feedback, and bookmark articles. The augmentation phase is the second phase of technological incorporation. Throughout this phase, digital tools are utilized to modify an instructional practice somewhat, but the instructional goals remain unchanged. The third phase of technology utilization is the modification, which happens when digital tools are utilized to alter the functionality of particular instructional practice. Modification entails learners' participation and innovation while also enhancing students' comprehension of the material. The final and highest phase of the SAMR framework is technology redefinition, which happens when many modes of technology integration are employed to synthesize new instructional activities. This phase requires skills including teamwork, creativity, communication and critical reasoning. At the transformation stage i.e. modification and redefinition phases, instructional goals are greatly enhanced and escalated (Puentedura, 2014).

2.10.1.2 SAMR as a Measurement Outcome of Technology Integration in Lesson Plans

Whereas TPACK model assists in the planning phase of instruction in higher education, the SAMR framework is an effective apparatus for evaluating the effects of educators' degree of technology incorporated into their instructional practices (Phillips, 2015; Zhai et al., 2019). According to Phillips (2015), it is beneficial to utilize SAMR in combination with some other technology enabling model, TPACK, for instance, to assist in designing the instruction and evaluating the content's effectiveness through technology incorporation. Once instructors gain expertise in incorporating digital tools into their teaching, they often include digital gadgets at varying SAMR levels (Nkonki & Ntlabathi, 2016).

The SAMR approach has four major phases, Substitution, Augmentation, Modification, and Redefinition, which assist instructors at higher education levels in determining which phase their particular learning assignment fits under (Puentedura, 20146). The SAMR framework is an effective tool for on-profession teachers to analyze instructional activities and review how they may have gone from the first level i.e. substitution to the highest level i.e. redefinition of the content/course (George & Sanders., 2017). Nkonki & Ntlabathi (2016) used SAMR to assess instructors' efficacy in using

Blackboard-Learn which is a famous Learning Management System (LMS) as a mode, medium, or technology for the transformation of the instructional process, particularly at the tertiary instructional level. Researchers observed that most Blackboard-Learn developments were ambiguous in design and resided under the first two phases of the model i.e. Substitution and Augmentation. Nkonki & Ntlabathi's research employed the SAMR paradigm to determine the degree of technology incorporation inside the Blackboard-Learn system. However, there existed no evidence of the respondents' highest level of technology incorporation competence regarding their self-perceived usability or self-recognized utility before the usage of Blackboard LMS. The SAMR approach was utilized to assess the degree to which mainly designed instructional activities correspond to instructors' self-perception, self-analyzed feasibility, and observed usefulness as evaluated by the TAM1 and TAM2 models. (Romrell et al., 2014).

As Phillips (2015) subsequently mentioned that although assessing TPACK is an excellent technique to establish proficiency, it does not address the distinct incorporation of digital tools by instructors. The SAMR approach enables instructors to assess their technology-enhanced instructional tasks. Puentedura (2014) established the SAMR paradigm, a structure for integrating digital tools. SAMR is a well-versed and well-classified paradigm that denotes four distinct levels: Substitution, Augmentation, Modification, and Redefinition. The approach supports instructors in analyzing each instructional practice and serves as equipment for enhancing and transforming the standard of teaching via digital tools (Romrell et al., 2014).

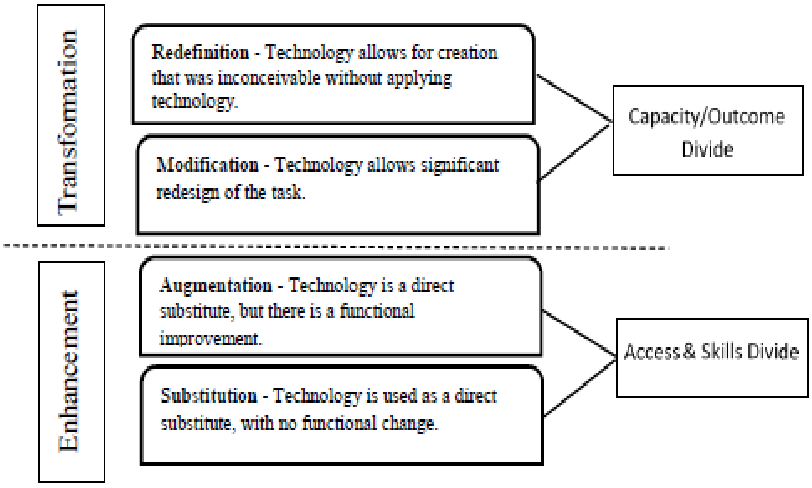

Figure 9: Digital divides enhanced SAMR model (Puentedura, 2014)

The initial phase, Substitution, denotes the incorporation of digital tools into an instructional practice that performs the very same purpose as the conventional technique. For instance, a learner may teach students to utilize Google Drive to write an article or review rather than scribbling it by hand. The second phase, augmentation, represents incorporating digital tools into instructional practice, but with specific structural replacements in place of the old technique. For example, with the assistance of instructors, learners may disseminate their assignments with classmates and use the discussion section in Google Documents to provide comments and discuss their perspectives. The initial two phases i.e. substitution and augmentation of the SAMR framework, are indicated as the Enhancement stages (Puentedura, 2014).

The Modification phase denotes whenever ICT and innovative technologies are employed to redesign a job completely. Following the instance, the instructor may request that students incorporate self-produced digital content in the Google Slides to enhance the animation effects. The Redefinition phase occurs when digital tools are utilized to create new instructional practices that would have been unattainable before using those particular digital tools. After learners accomplish their dynamic Google Slides, they may collaborate with learners in another institution to share and allow them to contribute to the Google Document or seek comments from genuine readers on their completed project. The upper two phases of learning, Modification, and Redefinition, are recognized as transformational stages of instructional practices. (Puentedura, 2014).

Romrell et al. (2014) conducted a study involving mobile learning practices and discovered that the SAMR framework is a useful assessment instrument. The SAMR paradigm was beneficial in assisting curriculum developers in producing outstanding transformational instructional practices. Accordingly, Hilton (2016) performed research evaluating the instructional activities of two social studies instructors over the course of one academic year utilizing SAMR approach, indicating that SAMR is recognized as an efficient measurement framework and a method for evaluating the quality and significance of each instructional practice. The research findings from such investigations demonstrated that although SAMR seems hierarchical in its pictorial presentation, the framework may not be interpreted that way, even though the concept of SAMR paradigm is to reflect technological incorporation at many levels. However, one research utilized SAMR model to assess the influence of tablets on potential pedagogical improvements and found that although effective communication and cooperation increased, many instructors continued in the augmentation level of the model (Geer et al., 2017; Hilton, 2016; Romrell et al., 2014).

A comprehensive career growth program for educators within a university may aid in the successful use of educational technology and the progression of instructors toward integrating digital tools into their teaching (online or on-campus etc.). Educators who deploy technology-mediated instruction want prompt assistance and adoption, flexibility to plan successful classes that use digital tools, and enough professional development programs, putting inefficient lethargic seminars aside (Howell et al., 2014). These technical training possibilities must be constructed in such a manner that they boost teachers' comfort with technology-based teaching and strengthen their self-competence in the process of integrating multiple technologies (Kilpatrick et al., 2014). As revealed by research after the deployment of SAMR model in an institution that initiated a one-to-one laptop, a solid and organized teacher training program may aid instructors in transitioning from the lower levels to the highest level of SAMR framework. It is clear from this research that institutions with more organized teacher training programs have a higher proportion of instructors in the higher stages of SAMR than institutions with less organized teacher training programs (Geer et al., 2017). The various research studies evaluated in-service educators' self-perceived scores on different technology integration models and self-assessed competency levels related to their degrees of incorporating digital tools as defined by four distinguished phases of SAMR framework in their classroom (Uslu, & Bumen, 2012).

2.10.2 1:1 Computer to Student Instruction

There exists a rising amount of unreliable research instances of one-to-one laptop distributions in different higher education settings throughout the country. There is a lack of studies examining the deployment approaches, effects, and efficacy. However, the GoP's (2009) Education for All (EFA) initiative is widely publicized as a pioneering effort and technically relevant initiative. It serves as an example of unique and independent situations in which a scientific and engineering institution verified procedures and results associated with this unique initiative. The 1:1 laptop initiatives required decade long funding initiative combined with a concentrated in-service training approach with the deployment of portable computers for every learner. Inside the particular learning environment, with the explicit goal of improving outcome and achievement in the areas of collaboration, effective communication, and critical thinking that are 21st-century learning abilities, and overall technological proficiency under a drastically transformed educational system. Lowther and associates conducted a longitudinal study (2004-2012) based on the University of Michigan's named Project Freedom to Learn and discovered that while learners revealed to 1:1 laptop educational paradigm demonstrated relatively limited academic achievement and outcomes, self-reported information collected from educators and learners indicated a significant increase in engagement, self-efficacy and motivation in the instructional practices (Lowther et al., 2012). While Lowther et al. (2012) conducted their longitudinal study and focused on the period before the android era and when virtual learning was at the emerging stage. It is also notable that the Draft National Education Policy 2017 assessed the results from National Education Policy 2009, a time frame of extensive smartphone availability and when virtual education (asynchronous instruction) was becoming popular (GoP, 2009, 2017).

2.10.3TPACK

TPACK is a model that offers a reflected and classified graphical presentation of technology instruction in a more deliberate and ordered manner. Conversely, TPACK is sometimes undermined. Critics of TPACK assert that the use of the framework is restricted by educator views and their degree of technology integration competence or expertise (Boschman, et al., 2015; Green, 2014). According to Kompa (2018), instructors struggle to comprehend each intersecting region of TPACK framework. Kompa described the paradigm as complicated, deceptive, and perplexing" (Kompa, 2018). This would be of the highest significance to reach mediocre learners through revolutionary digital platforms (Pamuk, 2012; Zielezinski & Darling-Hammond, 2016).

Shulman (1986) first suggested that an educator's capacity to develop an instructional activity/practice is characterized by the educator's successful use of the suitable methodology in conjunction with topic knowledge, a concept named PCK. Schulman's notion of pedagogical content knowledge (PCK) served as the foundation for Koehler, & Mishra’s (2009) study, which integrated the idea of educator's technology integration and awareness into the PCK construct. It is critical to illustrate that the inclusion of technological knowledge would not be considered an extension to the PCK construct, but rather a realignment of the teacher's decision-making for instructional strategy, in which the teacher selects suitable digital tools during the instructional planning of a course with the obvious aim of maintaining a right degree of precision. The newer construct is called TPCK since it incorporates technical competency into the PCK process (also referred to as TPACK in various studies). Along with the TPACK concept as it relates to education, the researchers explicitly identify emerging aspects such as institution and district value systems, administration, and staffing, among other vital aspects (Kopcha et al., 2014).

Furthermore, researchers from the University of Delaware discovered that TPACK learning in pre-practice/service institutions dramatically altered educational strategies and effectiveness as judged by the learners' academic achievement (Gibson et al., 2014). While this may seem modest, it is noteworthy in light of Ertmer and associates' discussion on the effect of professional development of tenure instructors and the challenges to technology deployment (Ertmer et al., 2012). Towards this end, research demonstrates viable strategies for extensively retraining seasoned instructors in the efficient integration of technology. With the widely anticipated Common Core Standards focusing on the integration of technology, both methods aimed at newly appointed and senior instructors will be critical in ensuring educational equality for learners throughout teaching and learning (Mouza, et al., 2014).

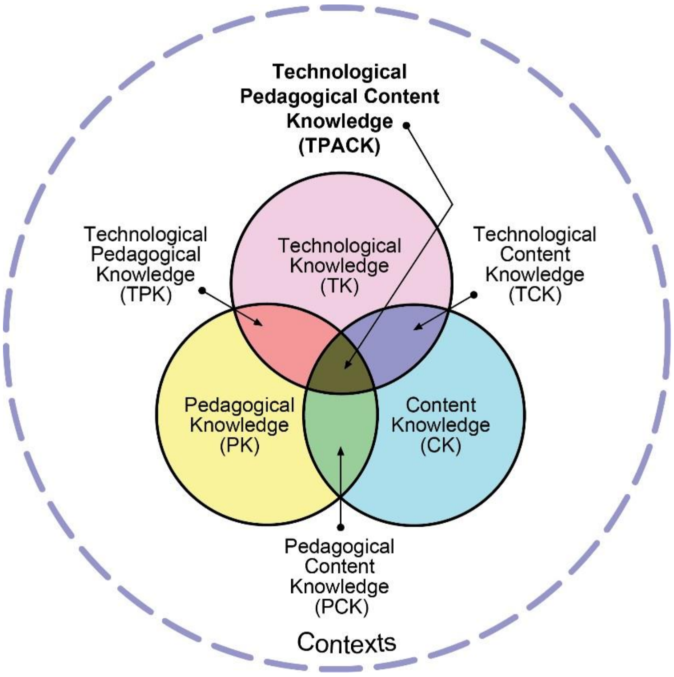

Figure 10: TPACK Model (Mishra & Koehler, 2006)

Technology, Pedagogy, and Content Knowledge (TPACK) presented by Mishra and Koehler, a framework for assessing teachers' competence to incorporate technology is based on Shulman's notion that instructional approaches often lacking in consideration of a critical aspect of digital and technological media (Koehler & Mishra, 2009; George & Sanders, 2017). Researchers often use the framework to evaluate educators' specific paradigms of competency in technology integration, understanding of pedagogy and content in order to establish the degree to which digital tools may be fully incorporated into pedagogical practices via technology-mediated planning and delivery (Buss, *et al.*, 2018; Ertmer & Ottenbreit-Leftwich, 2010; Wetzel & Marshall, 2011). Figure six illustrates the connections under the conceptual perspective of TPACK (Koehler & Mishra, 2009).

2.10.4Triple E

To ensure that students' instructional objectives remain prominent, many instructors prefer using Kolb's (2017) Triple-E approach. Triple-E was created mainly for college-level teachers in practice. The main objective of the model is to eliminate uncertainty in the preparation of using suitable digital tools by establishing standards for the effective and meaningful integration of digital tools into the learning process. It incorporates the most successful features of several technological incorporation frameworks, such as TPACK, but the primary emphasis is on the instructional process via:

1) Engagement: educational objectives, collaboration and timely completion of tasks, and time spent on each task.

2) Enhancement: distinction, customization, scaffolding and assistance, quality enhancement.

3) Extension: effective communication, constant linkage with instruction, meaningful events or experiences.

Triple-E paradigm aligns with the International Society for Technology in Education (ISTE) criteria for 2021, which inspires higher education teachers to equip learners to be effective technology users, creators, researchers, and critical thinkers. Additionally, instructors are expected to promote knowledge acquisition and bear while thinking that the incorporation of digital media will only be effective and successful when the teaching methods revolve around the particular and necessary digital gadgets and devices (Kolb, 2017). Majority of teachers in now use the Triple-E approach as a measurement tool and benchmark for ensuring meaningful inclusion of digital media (Zielezinski & Darling- Hammond, 2016). Furthermore, opponents asserted that this framework lays insufficient focus on the potential of digital media to merely raise ordinary learners (Muratie & Ceka, 2017).

2.10.5 The TAM and TAM-2

Davis *et al*. (1989) informed that an appropriate way to foresee if any teacher can integrate technology in a particular educational setting for instance higher education system, and which aspects may support or inhibit the effective incorporation of digital tools is to avail the Davis's (1985) model named as Technology Acceptance Model (TAM). According to Davis (1985), while focusing on the usability of any digital tool, the technology acceptance model can determine the accuracy of any digital medium for any particular educational environment.

Fishbein & Ajzen's (1975) presented a famous theory named the Theory of Reasoned Action. The theory allows researchers to comprehend an individual's aim to respond in a particular manner to understand if the individual will keep exhibiting that particular response. Davis (1985) determined not to inherit the factor of the subjective norm from TRA theory due to particular reasons. Davis *et al*. (1989) mentioned that no evidence was found related to the statistical effect of subjective norms on usefulness but slightly on educators' self-perceived usability and self-observed efficacy of instructional technology in the educational process (Venkatesh & Davis, 2000). Davis *et al*. (1989) later informed that TRA framework seems to be more standardized in scope and could be employed in a variety of subjects and areas. However, the researchers restricted the scope of TAM, which only targeted technology integration in education (Wu *et al*., 2011).

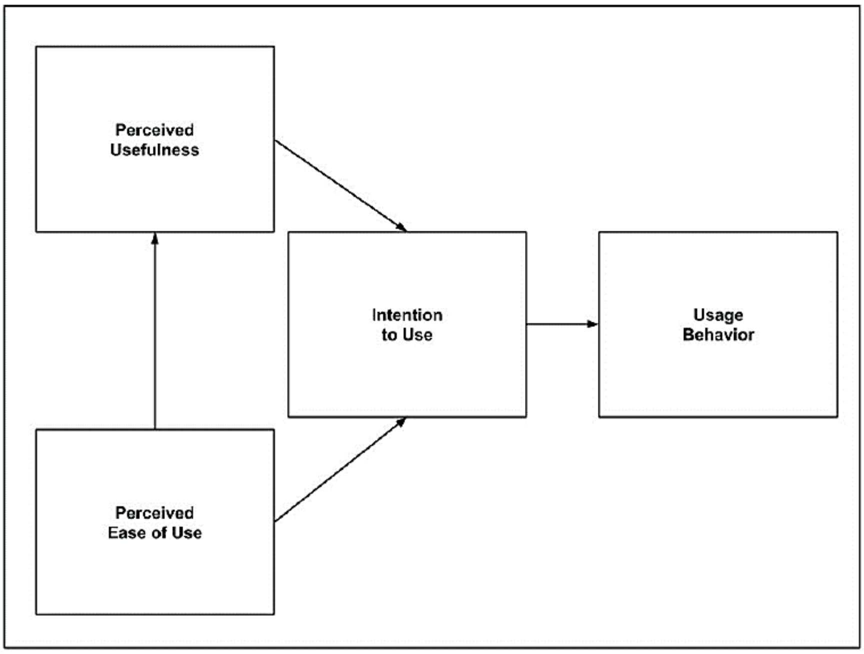

Figure 11: Technology Acceptance Model 1 (Venkatesh & Davis, 1985)

Additionally, various studies indicated that self-efficacy in technology integration substantially affected perceived usefulness before and after participants were introduced to a new technological device (Wingo et al., 2017). In another Holden & Rada (2011) used the basic TAM paradigm to assess teachers' reported accessibility and self-efficacy with regard to the recent digital tools they were incorporating and discovered that educators' self-efficacy with regard to usage of digital media significantly affected self-reported practicality and persuasiveness, was much more effective than technology-related self-efficacy. Self-perceived usefulness is a significant determinant, or forecaster, of educators' dedication to integrating particular digital devices or media (Aypay et al., 2012). To keep up with constant developments and advancements in instructional technology, higher education educators are critical determinants or factors to the successful deployment of functional and meaningful technology integration, and they are required to remain well-versed with the reforms and developments in the field of instructional technology (Tozkoparam et al., 2015).

Later, Venkatesh & Davis (2000) improved the TAM framework in a broader way and termed it as TAM-2 model to investigate how factors impact essential indicators such as instructors' self-perceived feasibility and observed efficacy. The investigators considered two significant aspects involving cognitive factors, which comprised self-perceived feasibility and effectiveness, observation of learning outcomes, work relevance, outcome quality, and authenticity of results. Second, they included social factors for instance, educators' voluntary participation, instructional experiences, figures, and subjective norms.

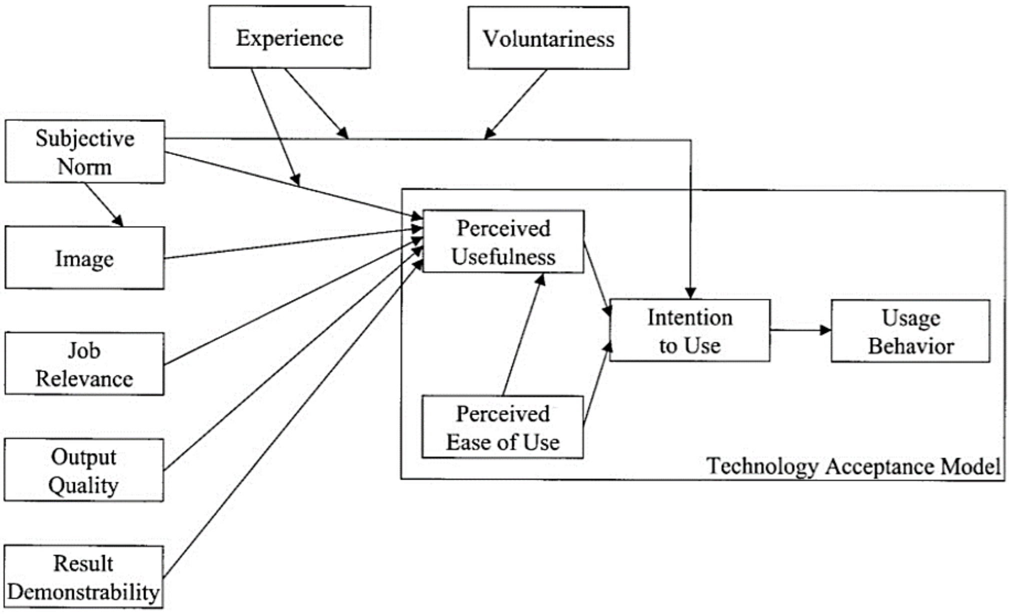

Figure 12: Technology Acceptance Model 2 (Venkatesh & Davis, 2000)

After assessing the new framework TAM-2, researchers discovered that the recently incorporated factors, which included cognitive functions and sociological factors, significantly influenced framework adoption by educators at any instructional level, that could guide forthcoming studies on how teachers accept and integrate digital resources. In the future, TAM-2 can be employed in place of basic TAM since it supports cognitive as well as socially constructive factors (Venkatesh & Davis, 2000).

2.11 Research Measures for Technology Integration

2.11.1 Measures of Teacher Perception and Skill

The number of studies has led to the development of many instruments for assessing teachers’ views regarding technology integration competencies, experience levels, and self-awareness. Numerous measurements, including TPACK rankings, thematic assessments, observational tools, questionnaires, and semi-structured and structured interviews, are quantitative, qualitative and mixed-methods in essence, with a preference for quantitative and qualitative descriptors (Buss et al., 2018; Cifuentes Maxwell, & Bulu, 2011; Hulon, 2015). A particular qualitative metric, Determining Educational Technology and Instructional Literacy Skillsets for the Twenty-First Century, categorizes instructors' competency levels and levels of technology incorporation as essential, moderate, or strong. Generally, quantitative research included treatment procedures, questionnaires, surveys, inventories, and rating scales that were examined utilizing measurements of variation (Cifuentes, *et al*., 2011; Liu, *et al*., 2017). The Technology Skills, Beliefs, and Barriers (TSBB) measures are one of many known quantitative metrics. These are utilized to assess teachers' technology integration practices and competencies (Hulon, 2015). The information acquired via the use of the TSBB instrument was derived from a 3-year survey administered to prospective educators. It was able to define and forecast technology utilization in teaching and learning accurately. Several reliable quantitative instruments include the Teacher Technology Survey (TTS) and the Technology Uses and Perceptions Survey (TUPS). Both instruments were developed to ascertain the extent to which digital tools are being used in instructional settings in connection to educators' attitudes and experiences about the integration of technology (Liu, *et al*., 2017; Ritzhaupt, *et al*., 2017).

2.11.2 Measures of Technology Integration

Because to the prominence and demonstrated reliability of the Technological Pedagogical Content Knowledge (TPACK) conceptual model/framework, many measurement techniques have been established to quantify and qualify forecast and estimate technology utilization competencies (Koehler & Mishra, 2009; Koehler, *et al*., 2012; Wetzel & Marshall, 2011; Kopcha, *et al*., 2014). Spencer (2019) designed an additional questionnaire, the Survey of Preservice Teachers' Knowledge of Teaching and Technology, to evaluate the TPACK framework's basic elements. Thomas (2018) established a substantial and comparable measure that was also utilized to measure educators' technology incorporation competency. Along with questionnaires, apparatus designed following the TPACK conceptual paradigm comprises open-ended surveys, interview questions, observations, and competency evaluations (Koehler, Shin, & Mishra, 2012). Other instruments designed to assess technology-related competencies include Mills & Tincher's (2003) Technology Integration Standards Configuration Matrix (TISCM) and Peeraer & Van Petegem's (2012) Likert scale questionnaire for describing ICT integration. The SAMR model was also utilized to prepare numerous checklists, observation tools, questionnaires, and interviews (Amick, 2019; Beisel, 2017; Bradley, 2020; Bruton, 2018; Froemming, 2020; Horgan, 2019; Humes, 2017; Jenkins, 2021; Martin, 2020; Patton, 2015; Perry, 2018; Pfaffe, 2017; Savignano, 2017; Wilson, 2021).

2.12 Teacher Attitudes toward Technology Integration

Effective technological usage at the higher education level is impossible without classroom instructors' involvement, comprehension, and motivation. Winterhalder (2017) administered a qualitative study comprising ten teachers in Grades 6–12 from two public sector institutions to assess their opinions about adopting portable devices such as tablets in the classroom. Nine out of ten participants reported comfort with digital devices and tools as an advantage. The most frequently reported advantages of employing potable smart devices were the capacity to operate a paperless environment and quicker accessibility to learners' work, which enabled educators to offer rapid responses to learners (Sawyer, 2017).

Cotton (2021) identified numerous themes in the research study that corresponded to the SAMR model's first two phases. The enhancement stage is regarded as the fundamental stage of the technology usage paradigm (Campbell, 2016; Hardisky, 2018; Puentedura, 2014). Substitution occurs throughout the technology incorporation procedure when instructors only utilize digital media as a tool to replace more conventional methods of the instructional process. A substitution phase, based on the results of Winterhalder's (2017) research, would be an English instructor who requires pupils to study articles on a smartphone rather than from printed material. While the substitution device may be convenient, it does not alter the fundamental purpose of instruction. Thies (2017) conducted a case study and found similar results on teacher motivation toward adopting digital technology for instructional practices. Furthermore, the research results suggested that respondents in the instructional process discovered more sophisticated methods of using digital media as they progressed through the SAMR model's enhancement to transformation phases. During the transformation phase, teachers utilize digital gadgets to enhance not just the effectiveness of educational practice but also to drastically alter its functionality, hence enhancing the students' achievement. Cotton (2021) discovered a favorable and statistical relationship between educators who routinely instruct and deliver content at the SAMR modification and redefinition levels and educators who consider themselves competent in the TPACK dimensions. (Bataller, 2018; Kim, 2019; Wright et al., 2017).

According to research, teacher beliefs regarding technology affect how they utilize digital tools and media in the classroom. If teachers believe that certain digital media or tool is advantageous for instruction, they choose to include digital resources in their instruction when they have availability to them (Foley, 2016; Kohl, 2017). Teachers' beliefs are also influenced by the quality of assistance provided by educational experts and the capacity of institutional administration to convey and adhere to technology usage objectives (Green, 2016; Wright, 2017).

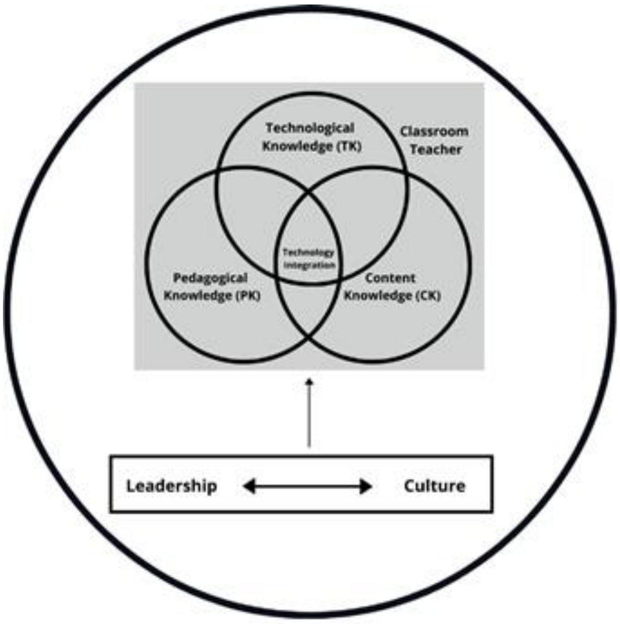

Figure 13: TPACK Leadership Culture (Heineman, 2017)

2.13 The Effect of COVID-19 on Educational Process

The COVID-19 epidemic surprised the whole planet and touched every aspect of humanity. Nobody seemed to be expecting how rapidly the epidemic expanded, how tough it was to medicate, and how devastating and lethal it was worldwide. Second-phase obstacle identified in the study literature that affects instructors' ability to incorporate newly acquired digital tools is their perception of the compatibility of digital tools to the subject they are dealing with. By requiring instructors to accept an invention without a clear goal or a thorough grasp of the digital media, the probability of the particular media being used effectively is decreased (Cotton, 2021).

More importantly, the pandemic's cascading impact on every sector and industry including the financial and economic system, healthcare organizations, sports, media and broadcasting industries, and religious places, was greatly underrated. The COVID-19 outbreak has had a devastating and wide-ranging impact on every specialized area of education. Due to the less time available to plan and prepare for the sudden transformation from traditional classroom education to online education, state representatives, directors, administrators, principals, instructors, learners, and even guardians were compelled to adjust immediately. The unspecified and irregular shutdown of institutions around the world led parents to seek spontaneous childcare plans or the hazard of becoming unemployed (Cotton, 2021).

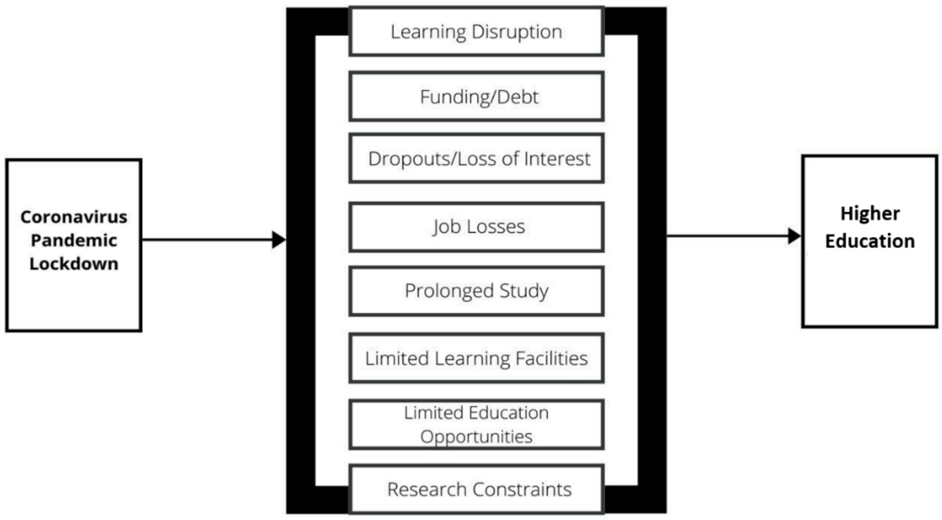

Figure 14: COVID Impact on Education (Onyema et al. 2020)

These choices proved more difficult for minimal-wage families whose parents worked hourly and did not have any choice of telecommuting or rearranging their working hours. Families from poor socio-economic status were also more likely to be classified as vital employees, which may have affected their options about how to educate their children in the middle of an unknown disaster. Over a year, more than 20,000 COVID-

19-related mortality in Pakistan, and the effect on every area, especially primary to intermediate education, is still being felt. While a degree of normality is gradually being regained due to the rapid development of vaccinations, the full effect of the epidemic on the whole instructional process and emotional well-being of learners may not be realized for several decades. COVID-19's direct impact on intermediate education is seen in Figure 11. (Onyema et al., 2020).

2.14 Empirical Evidence on Technology Integration

2.14.1 Panoramic View of related Researches in Pakistani Context

Akhtar (2009) conducted a case study to explore the use of educational technology in rural areas of NWFP province. Akhtar observed the effective use of educational technology in rural areas. The study also found few instances of technology integration in technical subjects. The study further found that teachers were provided with few professional development opportunities. Cheema (2012) explored the use of technology to teach prospective teachers. The study found that using educational technology makes the instructional process more effective. Cheema observed that adequate resources were also available for teacher training institutions. The administrators also monitor the requirements of adequate resources within institutions. Respondents mentioned that integrating technology is sometimes costly but it enhances the quality of the instructional process. Afzal (2012) conducted an experimental study to explore the use of digital tools in mathematics learning and its effects on student achievements. Afzal developed software and integrated the teaching units with it. The ten-week experiment was conducted before the post-testing. Afzal found that learning through software is better than the traditional method of instruction. Software teaching may produce better results and enhance student learning. The study also found that for male students, software-based instruction is a better technique than the traditional method of instruction.

Hussain (2012) also conducted an experimental study to explore the effects of technology-based instructions on the motivation, retention and academic achievement of secondary-level physics students. Hussain identified that computer-assisted instruction is more effective than the traditional teaching method. Hussain further found that computer-assisted instruction helps motivate students, their retention, and academic achievement. While comparing the gender differences, Hussain found that female students were better in their academic achievement both in computer-assisted instruction and traditional lecture methods.

Safdar (2012) also conducted an experimental study to assess the effectiveness of ICT in teaching mathematics at the secondary level. Safdar observed that integration of ICT was effective in enhancing the academic achievement of female and mediocre learners in the mathematics classroom. The method was also found effective for slow learners public sector students as compared to the traditional method of teaching. The study indicated that for high achievers, the ICT as the instructional method was least effective in contrast to traditional techniques in individual and overall cases. Alam (2012) conducted an experimental study to assess the effectiveness of the information processing model in mathematics classrooms. Alam intended to explore the cognitive improvements of students in mathematics. Johnstone’s (1997) model mainly predicts that if memory is overloaded, then there is a decrease in learners’ performance. Alam introduced the idea of pre-learning and found that the pre-lecture approach aided to learning of both girls and boys. Post-test results revealed that girls surpassed the boys both in the control and experimental groups. Alam also found that scores of girls were improved in procedural learning. The study also found that the pre-learning process has improved learning in mathematics. Javed (2016) conducted a study to explore the performance of prospective teachers through computer-supported instruction. Performance was assessed through two dependent variables, i.e., attitude and academic achievement of the respondents. Javed used a modular approach to treat the group and found that approach was equally effective for all prospective teachers. The modular approach further helped improve their professional attitudes and academic achievement.

Mushtaq (2015) used Bandura's Symbolic learning theory to explore the effects of internet and mobile learning on higher education students. Faculty members mentioned that ICT and digital gadgets have positive effects on the learning process. Digital content such as blogs, professional groups, social media networks, and digital libraries significantly affected student performance. Mushtaq noted that students prefer reading online material rather than printed. Mushtaq suggested that students of social sciences may use ICT inside and outside the classroom to enhance their knowledge. Mushtaq further suggested that teachers may focus on ICT-oriented tasks, applied knowledge, and practical applications of learning material.

Shaheen (2013) also used ICT based modular approach to assess the retention and academic achievement of the students. Shaheen developed technology-integrated modules of grade-IX biology. The modules were based on graphics, animations, and movie clips of the related concepts of learning. Two teachers of similar profiles were assigned to teach the groups of students. Achievement and retention tests were administered and it was found that students of the experimental group outperformed in achievement and retention tests. The study found that the modular approach was practical for each category of the learner i.e. below average, average and above average. Shaheen found the modular approach more effective for enhancing the performance and retention of students and a noticeable improvement was found in below-average students. Khan & Jumani (2012) conducted a study to assess the differences between e-learning and traditional learning. Respondents mentioned that the traditional method of instruction is comparatively more difficult than virtual learning. Respondents from distance learning institutions agreed that e-learning is a suitable method of instruction. E-learning material is as effective as instructional material of traditional learning.

Farid et al. (2015) explored issues and challenges in promoting virtual learning in Pakistan. Farid et al. indicated several issues which hinder in promotion of online learning, such as lack of ICT-enabled teachers and students, availability of practical courses, lack of instructional designs, internet bandwidth, lack of adequate software, power failures, cost of internet packages, lack of faculty interest, literacy rates, lack of adequate resources and lack of implementation. The study also found that e-learning is one of the significant tools that emerged from ICT and has been incorporated into many university programs to enhance the learning of virtual learners. Study also indicated that virtual learning is not growing at a rapid pace in contrast to developments in ICT.

Nawaz, & Kundi (2013) explored the developments in e-learning and adopted practices in HEIs of Pakistan. The study used participants' perceptions to predict the user attitudes towards ICT development, problems, and online learning prospects. The study was based on the psychological fact that perceptions are related to human attitudes. The study found that participants' perceptions were related to the criterion variable i.e. problems of e-learning. The study also found that learning preferences are significantly associated with learning styles and technology perceptions. Rafiq, Hussain, & Abbas (2020) conducted a case study and assessed the learners’ attitudes toward e-learning. The study used TAM model to determine student attitudes and found positive attitudes towards ICT and e-learning at higher education levels. A significant difference was found between male and female students. Male students were found more enthusiastic about virtual learning and ICT. However, the government may provide financial support and adequate infrastructure to improve students’ attitudes towards ICT and e-learning. Asad et al. (2020) conducted an empirical study on Pakistan's higher education to assess technology integration. The study found that it is necessary to integrate adequate technology for an interactive teaching and learning process. The study also found the students’ level of interest in integrating ICT in social sciences. Technology integration supports teachers in the teaching process and through ICT and virtual learning, students can acquire knowledge more effectively.

Nawaz & Kundi (2010) explored perceptions of e-learning in Pakistani HEIs. The study took demographic diversities in HEIs as an independent variable to assess its impact on the perceptions of students and teachers about e-learning. The study found that demographic variables play a lessening role in the perceptions of teachers and students. The e-learning perceptions are generally related to the contextual factors of the learning environment. Actual knowledge about user characteristics in developing the technology-mediated environment in HEIs is necessary to deploy meaningful educational technology.

Soomro et al. (2020) explored digital divides among higher education teachers. Digital divides were based on various factors of ICT, including integration of digital devices, motivation, skills, and infrastructure. Researchers developed a Faculty ICT access questionnaire to assess the digital divide among Pakistani faculty. Study also assessed faculty integration of ICT and various factors of ICT access. Study found significant differences in teachers’ access to ICT based on their demographic characteristics. The study found a prominent, substantial and significant gap between public and private sector faculty.

Ishaq et al. (2020) investigated the relationship of ICT with the academic achievement of higher education students in Pakistan. Data were collected from 300 students using a questionnaire. The study found that the majority of students have adequate access to ICT infrastructure. It was also found that the appropriate use of ICT resources has a substantial effect on the academic performance of the students. Students mentioned that they use digital tools to improve their knowledge and skills. ICT helps students to carry out their academic activities effectively with more engagement.

Shaikh & Khoja (2013) depicted the scenario of technology integration at higher education level. The study found that there are sufficient use ICT applications in Pakistani HEIs situated in major cities. Study also found that university personnel utilizes ICT applications in their routine tasks. Participants mentioned that effective technology integration in Pakistani HEIs could play a significant role in promoting learning. The study mentioned ICT-related issues such as the non-systematic method of technology implementation, making technology compatible with the university vision and mission, defining the role of technology, lack of infrastructure, and robust ICT policies.

Chandio et al. (2019) reviewed and analyzed the existing literature on technology integration at higher education institutions in Pakistan. Chandio et al. also reviewed different projects and plans related to ICT by the government of Pakistan. Based on relevant literature, the study highlighted four essential factors including the significance of ICT, challenges, infrastructure, and suggestions to improve technology integration. The study suggested the technology-related areas those need to be addressed in HEIs including the requirement of a budget for a technology upgrade, uniform implementation policies, adequate professional development, inter-university research initiatives and virtual collaboration, and e-library for university and campus management systems for each institution. Shaikh (2009) analyzed technology-based teaching and learning issues at Pakistani HEIs. The study also attempted to propose solutions to specific technology-related issues. The study used the Delphi technique to develop the questionnaire. The questionnaire was based on various ICT-related issues along with their possible solutions. The study also utilized the ZPD incidence development approach to propose measures for properly integrating technology in HEIs. The study determined that technology integration in higher education needs to be parallel with suitable policies to obtain its merits. Kazi (2013) conducted a case study research to explore the factors affecting the use of internet banking among students of HEIs in Pakistan. A self-developed questionnaire was administered using convenience sampling. Study indicated that perceived usefulness and convenience had a positive and significant effect on the adoption of internet banking among students. However, perceived ease of use was not a significant factor in predicting the adoption of internet banking.

Malik et al. (2019) assessed the students' awareness of sustainability concepts regarding information and communication technology. Study addressed various dimensions of sustainability, including environmental, social, and economic sustainability. Study assumed that lack of awareness regarding sustainability could significantly affect students' competence to maintain sustainability in ICT development. Therefore, it is necessary to incorporate sustainability concepts into the technology curriculum. Study was delimited to three disciplines software development, computer sciences and IT. Study found that majority of students were unaware of sustainability concepts. Study also found that very few students were aware of the idea of how sustainability is linked to technology. It was further found that the current curriculum merely covers sustainability concepts.

Adnan & Anwar (2020) explored the perceptions of post-graduate students regarding online learning during the mist of COVID-19 pandemic. The study was conducted at the initial stages of the pandemic when institutions were struggling to implement virtual learning modes. The study found that online learning is not producing the required results in developing countries like Pakistan. The students were facing issues related to internet access due to monetary and technical issues. Students identified online learning issues, including the absence of socialization, response time, and lack of interaction with teachers. Kanwal & Rehman (2017) investigated the factors affecting online learning adoption in Pakistani higher education institutions. The study indicated that system characteristics, perceived ease of use, internet bandwidth, and self-efficacy are significant predictors of virtual learning adoption. The study indicated that system characteristics were statistically significant with perceived usefulness and ease of use. However, technology accessibility and anxiety were found insignificant. Shaikh & Khoja (2011) explored the challenges of incorporating information and communication technology in Pakistani HEIs. The participants identified significant gaps in technology integration and ICT demands and supply. The findings indicated that a robust ICT policy could promote the status of a knowledge-based economy, hence supporting to development of a technology policy for planning, integration and administration at the higher education level. Suggestions relating to ICT-mediated higher education include piloting the technology-based higher education model, modification in current curricula for integrating technology into content, adequate resources, implementation of robust and target-oriented policy, provision of finances and recruitment of trained IT personnel.

Iqbal & Campbell (2021) investigated the challenges of learning technology integration in Pakistani HEIs. The study indicated different challenges for technology integration involving the professional development of faculty members, lack of interactive curriculum, lack of social acceptance, and internet availability in remote areas. Possible solutions for challenges involve personalized and interactive learning, professional development opportunities, provision of internet facilities, and use of digital devices. Munir & Shabir (2021) utilized the TAM model to conduct a multi-group analysis to discover the technology integration in Pakistani higher education institutions. Findings indicated that the dimensions of the model had a prominent effect on the performance of private and public institutions. The study also identified moderating effect of self-efficacy on academic performance. The study indicated that private sector institutions provide sufficient ICT resources than public sector institutions.

Ali et al. (2015) conducted a study to explore ICT integration for the effective instructional process at the secondary level in Punjab. The findings indicated that teachers are keen to integrate technology into the instructional process. The study suggested that stakeholders may facilitate teachers with adequate resources. The study recommended that the ministry of education may establish a comprehensive vision to provide finances for the promotion and development of technology integration.

2.14.2 Panoramic View of related Research around the Globe

In several other nations, the advantages and obstacles of integrating digital tools into instructional processes are equivalent to those in Pakistan. In developing nations, the hurdles are exacerbated by phase-one type constraints to instructional materials that have little to do with the integration of digital tools, for instance, lack of technological facilities, insufficiently trained instructors, and a significant proportion of underprivileged children (Doshmanziari & Mostafavi, 2017; Muratie & Ceka, 2017). Even though these hurdles are addressed, and instructional technology is available, adequate accessibility to laptops and digital media, as well as a deficiency of supporting personnel with technical experience, are indeed significant obstacles to control (Alkraiji & Eidaroos, 2016; Solano, Cabrera, Ulehlova, & Espinoza, 2017). Educators are expected to include evidence-based techniques into their educational practices, such as learner-centered approach, problem-based instruction, and integration of suitable digital tools, but mainly the educators' lack of understanding and unawareness of these educational methodologies and approaches (Kamalodeen, Figaro-Henry, Ramsawak-Jodha, & Dedovets, 2017). The instructional emphasis, and therefore the ways the digital tools are accessible for the instructional environment, might also vary depending on the nation's economic growth and recruitment demands (Eze, 2016; Subramaniam & Subramaniam, 2017).

Learners these days want their experiences with digital devices in the learning environment to be as numerous and exciting as they feel outside the classroom (Carver, 2016; Stefl-Mabry, Radlick, & Doane, 2010). Numerous research instances indicate that learners in urban institutions have higher availability of digital devices than learners in rural areas and that this particular phenomenon happens even when children have accessibility to digital devices at home, resulting in a wide range of learners without digital competencies and expertise (Francom, 2016; Kalonde, 2017; Kamalodeen, *ei al.*, 2017). Learners who interact with digital tools for educational reasons outside of the classroom obtain higher educational accomplishments than other learners who rarely adopt this practice; and understanding the emerging styles and standards of learners' technology usage outside the classroom might help teachers and researchers develop professional development programs for higher education institutions (Hughes, Read, Jones, & Mahometa, 2015). This phenomenon of technology integration outside the classroom is weighted toward smart cellular phones and digital devices, which are considerably cheap and allow better access to online learning materials, particularly in rural regions, where students use technology to enhance their information (Harper & Milman, 2016; Li, Snow, & White, 2015). Learners are experiencing oppressive impacts as a result of systematic and standardized assessments, particularly in writing, being administered on laptops and personal computers, and the majority of their online interactions being restricted to smartphones or tablets, preventing learners from demonstrating their competency in writing due to technological constraints (Stefl-Mabry, Radlick, & Doane, 2010; Tate, Warschauer, & Abedi, 2016).

A detailed analysis of the literature revealed that no significant research had been conducted on the technology-related competencies of higher education teachers utilizing the SAMR paradigm. Blanchard et al. (2016) used a mixed method approach to investigate the influence of digital-based teacher training on elementary-level instructors. The findings indicated that instructors who received more opportunities to participate in teacher training programs over the years were more successful at boosting students' standardized exam scores. Blanchard et al. (2016) report that most instructors have used digital devices to increase their learning effectiveness and self-efficacy. The linkages between this research and the previous one were the emphasis on career growth of teachers through training programs and the usage of teachers' perceptions before and after the delivery of the particular training sessions. The research of Blanchard et al. (2016) centered on Chromebook integration, addressing four central aspects.

Previous research examined the variables that influence student accomplishment in terms of technology usage and incorporation, as well as meaningful technology usage in learning. Darling-Aduana & Heinrich (2018), for instance, employed a mixed research approach to explore the relationship between technology usage and educational achievement for ESL learners. The studies discovered that integrating technology with effective teaching techniques is critical for transforming the educational practices of bilingual students. For bilingual students, the usage of digital tools in reading assignments and practices was more significant than the integration of digital media in mathematics courses. The research of Darling-Aduana & Heinrich (2018) is comparable to the current study in that it is based on student learning through integrated technology. The research examined the technology integration practices of teachers, adding meaningful contributions to the existing body of knowledge (Darling-Aduana & Heinrich, 2018).

In another research, González-Carriedo & Harrell (2018) investigated instructors' opinions about using digital media to improve the instructional outcomes of students. Research findings suggested that instructors believed in integrating incorporation to enhance educational outcomes. The previous research concentrated on learner accomplishment, but the new research concentrated on instructional practices and students' achievements.

Another instance is research by Hanımoğlu (2018), which examined technological incorporation, learner and teacher collaboration and interaction, and the advantages/limitations of digital devices. Hanımoğlu (2018) determined that technological resources were more important than improving instructional strategies. The research examined technology usage, with an emphasis on various characteristics of technology competencies of teachers. Given the authors' need for technological skill measurement using accurate and reliable measurements, the study utilized a mixed method approach (Scherer, Tondeur, & Siddiq, 2017).

Jati (2018) performed research utilizing the SAMR paradigm to examine how mobile apps might revolutionize teachers' instructional practices. Learners were issued smartphones and tablets for use during learning. According to Jati (2018), instructors ready to investigate the possibilities of integrating smartphone applications and educational software may discover that their instruction becomes more constructivist or moves to higher phases of SAMR model.

The TPACK approach enabled instructors to lay the groundwork for effective instruction using digital media in connection with technology, content, and educational practices (Hilton, 2016). Hilton (2016) mentioned that the SAMR model emphasized learners, whereas the TPACK model emphasized instructors. The research employed the SAMR approach to assessing the integration of technology at the higher education level, focusing on a more significant sample of instructors in disciplines of engineering, social sciences, and computer science. The research focuses on higher education teachers of a core subject in Punjab Province.

During the review of the related studies, it was discovered that two models were often employed in connection with technology usage. The two famously used frameworks are SAMR and TPACK. When evaluating both models for the questionnaire developed for the current study, the SAMR Model aligns more closely with the STaR Chart due to the four matching levels. The STaR (School Technology and Readiness Chart) inventory is designed to promote suitable practices in technology integration. The SAMR framework's phases go from substitution (the first phase of technology usage and incorporation) to redefinition (the fourth and final phase of technology usage and incorporation). With seven components, the TPACK framework emphasizes on technology usage in the instruction. In contrast to the SAMR, the TPACK framework does not follow a hierarchical formation. The TPACK approach places a choice on educators' ability to incorporate and use technology in teaching and learning. The SAMR however applies to the questionnaire and procedure of the study since it demonstrated development in a proper sequence by progressing from one phase to another in a hierarchical fashion. (Koehler, 2012).

Since Apple incorporation supported the SAMR Model as a model for fostering technological adoption and incorporation, research studies have utilized it as a theoretical paradigm (Romrell, Kidder, & Wood, 2014). Batiibwe et al. (2017) investigated the SAMR model's applicability and consistency. The authors assessed each phase in the SAMR framework to see whether the phases were independently functional. Additionally, the researchers generated mean indices for the survey items in the respective phases and then used Pearson's correlation to compare the indices. The authors found that all four SAMR levels were validated and consistent through statistical analysis, emphasizing that the targeted dimensions were appropriately measured (Batiibwe et al., 2017). Kihoza et al. (2016) similarly examined technical expertise, beliefs, and preparedness while introducing digital tools in teaching and learning using the SAMR paradigm. To facilitate the collection of data, the questionnaire was synchronized with the SAMR framework. According to the authors, the majority of respondents were practicing the instruction at the substitution level because of a variety of causes. The connection might include a lack of technical expertise or an inability to integrate digital tools into the instruction.

Current research focuses on the use and incorporation of digital tools in educational settings, as well as its significant impact on the technology integration competencies of the teacher. Robinson (2016) included Chromebooks to enable technology usage in a writing course. Robinson (2016) stated that learners thought that although utilizing Chromebooks would increase success and improvement, they would be simply off-tracked when completing the assigned tasks. Administrators in government recognize the advantages of investing in digital tools due to the many policies implemented by federal and provincial governments. Educational ministry administrators depend on research to develop standards and distribute funds for educational technology in specialized areas of education. Hur et al. (2016) researched the variables influencing educational technology and its integration. The researchers investigated five variables. One of the five variables examined by the researchers was suitable finance. Adequate finance is crucial for technological usage, according to the results for this component. According to the researchers' assessment of the proper allocation of finance, institutions with suitable infrastructure (hardware and software), and support are more likely to employ digital tools in teaching and learning (Hur et al., 2016). Bakir (2011) reviewed several research studies on teacher education and technology integration. The author compiled a list of research on financing projects. Bakir (2011) identified many ways for institutions to enhance their technology integration budgets. The author adds that several of these possibilities need proposals and reports detailing the allocated finances. Enhancing Education Through Technology initiative, Technology Literacy Challenge Fund, and Preparing Tomorrow's Teachers were all available for financing. The policymakers, stakeholders, and federal and provincial governments, have spent significant funds on educational technology to prepare learners for success in learning and the modern world.

Organizations evolved in pattern with evolving rules and strategies aimed at preparing learners for 21st-century skills. Organizations saw a bright future for the public sector educational system, but provincial sector institutions need economical deployment of digital tools. Google successfully launched Chromebook devices in the year 2011. (Google for Education, 2019). Google for Education (2019), mentioned that some people responded differently regarding Chromebook pricing. Google chose to target a modern classroom demand and began developing lower-cost gadgets aimed at public sector education. Hart-Davis (2018) informed that Chromebooks accommodated approximately 6% of classroom digital gadgets in 2012. Chromebooks, on the other hand, represented 60% of portable gadgets at primary and secondary levels at the end of the academic year 2016. Considering regulations and a variety of digital media in classroom instruction, a gap in technology integration persists. Numerous public sector institutions' preparation of pupils lagged behind the world (Guggemos & Seufert, 2021).

2.15 Gaps in the Literature

After conducting a comprehensive review of related studies, several gaps were identified. However, while measuring the teachers' technology integration competencies in higher education, the study concentrated on the following areas: resources for technology usage, management support, technical assistance through supporting IT staff, educational assistance, mentorship, teacher training programs, instructional strategies, and educational practices. Amick, 2019; Beisel, 2017; Bradley, 2020; Bruton, 2018; Froemming, 2020; Horgan, 2019; Humes, 2017; Jenkins, 2021; Martin, 2020; Patton, 2015; Perry, 2018; Pfaffe, 2017; Savignano, 2017; Wilson, 2021 and other studies (mentioned in the methodology section) on technology integration all contributed to the measurement approaches of the current study. Moreover, this research contributed an in-depth view to the related literature by examining statistical differences in teachers for technology integration with their demographic variables while concentrating on measurement variables are not limited to technological resources, educational assistance, knowledge of troubleshooting, leadership influence, professional development, teacher preparation for technology integration, and instructional strategies through technology integration at the higher education level.

Much research has been done on blended learning, technology competence, and technology acceptance (Dullien, 2017; Golzar, 2019; Fallatah, 2019; James, 2020), but very few have addressed the area of technology integration aligned with Bloom's taxonomy (Patton, 2015; Humes, 2017; Pfaffe, 2017; Foremming, 2020). The literature review has identified that levels of technology integration, if aligned with Bloom's taxonomy, can lead to the development of higher-order thinking skills laden with digital transformational competence (Romrell et al. 2014; Hamilton et al., 2016; Bradley, 2020; Martin, 2020; Cotton, 2021). SAMR model (Puentedura, 2014) is a technology integration model. It explains various levels and uses of technological tools in the classroom. This study carries a novelty in the sense that it uses using SAMR model for technology integration through the lens of Bloom's Taxonomy.

CHAPTER 3

RESEARCH METHODOLOGY

This study comparatively analyzed the technology integration competency of teachers in both public and private sector universities of Punjab, Pakistan. The major concern of this study was to assess the competencies of teachers while taking SAMR model and Bloom's revised taxonomy parallel in the same framework. This section of the study explains a comprehensive detail of research process that includes a description of research design, population, sample, and research tool in the form of a checklist, questionnaire and semi-structured interview about technology integration. A pilot testing with reliability table with explanation; data collection and analysis parallel with the alignment of research questions and objectives of the study. A justification of statistical techniques was also explained in it.

3.1 Research Approach

The mixed method approach was used to conduct the study. The responses of university teachers regarding technology integration were tested through a quantitative approach and the semi-structured interviews of Heads of departments were tested through a qualitative approach of investigation because a research approach involves the illustration of the procedures to assess the phenomenon under the study in a qualitative, quantitative or combining both methods (Creswell, 2018). A mixed method approach was used to analyze the collected data by using appropriate statistical techniques.

3.1.1 Mixed Methods Approach

Mixed methods research enable researchers to use multiple approaches in order to study a research question or problem. This approach allows researchers to collect and analyze data from various sources and using various methods, it provide a more comprehensive and in depth understanding of the research problem. In mix methods research, researchers may collect and analyze both numerical data (quantitative data) and non-numerical data (qualitative data), and may use different research instruments, such as surveys, interviews, focus groups, and observations (Creswell, 2018).

Mix methods research is often used in social science and education research, but can also be applied in other fields. The goal of mix methods research is to triangulate findings from multiple sources and methods in order to increase the validity and reliability of the research. By using both qualitative and quantitative methods, researchers can confirm or extend findings from one method with those from the other method, and can also explore how different aspects of the research problem relate to one another.

3.2 Research Design

The study used a convergent parallel design. This design is based on a parallel process of data collection and analysis. This design required researcher to simultaneously collect and analyze quantitative data as well as qualitative data. In the second phase, the results were compared and the researcher proceeded toward interpretation (Creswell & Creswell, 2017). The ultimate purpose of this design is that one aspect, for example, quantitative form provides strengths to reduce the weakness of the other aspect i.e. qualitative form, which results provide more understanding of a research problem. Quantitative scores of a questionnaire responded by many individuals supply strengths to reduce the weakness of qualitative responses of an interview responded by few individuals (Creswell, 2018).

This design allows the researcher to triangulate data from different sources and increase the reliability and validity of the results. Additionally, this design provides opportunities for a more in-depth and thorough examination of the problem, which can result in a more nuanced understanding of the phenomenon being studied.

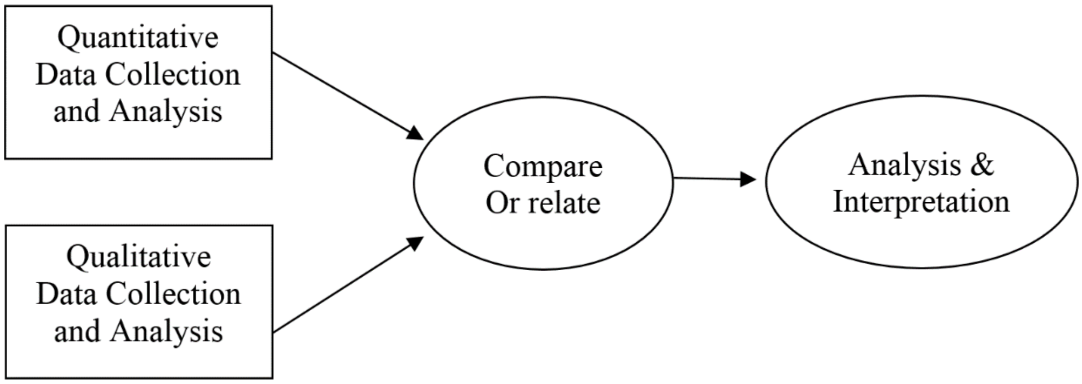

Figure 15: Convergent Parallel Design (Creswell, 2018, p. 541)

3.3 Population of the Study

The university teachers of Punjab province constituted as population of the study. There are 79 public and private universities in Punjab (HEC, 2021). These universities include faculties of social sciences, natural sciences, medical, engineering and languages etc. The study was delimited to two disciplines (Social Sciences and Management Sciences). The researcher has selected 32 universities in Punjab. The targeted population contained 4233 faculty members and 380 heads of Social Sciences and Management Sciences teaching in 32 public and private sector universities of Punjab (HEC, 2021). The population was divided into two major strata, i.e., public and private sector universities. From thirty-two universities in Punjab, sixteen were affiliated with public sector while the other sixteen universities were affiliated with private sector of Punjab. There were 2554 Public sector and 1679 Private sector faculty members; on the other hand, 245 public sector and 135 private sector heads working in 32 universities of Punjab in the year 2021. The number of public sector faculty members was higher compared to private faculty members. To indicate appropriate representation to each stratum, 14% of both sectors were selected for the sample from faculty members.

Table 3.1

Population of the Study

Universities	Delimitation (SS & MS)	HoDs (SS & MS)	Faculty (SS & MS)
79 *Public & Private*	32 *(Public=16 Private=16)*	380 *(Public=245 Private=135)*	4233 *(Public=2554 Private=1679)*

Sources: HEC, 2021; Website of HEIs

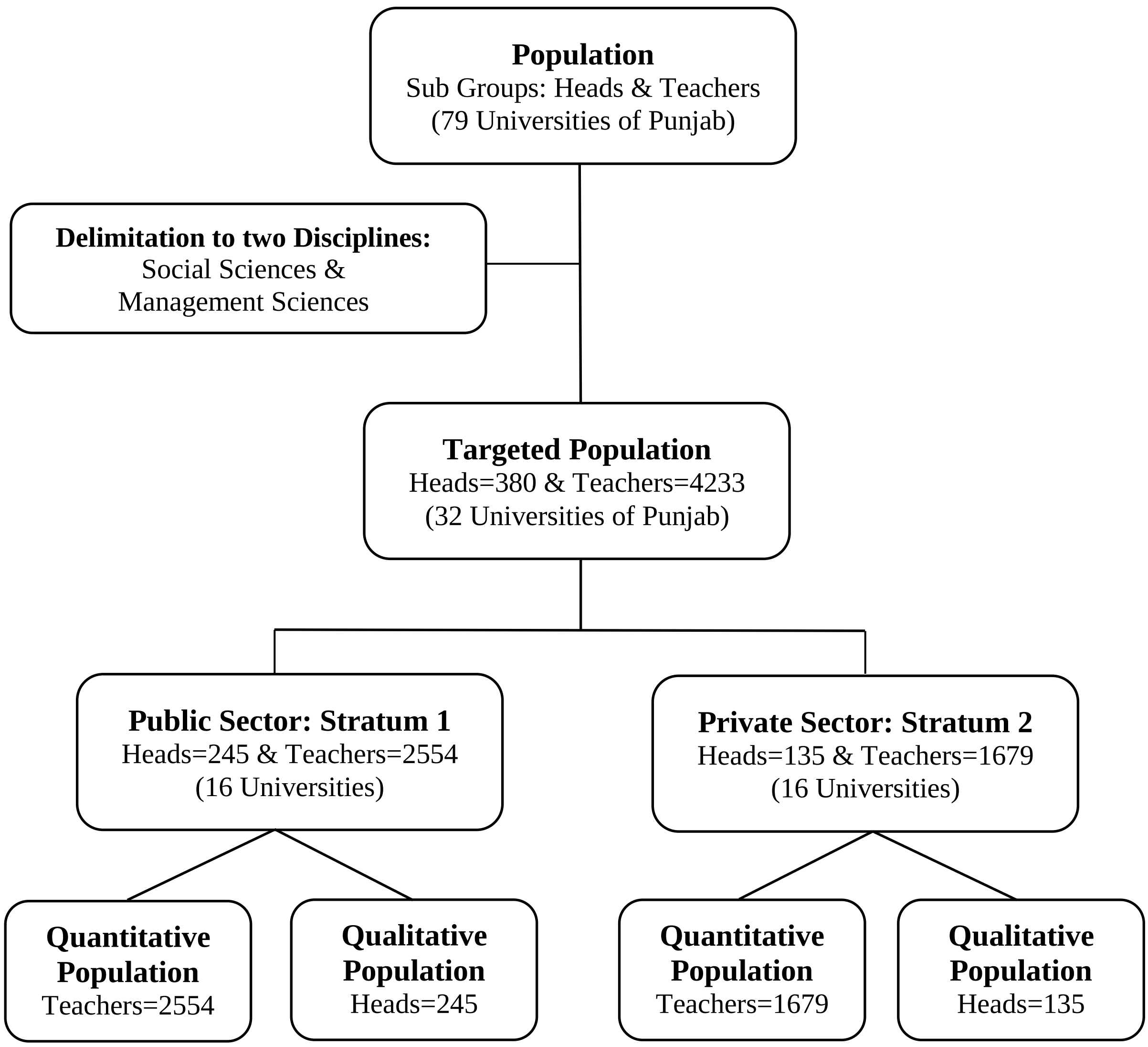

Figure 16: Population of the Study

Out of these 79 universities faculty of 32 universities (depending on the inclusion criteria) comprised the population of study i.e., faculty of 16 public sector universities and faculty 16 private sector universities. Population of present study was based on inclusion criteria in the universities. Furthermore, heads of departments in public and private sector were selected as quantitative population to achieve the saturation point of the required data (List of universities can be seen in Appendix-G).

3.4 Inclusion Criteria

The inclusion criteria of the study were as follows:

1. Universities with sound technological facilities (LMS etc.).
2. Universities with proper ICT directorates.
3. Random selection of Faculty & Heads for responses of scales.

3.5 Sample of the Study

3.5.1 Sampling Technique (Quantitative)

Sampling allows researcher to systematically select the subset of individuals from the targeted population. The process allows to estimate and generalize the properties of overall population. The sampling technique helps researcher to address the samples that are truly representative of the targeted population.

Stratified sampling technique is appropriate where subpopulations (stratum) vary within the population. The stratification process helps divide population into homogenous groups before drawing sample from it. Taking equal proportion from each strata is called proportionate stratified random sampling; otherwise, the process is called disproportionate stratified random sampling. This study used proportionate stratified random sampling to draw equal samples from each stratum. The study was based on two strata, public and private. Taking appropriate proportion from each stratum, 14% of both strata were selected for the sample. Creswell (2012) suggests that 10% of large and 20% of small populations may be selected as minimum sample. Cohen, Manion & Morrison (2013) suggested sample size of 536 against population under 5000 at 95% confidence interval. Therefore, 593 teaching faculty were selected from universities which include 358 public sector and 235 private sector teachers which is 14% of each strata. This method can help to ensure that groups in the population are adequately represented in the sample, which is important for ensuring the generalizability of the results to the larger population.

3.5.2 Sampling Technique (Qualitative)

For an in-depth understanding of the current scenario, the qualitative responses were collected parallel to the questionnaire. For this purpose, the heads of department were selected to avoid personal bias and socially desired responses. Open ended-responses supported the existing collected data in various ways.

As mentioned in methodology the heads of departments were selected for qualitative sample. Population of faculties indicates that there were 245 heads in public sector universities of Punjab. Furthermore, there were 135 heads in private sector universities. Purposeful sampling technique for qualitative sampling. The technique is also called purposive or selective sampling; the process allows researcher to draw sample from the population which can provide detailed and in-depth information about the problem under study (Prudon, 2015). Purposeful sampling further proceeds to Homogeneous Sampling in which the participants possess similar trait or characteristics (Creswell, 2018). In this case, the common characteristics of head teacher are to lead the department towards the productivity and achievement of certain goals.

Selection criteria for interview respondents were supported by Creswell (2018) which is selecting 6 to 8 interviewees from each group. Creswell & Creswell (2017) suggested the sample of qualitative study from 1 or 2 to 30 or 40. Because qualitative method requires reporting details about each individual, the larger sample can become unwieldy and result in superficial perspective. Moreover, collecting and analyzing qualitative data takes considerable time, and adding the opinion of each individuals only lengths the time. Yin (2015) stated that there is no formula for defining the desired number of instances in the qualitative study. Yin (2015) further informed two levels of qualitative study; at broader level most qualitative studies have only a single instance, while at narrower level number of interviewees can fall in the range of 25-50.

Considering the above two criteria, the researcher selected 30 heads from public and private universities. To achieve the saturation point of the study, 13 heads from public sector and 17 heads from private sector were selected.

3.5.3 Sample

Teachers and heads working in public and private sector universities of Punjab were considered as two major strata for the population of the study.

For quantitative phase, a total number of public sector teachers was 2554 and private sector teachers 1679, 14% of both strata were drawn as quantitative sample. Five hundred ninety-three questionnaires along with faculty response checklist were distributed among faculty working in universities of Punjab following the criteria suggested by Cohen, Manion & Morrison (2013) and from them only 552 teachers returned questionnaire and checklist to the researcher and the return rate was thus 93%.

For qualitative phase, total number of public sector heads was 245 and private sector heads were 135, from both strata 30 heads were taken as qualitative samples, following the criteria suggested by Creswell & Creswell (2017). Interviews were conducted with a response rate of 100%.

Table 3.2

Sample of the Study

Universities	Universities within Inclusion Criteria	HoDs (For Saturation Point)	Faculty (SS & MS)
32 *Public=16* *Private=16*	32 *Public=16* *Private=16*	30 *Public=13* *Private=17*	593 *Public=358* *Private=235*

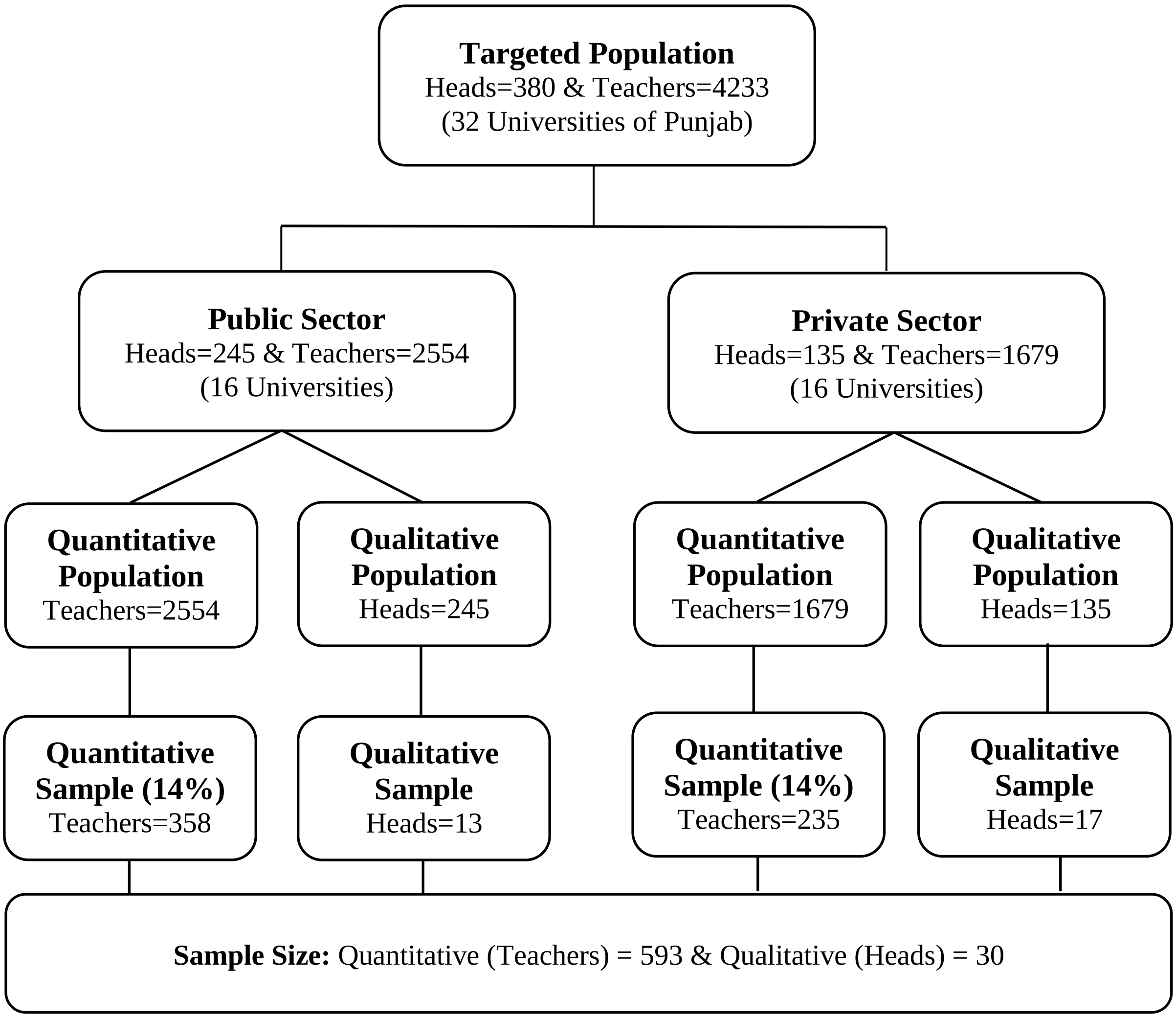

Figure 17: Sample of the Study

3.6 Instrumentation

For measuring the faculty competence towards technology integration, Puentedura's model of SAMR, parallel to Bloom's revised taxonomy by Anderson & Krathwohl, was used to construct a questionnaire that has a broad theoretical base. The SAMR model can be used parallel to Bloom's revised taxonomy since both share parallel cognitive levels.

Secondly, standardized instruments by Humes (2017) and Pfaffe (2017) were used to closely evaluate the teaching practices of faculty members at each level of SAMR Model.

Thirdly, a semi-structured interview was developed for heads of departments. The purpose of this interview was to evaluate how teachers integrate technology into their lectures and how much the teaching practices are aligned with Puentedura's SAMR framework.

3.6.1 Description of Technology Integration Questionnaire

Technology Integration questionnaire was developed by researcher after a thorough study of literature and keeping in view the framework of the study. Questionnaire statements cover various aspects of technology integration, but it was extracted through the work of Puentedura (2014) keeping parallel with Bloom's revised taxonomy by Anderson & Krathwohl (2001). Puentedura originated the SAMR model about technology integration and presented two major phases of model, Enhancement and transformation. Each of two major phases holds further two dimensions of technology integration. For example, Enhancement phase holds Substitution and Augmentation. At Substitution level technology acts as a direct substitute for an older tool, with no change in the tasks undertaken by the students. At augmentation level features of new technology are used to improve how learners carry out these tasks but task undertaken stays the same. Transformation phase holds Modification and Redefinition. At Modification level with the use of new technology features the tasks undertaken by the students are significantly redesigned in order to achieve new educational goals. The redefinition level replaces the older tasks with newer ones to achieve previously unattainable educational goals. Bloom's revised taxonomy by Anderson & Krathwohl (2001) presented a revised version of Bloom's taxonomy of educational objectives. Authors presented a new cognitive version which used six categories and indicated these categories using verbs, which reflected a more accurate form of learning i.e. remember, understand, apply, analyze, evaluate and create.

Table 3.3

Sources of Technology Integration Questionnaire Items

S#	SAMR Levels	Sources of Items
1	Substitution Level	(Afridi, & Chaudhry, 2019; Alkraiji, & Eidaroos, 2016; Angeli, & Valanides, 2014; Arnold, 2018; Bajabaa, 2017; Barnello, 2017; Green, 2016; Heineman, 2017; Horgan, 2019; Klein, 2016; Martin, 2016; Pfaffe, 2017)
2	Augmentation Level	(Samsonova, 2017; Amick, 2019; Sroka, 2020; Thomas, 2018; Tondeur et al., 2017; Vargas, 2017; Wilson, 2021; Golzar, 2019; Thomas, 2018; Spencer, 2019; Kilty, 2019; Bradley, 2020)
3	Modification Level	(James, 2020; Stepanian, 2017; Savignano, 2017; Tietjen, 2020; Muratie, & Ceka, 2017; Barnello, 2017; Bataller, 2018; Mertler, 2017; Humes, 2017; Pfaffe, 2017; Perry, 2018; Horgan, 2019; Kilty, 2019)
4	Redefinition Level	(Beeson, 2013; Cox, 2019; Martin, 2016; Humes, 2017; James, 2020; Foley, 2017; Ritter, 2016; Miller, 2017; Amick, 2019; Villeda Fernandez, 2019; Wasilko, 2020; Froemming, 2020)

Therefore both concepts of cognitive learning were collectively used in questionnaire; in this way first six statements of the instrument explained Substitution level and cover the remember phase in parallel. Next 12 statements explain Augmentation phase and collectively covere both Understand and Apply phase. Next 18 statements explained

Modification phase which covers Apply, Analyze and Evaluate. Similarly remaining 12 statements explained Redefinition phase which combined Evaluate and Create.

The SAMR model and Bloom's revised taxonomy are combined in a single instrument to test technology integration. The questionnaire was called Technology integration questionnaire. The questionnaire consisted of 48 statements. Through these statements, researcher measured the opinions of university teachers about their competence regarding technology integration in the context of Pakistan.

3.6.2 Description of Faculty Response Checklists

Humes (2017) used SAMR evaluation matrix to assess the technology integration skills, and Pfaffe (2017) presented a checklist to identify the learning activities those teachers used at each level of SAMR model. Checklists were used to strengthen the questionnaire responses. Participants expressed their opinion by identifying learning activities at all four phases of SAMR. The last part of checklist present three options along with the learning activities those are "In Class, " "Out of Class" and "Both." The checklists were adapted and modified in the context of Pakistan. Researcher obtained permission from the developers of the checklists through emails.

3.6.3 Description of Semi-Structured Interview

Keeping in view the SAMR model and Blooms' revised taxonomy, a semi-structured interview was developed by researcher for heads of departments. This process was conducted to collect qualitative response for the study. First question probes heads about teachers' technology integration in SAMR levels. Second was related to transformation of practices. Third was related to the heads views on technology as an educational tool. Fourth was related to the challenges can teachers encounter during technology integration. Last but not least how technology integration can influence teachers professional development.

3.7 Pilot Testing

The pilot testing serves to initiate the validity of the instrument in order to improve the survey items (Creswell, 2018). Pilot testing is a necessary process to assess the reliability and validity of the instrument (Prudon, 2015). The pilot testing serves as a cognitive discourse that support the researcher in determining if certain items of the instrument are to be eliminated or improved (Camelia & Ferris, 2018). The pilot testing was carried out to measure the validity and reliability of questionnaire, checklist and interview,. The other reasons to carry out the pilot testing were to identify and understand the variables that are involved in the instrument administration and smooth process of research, to indicate any hindrances that may involve in overall data collection, and test the reliability of the instruments. A sample of 60 individuals (10% of sample) was taken from 2 universities in Punjab to pilot test the instruments (checklist, questionnaire and semi-structured interview). For this process, 36 public sector and 24 private sector teachers along with 4 heads of departments were taken for pilot testing. Participants were randomly selected to participate in the pilot testing, a researcher paid personal visits to complete the process. The heads were interviewed, and teachers were requested to respond to the checklist and fill out the questionnaire. Participants were also allowed to give their opinion on improving the instruments. Therefore, the process allowed to test the overall research approach before conducting the main study. The data was analyzed through the appropriate tests. Instruments were improved based on the suggestions and opinions of experts and participants.

3.7.1 Validity of the Instruments

Creswell & Creswell (2017) define validity as the essential characteristic of the instrument; it refers to the extent to which an instrument measures what it declares to measure.

The researcher adopted checklists used by Humes (2017) and Pfaffe (2017) which is based on four level of SAMR model. The content and face validity of the checklist was established by the authors of checklists. Humes and Pfaffe gave the researcher the permission to use their checklists.

The content validity of the questionnaire was checked by the social sciences experts working in different HEIs. They provided some useful suggestions regarding its improvements. The suggestions and recommendations of experts were incorporated. The questionnaire's psychometric properties were checked by exploratory factor analysis (EFA) and reliability was checked with Chronbach’s Alpha (Prudon, 2015).

Construct validity was assessed through factor analysis. For this purpose, the component analysis was used with Varimax Rotation which facilitates maximum factor loading. Two additional tests were run for the sustainability of the factor analysis. The Kaiser–Meyer–Olkin (KMO) test resulted in 0.754 which is greater than 0.5 indicating the sustainability of the analysis. Bartlett’s test of Sphericity indicates the *p-value=.000* which is less than .05 which shows that variables are related and ideal for factor analysis. Item under each construct was tested and items with a value less than 0.4 were eliminated (Appendix, M).

Questions were further organized according to SAMR Model. The questionnaire then came into final shape and was administered to the sample of study.

Interview was distributed to experts for review. Doctoral committee members reviewed the interview following the research questions, objectives and appropriateness of the questions. The experts provided suggestions and guided for additional items that should be included.

3.7.2 Reliability of the Instruments

Reliability is the consistency with which a measure assesses whatever it is measuring (Creswell & Creswell, 2017). Reliability is a property of an instrument that indicates the instrument can produce consistent results if the trial is repeated multiple times (Camelia & Ferris, 2018). To check the reliability of the instruments field test was performed. The field-test sample was asked to respond to the instruments. Participants were asked to provide written and oral feedback regarding the clarity of the statements and to determine if any questions needed modification.

The test-retest correlation coefficient was performed to check the reliability of the checklist. Results for test-retest correlations are presented in table 3.4.

Table 3.4

Test-Retest Correlation Coefficients for Checklist (n_1=60)

S#	Steps in the Checklist	Test-Retest Correlation
1	Substitution Level	0.72
2	Augmentation Level	0.89
3	Modification Level	0.96
4	Redefinition Level	0.87
	Overall Result	**0.88**

Table 3.4 shows that the correlation values of all the steps are above 0.60. Therefore the test-retest correlations are in acceptable range.

To check the reliability of the questionnaire, the exploratory factor analysis (EFA) and reliability analysis were performed (Appendix-M). The mean of items is considered as item difficulty level in EFA (Prudon, 2015). The statistical item analysis resulted in total correlation value for items that were identified as discrimination index of the item. The reliable and retained items of the questionnaire showed higher correlation with respect to total score. If an item shows a very low relationship (Less than 0.4) reflects that the item is not discriminated between groups and is indicated as weak item. Through Cronbach's Alpha values it was found that few items has lower inter-correlation. It was observed that 6 items related to different domains of technology integration, such as substitution (item 4 & 5), augmentation (item 9 & 12), modification (item 25) and redefinition (42), had lower inter-correlation. Due to those items, the reliability values of factors were affected. Researcher excluded 6 items from the pool of items. Items were further organized according to the framework of the study.

The initial pool of survey items consisted of 54 items. Researcher had to exclude six statements from the initial draft of the survey. Items were then rearranged based on the research constructs. The final instrument contained 48 items, of which 6 items were related to the Substitution, 12 to the Augmentation, 18 to the Modification and the remaining 12 to the Redefinition level of the framework. Table 3.5 shows the items with lower inter-correlation.

Table 3.5

Items with Lower Inter-Correlation in Technology Integration Scale (n=60)

Items	**Statements**	**Item-Total Correlation**
1	Teachers often integrate digital tools during my instruction.	0.217^{*}
2	Use of technology have transformed the instructional activities in a meaningful way.	0.280^{*}
3	I feel my instructional approach more collaborative and interactive when technology is used into teaching.	0.229^{*}
4	The use of digital tools increases the learners' collaboration and interaction.	0.055^{*}
5	I provide leadership support for assisting my colleagues with technology.	0.114^{*}
6	My teaching is more student-centered when technology is used during instruction.	0.130^{*}

* *$p>0.05$*
** *$p>0.01$*

Final questionnaire contained 48 items. The reliability of technology integration questionnaire with its four broader categories which are Substitution, augmentation, modification, and redefinition contained six dimensions of Bloom's revised taxonomy i.e. remembering, understanding, applying, analyzing, evaluating and creating, is shown in the table given below.

Table 3.6

Reliability of Technology Integration Scale (n_1=60)

Phases/ Factors	***No of Items***	***Cronbach's Alpha***
a. Substitution	***06***	***0.77***
1. Remembering	06	0.77
b. Augmentation	***12***	***0.79***
1. Understanding	06	0.75
2. Applying	06	0.85
c. Modification	***18***	***0.81***
1. Applying	06	0.81
2. Analyzing	06	0.80
3. Evaluating	06	0.79
d. Redefinition	***12***	***0.76***
1. Evaluating	06	0.68
2. Creating	06	0.75
Total	**48**	***0.79***

The eight characteristics of the scale were found reliable for testing after removing six items that had lower inter-correlation values because those inter-correlation values placed an effect on the reliability value of the technology integration scale and its sub-factors.

Table 3.7
Item Total Correlation of Technology Integration Scale (n_1=60)

Items	**Item-Total Correlation**	**Items**	**Item-Total Correlation**
1	.659**	25	.704**
2	.655**	26	.691**
3	.847**	27	.839**
4	.430**	28	.716**
5	.606**	29	.659**
6	.826**	30	.792**
7	.716**	31	.868**
8	.729**	32	.630**
9	.680**	33	.684**
10	.408**	34	.773**
11	.820**	35	.637**
12	.712**	36	.668**
13	.621**	37	.700**
14	.880**	38	.637**
15	.710**	39	.640**
16	.716**	40	.720**
17	.662**	41	.851**
18	.802**	42	.606**
19	.710**	43	.430**
20	.611**	44	.847**
21	.741**	45	.655**
22	.659**	46	.430**
23	.514**	47	.847**
24	.720**	48	.655**

* $p<0.05$
** $p<0.01$

Table 3.7 shows the total correlation of technology integration scale. Results indicated that scale items correlate positively and significantly with the overall scale. While the item results of 10, 43 and 46 indicated low correlation as the correlation value is less than 0.5.

Table 3.8

Inter-Scale Correlation of the subscales in Technology Integration Scale (n_1=60)

		Substitution	Augmentation	Modification	Redefinition
Substitution		1.000	0.811**	0.761**	0.868**
			0.105	0.001	.002
Augmentation			1.000	0.611**	0.783**
	Pearson Correlation			.000	.070
Modification	*Sig. (2-tailed)*			1.000	0.698**
					0.20
Redefinition					1.000

* *p<0.05*
** *p<0.01*

Table 3.8 shows the inter-scale correlation or bivariate correlation of four subscales at p<0.01 and p<0.05. There exists significant inter-scale correlation between the scale and sub-sections of the scales. The highest correlation was found between substitution and redefinition level which is significant at 0.01.

Pilot testing of the interview was also conducted on 4 heads of departments working in social sciences. Participants were asked to provide written and oral feedback regarding the clarity of the interview statements and to determine if any questions needed modification. Semi-structured interview then came into final shape and were administered to the qualitative sample of study.

3.8 Data Collection

The researcher started data collection process after obtaining the permission letter for data collection to reduce the difficulty while approaching the respondents. The study used convergent parallel design, which required to collect the quantitative and qualitative data simultaneously. After obtaining the permission letter, the researcher approached the department heads and coordinators of the institution involved in the study. Faculty members were contacted through emails and department coordinators were requested for their support during follow-up. Faculty members were also requested to disseminate the online survey to their colleagues.

According to Lawrence (2014), the researcher needs to explain the purpose of the research to the participants and assure the confidentiality of the responses. In order to ensure credibility of the research study, the researcher addressed the ethical considerations and participants of the study were guided about the purpose of the research. The confidentiality and privacy of the quantitative and qualitative responses were insured.

3.8.1 Quantitative Data Collection

The quantitative data was collected through validated and expertly reviewed checklists and questionnaires. The data for checklists and questionnaires were collected online because majority of the quantitative and qualitative respondents were working online due to COVID-19-related restrictions applied by the provincial government. Participants' email addresses were collected from their university websites and used to forward the checklist and survey link. The digital checklist and survey were created using Google Forms and the link was distributed electronically via emails. The Google Form included a Formal letter of my introduction and permission for data collection. The researcher felt necessary to include some information about the targeted model of the study. The diagram of study framework was included, as defined for this study. Finally, the researcher included a diagram and description of Dr. Ruben Puentedur's SAMR model with a link to a short YouTube video by Ruben Puentedura further explaining the SAMR model. By opening the survey link and clicking next, the respondent gave their consent to participate in the study. Respondents' information has been kept confidential.

Ten days following the initial emailing, a soft reminder was sent to all participants.

Those participants who did not respond within a total four-week period received a second soft reminder, accompanied by an online link to survey. For a few respondents, four or five follow-up emails were sent to acquire their responses. The response frequency of lecturers and assistant professors was better compared to the associate professor and professors. The data collection incurred approximately six months.

The survey was kept active for 6 months (February 2021 to August 2021) to collect the desired number of responses. After this duration, the Google Form was closed. All the survey data was imported into Excel and then transferred to a flash drive only available to the researcher solely to use with this research.

Table 3.9

Quantitative Response Rate (n_1=593)

Sector	**Sample**	**Response Rate**	**Return %**	**Overall Response**
Public Sector	358	340	95%	
Private Sector	235	212	90%	93%
Total	**593**	**552**		

3.8.2 Qualitative Data Collection

Saldaña (2021) opined that the interview statements and processes could be directed and modified accordingly to ensure reasonable and unbiased data collection. Creswell (2018) recommends using semi-structured and standardized interviews to reduce bias. The researcher conducted professional interviews with semi-structured interview questions related to research questions.

The collection of qualitative data, i.e. semi-structured interviews, proved more challenging. The researcher collected the qualitative data in three phases. First was to personally visit the Heads of the department. The researcher arranged a few visits and approached the respondents, and the experience was pleasant. However, the process of taking an appointment and approaching the respondents seemed time taking. In this phase, the researcher managed to arrange interviews with 10 heads of departments (5 public and 5 private).

In the second phase, the researcher conducted phone interviews using the Call Recorder application. The phone numbers (landline and cell) were noted on university websites. The researcher first introduced himself and took a formal appointment for an interview. Researcher called the interviewee at the time provided. The interviewee was informed about call recording. The interview questions asked heads to expand on their experiences with technology integration activities used by the faculty in their departments concerning the SAMR model. Through this process researcher again managed to arrange interviews with 10 heads of departments (5 public and 5 private). Again this process had its limitations.

In the third phase, the researcher created a Google Form with a permission letter (https://forms.gle/9M63pBATrQ6GnpMN6), detail of the study and open-ended questions for interview. The link was forwarded via email to the targeted respondents (Heads of the departments) only. Ten days following the initial emailing, a soft reminder was sent to all participants. Those participants who did not respond within a total four-week period received a second soft reminder, accompanied by an online link to interview. The online interview was kept active for 3 months to collect the desired number of responses. After this duration, the Google Form was closed. This phase enabled researcher to obtain responses of 10 heads of departments (3 public and 7 private).

The set of instructions and detail about the study framework and soft reminders helped direct the interviews for each selected respondent. The face-to-face and telephonic interviews were recorded. Member checking was performed by providing the interviewee the opportunity to review their transcripts to verify the information they have provided (Yin, 2015). To ease the recording and collection of qualitative data, an online spreadsheet was created using Microsoft Excel. Excel enabled the quick entry and coding of information.

Table 3.10

Qualitative Response Rate (n_2=30)

Sector	Sample	Response Rate	Response %	Overall Response
Public Sector	13	13	100%	
Private Sector	17	17	100%	100%
Total	**30**	**30**		

3.8.3 Ethical Considerations

The researcher maintained neutrality and objectivity in the process of data collection. There was minimal interaction involved which could influence the responses. The participants gave consent to participate in the study by opening the survey link and clicking next. The confidentiality of the responses was ensured. Few associate professors who participated in the study were requested to support the researcher by referring their colleagues to the researcher, which cannot be interpreted as non-voluntary participation. Participants were appraised about their participation.

3.9 Data Analysis

Data analysis is a complicated process that requires careful consideration of available strategies (Creswell, 2018). Data analysis is the process of systematically arranging the field notes, transcripts, raw data and other material that researcher accumulate to come up with findings. Data interpretation is the process of obtaining ideas from findings and relating those ideas to a review of the literature to broader the concepts and concerns (Mayring, 2014).

3.9.1 Quantitative Data Analysis

The SAMR evaluation matrix and checklist had closed-ended statements. Section A of the questionnaire was designed to gather demographic information about the respondents. The demographics were mostly used for descriptive purposes. Section B was based on Likert scale questions. Descriptive and inferential statistics were used to analyze the data. Frequency count, percentages, Mean, Standard deviation, t-test, and Analysis of Variance were applied where needed. The raw scores of the checklist and questionnaire were analyzed in a different manner. The checklist was analyzed through frequency count and percentages. The questionnaire data collected from Google Forms was exported to an Excel sheet and then imported to SPSS. The numbers are assigned to the variables. Coding and assigning numbers to the variables was based on the Likert scale. To find the difference between the two variables independent t-test was applied. To find the difference between more than two variables ANOVA test was applied.

3.9.2 Qualitative Data Analysis

Creswell recommended that the study must continuously revisit the research questions to determine if the analysis is yielding the results that are leading toward the research questions. The qualitative data is coded and analyzed for common themes. This process was performed by mapping out the relationship of raw and textual data to the research questions. The process allows clearing the pathways between the coding and research questions (Creswell, 2018).

The inductive approach proposed by Creswell (2018) was used to code the qualitative data. The text was highlighted and grouped into specific segments. Codes are developed to represent the definitions. The coding this far is called open coding which provides distinct concepts and categories from the basic unit of the analysis of basic or raw data. The initial codes are re-examined to develop new categories and refined themes. This process is referred to as axial coding (Yin, 2015).

3.10 Delimitations of the Study

Delimitations show how the study will be narrowed in scope. Delimitations are the features of the study which the researcher can control. The researcher desires to delimit the research so that audiences can understand the study parameters (Creswell, 2018).

Delimitations of this study were as follows:

- Faculties of Social Sciences, and Management Sciences.
- Heads of departments from selected faculties (Qualitative).
- Regular faculty members of selected faculties (Quantitative).

Summary

The purpose of this chapter was to describe the research design of the study and the methodology used to conduct the research. Descriptive and inferential research utilizing a mixed method study through checklist, questionnaire and interview were the means of data collection. Population, sampling technique, sample, and description of instruments were provided. Process of pilot testing, validity and reliability of the instruments. The data collection and analysis procedures were also described. A table providing information regarding the alignment of objectives, hypothesis, research questions, statistical measures and justification of statistical analysis was also provided. The next chapter will provide detail about statistical analysis and interpretations related to research questions.

Table 3.11

Mapping of RQs, objectives, hypothesis, statistical measures, and their justifications (n_1=552 & n_2=30)

Research Question 1: What are the faculty perceptions regarding their competence towards technology integration?
Research Question 2: Does a statistical difference exist between survey scores of university teachers?

Sr#	Objectives	Hypotheses	Analysis & Measures	Justifications
1	To examine the faculty perceptions regarding their competence towards technology integration at higher education level with reference to SAMR model in the backdrop of Bloom's taxonomy.	----	Frequency, Percentage, Mean, Standard Deviation	**Descriptive** statistics is most commonly used to assess the average performance (Frequency, percentage, Mean), spread out of scores, and whether the scores are relatively closer or spread around the mean (S.D). (Creswell & Creswell, 2017)
2	To identify the differences in faculty competence towards technology integration at higher education level based on sectors, gender, qualifications, experience, designations, disciplines and ages.	$H_{01 \text{ to } 07}$: There are no statistical differences among teachers' technology integration while comparing Sectors, gender, qualifications, experience, designations, disciplines and ages.	Independent t-test & ANOVA *Assumptions:* ▪ *Homogeneity in population Variances* ▪ *Independent Sample* ▪ *Normally distributed data* ▪ *Interval or Ratio data* Tukey's Post Hoc Test	**The t-test** is the type of inferential statistics, commonly used to compare the average performance between two groups. Here we start by inferring the properties of a probability distribution (Prudon, 2015). **Analysis of variance** (ANOVA) is the type of inferential statistics that analyzes the level of variance within groups and tells whether differences among groups are statistically significant (Creswell, & Poth, 2016). **The Tukey's Post Hoc** test is typically used after an initial analysis, such as an ANOVA, has been conducted and significant differences between the groups have been found. The Tukey test can help identify which pairs of groups are significantly different, allowing researchers to more precisely understand the patterns and relationships between the groups (Ruxton, & Beauchamp, 2008).
3	To explore the views of heads regarding faculty competence towards technology integration.	----	Thematic Analysis	**Thematic Analysis** is the process of coding the qualitative responses and grouping the codes that later become variables of the researcher's interest in understanding a phenomenon (Saldaña, 2021; Creswell, & Poth, 2016; Yin, 2015).
4	To propose a model for technology integration based on gaps identified through research.	----	Findings, Conclusions & Recommendations	Based on findings, conclusions, recommendations, and gaps found through research, a model was developed for technology integration in Pakistan.

CHAPTER 4

ANALYSIS AND INTERPRETATION OF DATA

This part gives inquiry and explanation of information gathered through questionnaire and semi-structured interview. This study was based on assessing and comparing faculty competence toward technology integration of public and private sector teachers at higher education levels. The study used a mixed method design. The preliminary analysis in previous chapter showed that the tools are valid and reliable in accumulating data and information. The research results were based on the views of university teachers and Heads of departments. The quantitative instruments for data collection included a self-developed questionnaire and a standardized checklist, and semi-structured interviews for collecting in-depth views of heads.

The raw data was processed and tested through the prescribed numerical procedures. The analysis of data was presented in tabular and graphical form along with interpretation. The analysis was divided into three major sections. The descriptive statistic through which the teachers' opinions about technology integration were measured. The inferential statistic through which the inferences based on demographic factors over the technology integration were tested. The thematic analysis through which the responses collected through semi-structured interviews were analyzed.

4.1 Descriptive Statistics

The type of statistics that summarizes the acquired set of data to represent the entire population. This technique uses multiple measures along with graphical representation.

Section I: Demographic Analysis

This section represents the analysis and explanation of demographic data acquired through instruments. The demographic analysis revealed the necessary facts related to the respondents. Therefore, it is necessary for the study to provide demographic details of the respondents.

Section II: Objective 1- To examine the faculty perceptions regarding their competence towards technology integration at higher education level with reference to SAMR model in the backdrop of Bloom's taxonomy.

This section determines the extent of faculty competence toward technology integration in higher education. The Mean and S.D were computed for the analysis. The measures used for this section were a checklist and each phase of the questionnaire.

4.2 Inferential Statistics

The type of statistics that are used to make predictions about the population under consideration is based on the sample taken for the study.

Section III: Objective 2- To identify the differences in faculty competence towards technology integration at higher education level based on sector, gender, qualification, experience, designation, disciplines and age.

This section analyzes objective 2 of the study to find the differences among university teachers regarding their competence towards technology integration based on their demographics. For this purpose t-test statistics, and ANOVA (Analysis of Variance) statistics were utilized to calculate the significant differences.

4.3 Thematic Analysis

Thematic Analysis is the systematic approach to coding the qualitative responses and grouping the codes that later become variables of the researcher's interest in understanding a phenomenon.

Section IV: Objective 3- To explore the views of heads regarding faculty competence towards technology integration.

This section deals with an analysis of objective 3 of the study which was related to the semi-structured interview. Respondents of the interview were heads of the departments. Themes were obtained from the interview responses and the analysis was done by coding those themes into variables under consideration.

4.4 Comparison of Quantitative & Qualitative Analysis

Section V: Comparison of Results

This section deals with the requirement of convergent parallel design (Creswell, 2012), i.e., the comparison of quantitative and qualitative data analysis. The quantitative and qualitative results were then compared to strengthen the data analysis.

4.1 Descriptive Statistics

Section I

4.1.1 Demographic Analysis

Table 4.1

Distribution of Respondents based on Sector (n_1=552, n_2=30)

S#	Sector	Frequency *(n_1=Teachers)*	Percentage *(n_1=Teachers)*	Frequency *(n_2=Heads)*	Percentage *(n_2=Heads)*
1.	Public	340	62%	13	43%
2.	Private	212	38%	17	57%
	Total	**552**	**100%**	**30**	**100%**

Table 4.1 represents the sector-wise distribution of the respondents. Results indicate that majority of the teachers 62% (n=340) belong to public sector universities, while 38% (n=212) teachers belong to private sector universities. Results also indicate that participation of heads was 43% (n=13) for public and 57% (n=17) for private.

Table 4.2

Distribution of Respondents based on Gender (n_1=552, n_2=30)

S#	Gender	Frequency *(n_1=Teachers)*	Percentage *(n_1=Teachers)*	Frequency *(n_2=Heads)*	Percentage *(n_2=Heads)*
1.	Male	355	64%	17	57%
2.	Female	197	36%	13	43%
	Total	**552**	**100%**	**30**	**100%**

Table 4.2 depicts the division of the participants based on gender. Results indicate that majority of the teachers 64% (n=355) were male, while 36% (n=197) teachers were female. Results also indicate that 57% (n=17) heads were male and 43% (n=13) heads were female.

Table 4.3

Distribution of Respondents based on Academic Qualification (n_1=552, n_2=30)

S#	Academic Qualification	Frequency *(n_1=Teachers)*	Percentage *(n_1=Teachers)*	Frequency *(n_2=Heads)*	Percentage *(n_2=Heads)*
1.	M.Phil.	285	52%	0	0%
2.	Ph.D.	213	39%	19	63%
3.	Post Doc.	54	9%	11	37%
	Total	**552**	**100%**	**30**	**100%**

Table 4.3 represents the analysis of the heads and teachers regarding their academic qualifications. Results indicate that majority of the teachers 52% (n=285) were having M.Phil. degrees, whereas 39% (n=213) had Ph.D. degrees and 9% (n=54) were having Post Doc. Results also indicate that 63% (n=19) heads had Ph.D. degrees and 37% (n=11) heads had Post Doc.

Table 4.4

Distribution of Respondents based on Teaching Experience (n_1=552, n_2=30)

S#	Teaching Experience (Years)	Frequency *(n_1=Teachers)*	Percentage *(n_1=Teachers)*	Frequency *(n_2=Heads)*	Percentage *(n_2=Heads)*
1.	<3	145	26%	0	0%
2.	3 – 6	182	33%	8	27%
3.	7 – 10	135	24%	8	27%
4.	10<	90	15%	14	46%
	Total	**552**	**100%**	**30**	**100%**

Table 4.4 displays the distribution of the respondents regarding their teaching experience. Results indicate that 26% (n=145) of teachers had less than 3 years of teaching experience, whereas 33% (n=182) had experience ranging from 3– 6 years, 24% (n=135) had experience ranging from 7– 10 Years and 15% (n=90) were having more than 10 years' experience. Results also indicate that majority of heads 46% (n=14) had more than 10 years of experience.

Table 4.5

Distribution of Respondents based on Designation (n_1=552, n_2=30)

S#	Designation	Frequency *(n_1=Teachers)*	Percentage *(n_1=Teachers)*	Frequency *(n_2=Heads)*	Percentage *(n_2=Heads)*
1.	Professor	69	13%	11	37%
2.	Associate Prof.	84	15%	14	46%
3.	Assistant Prof.	191	35%	5	17%
4.	Lecturer	208	37%	0	0%
	Total	**552**	**100%**	**30**	**100%**

Table 4.5 depicts the distribution of the respondents regarding their designation. Results indicate that 13% (n=69) of teachers were professors, whereas 15% (n=84) were Associate Professors, 35% (n=191) were Assistant Professors and 37% (n=208) were Lecturers. Results also indicate that majority of heads 46% (n=14) were Associate professors.

Table 4.6

Distribution of Respondents based on Disciplines (n_1=552, n_2=30)

S#	Disciplines	Frequency *(n_1=Teachers)*	Percentage *(n_1=Teachers)*	Frequency *(n_2=Heads)*	Percentage *(n_2=Heads)*
1.	Social Sciences	220	40%	11	37%
2.	Management Sciences	332	60%	19	63%
	Total	**552**	**100%**	**30**	**100**%

Table 4.6 depicts the distribution of the respondents regarding their disciplines. Results indicate that 40% (n=220) of teachers belong to Social Sciences, whereas 60% (n=332) belong to Management Sciences. Results also indicate that majority of heads 63% (n=19) were from Management Sciences.

Table 4.7

Distribution of Respondents based on Age (n_1=552, n_2=30)

S#	Age (Years)	Frequency *(n_1=Teachers)*	Percentage *(n_1=Teachers)*	Frequency *(n_2=Heads)*	Percentage *(n_2=Heads)*
1.	< 30	105	19%	0	0%
2.	31 – 40	240	43%	5	17%
3.	41 – 50	187	35%	14	46%
4.	50 <	20	3%	11	37%
	Total	**552**	**100%**	**30**	**100%**

Table 4.7 depicts the distribution of the respondents regarding their age. Results indicate that 19% (n=105) of teachers had ages less than 30 years, whereas 43% (n=240) had ages ranging from 31– 40 years, 35% (n=187) had ages ranging from 41– 50 years and 3% (n=20) were having age more than 50 years. Results also indicate that majority of heads 46% (N=14) had ages ranging from 41– 50 years.

Table 4.8

Demographic Analysis of Quantitative Sample: Public and Private Sector (n_1=552)

Demographics		Frequency (n_1=Teachers)	Percentage (n_1=Teachers)
Public Universities Sample			
Gender	Male	225	66%
	Female	115	34%
	Total	***340***	***100%***
Academic Qualification	M.Phil.	182	54%
	Ph.D.	124	36%
	Post Doc.	34	10%
	Total	***340***	***100%***
Teaching Experience	< 3 Years	93	27%
	3 – 6 Years	103	30%
	7 – 10 Years	83	24%
	10< Years	61	19%
	Total	***340***	***100%***
Designation	Professor	48	14%
	Associate Prof.	60	18%
	Assistant Prof.	112	33%
	Lecturer	120	35%
	Total	***340***	***100%***
Disciplines	Social Sciences	136	40%
	Management Sciences	205	60%
	Total	***340***	***100%***
Age	< 30 Years	60	18%
	31 – 40 Years	138	41%
	41 – 50 Years	132	38%
	50 < Years	10	3%
	Total	***340***	***100%***
Private Universities Sample			
Gender	Male	130	61%
	Female	82	39%
	Total	***212***	***100%***
Academic Qualification	M.Phil.	103	49%
	Ph.D.	89	42%
	Post Doc.	20	9%
	Total	***212***	***100%***
Teaching Experience	< 3 Years	52	25%
	3 – 6 Years	79	36%
	7 – 10 Years	52	25%
	10 < Years	29	14%
	Total	***212***	***100%***
Designation	Professor	21	10%
	Associate Prof.	24	11%
	Assistant Prof.	79	37%
	Lecturer	88	42%
	Total	***212***	***100%***
Disciplines	Social Sciences	84	39%
	Management Sciences	127	61%
	Total	***212***	***100%***
Age	< 30 Years	45	21%
	31 – 40 Years	102	48%
	41 – 50 Years	55	26%
	50 < Years	10	5%
	Total	***212***	***100%***

Table 4.8 demonstrates the sample distribution of public and private sector universities taking into account of demographic variables of the faculty members. The sample of quantitative respondents was comprised of 552 regular/permanent teachers employed at public and private higher education institutions in Punjab, Pakistan. Out of 340 public sector respondents, 66% (n=225) were Male and 34% (n=115) were female. The majority of respondents 54% (n=182) were having M.Phil. degree, 36% (n=124) had a Ph.D., and 10% (n=34) had Post Doc. About 27% (n=93) of respondents had less than 3 years of teaching experience, whereas only 19% (n=61) of respondents had more than 10 years of experience. Most of the respondents 35% (n=120) were lecturers, whereas only 14% (n=48) were professors. The management sciences discipline has the most participation i.e. 60% (n=205), whereas 40% (n=136) belong to Social Sciences. The majority of public sector respondents 41% (n=138) were having their ages ranging from 31-40 years, while only 3% (n=10) had their ages more than 50 years.

Table 4.8 also demonstrates the sample distribution of private sector universities taking into account of demographic variables of the faculty members. Out of 212 private sector respondents, 61% (n=130) were Male and 39% (n=82) were female. The majority of respondents 49% (n=103) were having M.Phil. degree, 42% (n=89) had a Ph.D., 9% (n=20) had Post Doc. About 25% (n=52) of respondents had less than 3 years of teaching experience, whereas only 14% (n=29) of respondents had more than 10 years experience. Most of the respondents 42% (n=88) were lecturers, whereas only 10% (n=21) were professors. The Management Sciences discipline has the most participation i.e. 61% (n=127), whereas 39% (n=84) belong to Social Sciences. The majority of public sector respondents 48% (n=102) were having their ages ranging from 31-40 years, while only 5% had their ages more than 50 years.

Section II:

Objective 1- To examine the faculty perceptions regarding their competence towards technology integration at higher education level regarding SAMR model in the backdrop of Bloom's taxonomy.

4.1.2 Faculty Perceptions towards Technology Integration

The following table summarizes the technology integration scores of faculty at the university level, keeping in view four dimensions of SAMR model comprising Substitution, Augmentation, Modification and Redefinition.

Table 4.9

Faculty Competence towards Technology Integration at University Level (n_1=552)

Phases of Technology Integration		**n_1**	**Mean**	**S.D**
SAMR Model	***Bloom's Taxonomy***			
Substitution *(M=4.51, SD=0.75)*	Remembering	552	4.51	0.75
Augmentation *(M=4.33, SD=0.44)*	Understanding	552	4.54	0.38
	Applying	552	4.11	0.52
Modification *(M=3.78, SD=0.68)*	Applying	552	4.13	0.61
	Analyzing	552	3.99	0.77
	Evaluating	552	3.66	0.72
Redefinition *(M=3.45, SD=0.97)*	Evaluating	552	3.53	0.78
	Creating	552	3.20	1.01
Total		**552**	**3.98**	**0.70**

Table 4.9 shows the self-perception score of faculty members regarding their competence in technology integration. The first dimension of SAMR model i.e. Substitution indicates high mean scores (Mean=4.51, S.D=0.75). The second dimension of the model i.e. Augmentation again indicates high mean scores (Mean=4.33, S.D=0.44). The third dimension of the model i.e. Modification indicates medium mean scores (Mean=3.78, S.D=0.68). The fourth dimension of the model i.e. Redefinition indicates low mean scores (Mean=3.45, S.D=0.97). Results obtain through mean scores indicate that majority of the faculty members are practicing technology integration at Substitution and Augmentation level of the Model.

Table 4.10a

SAMR Matrix Response from Faculty (n_1=552)

Variable	SAMR Level			
	S	**A**	**M**	**R**
Faculty Rating of Technology Integration	50%	35%	10%	5%

Table 4.10b

Checklist Response from Faculty (n_1=552)

S#	ICT Learning Activities	SAMR Level Percentage			
		S	**A**	**M**	**R**
1	Note-Taking (taking pictures, videos, or recordings)	50%	35%	14%	1%
2	Research	48%	32%	18%	2%
3	Communication (Audio/video conferencing, homework reminders)	53%	27%	16%	4%
4	Individual/Group Collaboration	47%	31%	20%	2%
5	Content Creation	48%	30%	19%	3%
6	Learning Organizers	50%	27%	18%	5%
7	Presentation Apps (e.g. photo, video, music)	57%	24%	12%	7%
8	Data Collection Software Interfacing with Built-in sensors or external probes	40%	31%	18%	11%
9	Formative Feedback	58%	38%	4%	0%
10	Texting (SMS)/Twitter/ Social Networking	50%	25%	19%	6%
11	WebQuests	77%	19%	4%	0%
12	Augmented Reality (e.g. Google Earth, Google Goggles, Google Map)	17%	24%	59%	0%
13	Simulations	22%	24%	53%	1%
14	Guided Reading	65%	24%	9%	2%

Table 4.10a and 4.10$_b$ indicated that most of the respondents were practicing ICT learning activities at the first two levels of the SAMR model. For instance, Note-taking task was performed by the teachers through digital tools with 50% integration of digital tools at substitution level. It is the same for content creation and researches etc.

Table 4.10c

Checklist Response from Faculty (n_1=552)

S#	ICT Learning Activities	Usage		
		In Class	Online	Both
1	Note Taking (e.g. taking pictures, videos, or recordings)	5%	75%	20%
2	Research	4%	80%	16%
3	Communication (e.g. audio/video conferencing, homework reminders, etc.)	7%	77%	16%
4	Individual/Group Collaboration	8%	73%	19%
5	Content Creation	2%	85%	13%
6	Learning Organizers	4%	84%	12%
7	Presentation Apps (e.g. photo, video, music)	3%	81%	16%
8	Data Collection Software Interfacing with Built-in sensors or external probes	0%	86%	14%
9	Formative Feedback	2%	79%	19%
10	Texting (SMS)/Twitter/ Social Networking	4%	81%	15%
11	WebQuests	0%	100%	0%
12	Augmented Reality (e.g. Google Earth, Google Goggles, Google Map)	0%	100%	0%
13	Simulations	10%	70%	20%
14	Guided Reading	30%	50%	20%

Table 4.10b shows the results obtain from the checklist responses of the faculty members. Analysis indicated that most respondents were practicing ICT learning activities in Online Teaching. For instance, Note-taking task was performed by the teachers through digital tools with 75% integration of online digital tools. Furthermore, the Content Creation activity was mostly dealt with online i.e. 85%. Results also indicate that Research activity was also mainly performed online with 80% at Modification and 16% at the hybrid mode of teaching.

Section III:

4.2 Inferential Statistic:

Objective 2- To identify the differences in faculty competence towards technology integration at higher education level based on sector, gender, qualification, experience, designation, disciplines and age.

4.2.1 Sector-Based Comparison of Technology Integration

H_{01} There are no statistical differences among teachers' technology integration while comparing Sectors.

The following table explains the difference in technology integration scores of faculty members while comparing the sector (Public and Private).

Table 4.11

Technology Integration (Comparison of Public and Private Sector) (n_1=552)

Variable	Group (**Sector**)	n_1	Mean	S.D	*t*	*df*	Sig (2-tailed)	Cohen's d
Technology Integration	Public	340	3.71	0.60	3.95	550	.00*	0.34
	Private	212	3.90	0.63				

* *$p<0.05$*

Table 4.11 indicates the comparative analysis based on sector. The test compared the teachers' technology integration between public and private sector teachers. The results were found significant at $t(550)=3.95$ where $p=.00$. Therefore, there exists a significant difference in technology integration between public (Mean=3.71, S.D=0.60) and private (Mean=3.90, S.D=0.63) sector teachers. Results also indicate that private sector teachers (Mean=3.90) have significantly higher competency toward technology integration than public sector teachers (Mean=3.71). The effect size was found at 0.34 which indicates a Medium effect size. Hence, the Null hypothesis **H_{01}** 'There are no statistical differences among teachers' technology integration while comparing Sectors' is rejected.

H_{01a} There are no statistical differences among teachers in connection with *'Substitution'* in the backdrop of '*Remembering*' while comparing Sectors.

The following table explains the difference in technology integration scores of faculty members while comparing the sector (Public and Private) in relation to *'Substitution'* in the backdrop of '*Remembering*'.

Table 4.12

Substitution: Remembering (Comparison of Public and Private Sector) (n_1=552)

Variable	Group (Sector)	n_1	Mean	S.D	*t*	*df*	Sig (2-tailed)	Cohen's d
Substitution: *Remembering*	Public	340	4.24	0.77	2.64	550	.001*	0.25
	Private	212	4.45	0.71				

$^{*}p<0.05$

Table 4.12 indicates the comparative analysis of teachers' technology integration in relation to *'Substitution'* in the backdrop of '*Remembering*' among public and private sector teachers. The results were significant at $t(550)=2.64$ where $p=.001$. Therefore, there exists a significant difference in technology integration between public (Mean=4.24, S.D=0.77) and private (Mean=4.45, S.D=0.71) sector teachers. Results also indicate that private sector teachers (Mean=4.45) have significantly higher competency toward technology integration than public sector teachers (Mean=4.24). The effect size was found at 0.25 which indicates a Medium effect size. Hence, the Null hypothesis **H_{01a}** 'There are no statistical differences among teachers in connection with *'Substitution'* in the backdrop of '*Remembering*' while comparing Sectors' is rejected.

H_{01b} There are no statistical differences among teachers in connection with *'Augmentation' in the backdrop of 'Understanding' and 'Applying'* while comparing Sectors.

The following table explains the difference in technology integration scores of faculty members while comparing the sector (Public and Private) in relation to *'Augmentation' in the backdrop of 'Understanding' and 'Applying'*.

Table 4.13

Augmentation: Understanding & Applying (Comparison of Public and Private Sector)

Variable	Group (Sector)	n_1	Mean	S.D	*t*	*df*	Sig (2-tailed)	Cohen's d
Augmentation*: Understanding & Applying*	Public	340	4.07	0.65	3.38	550	.001*	0.44
	Private	212	4.25	0.76				

** p<0.05*

Table 4.13 indicates the comparative analysis of teachers' technology integration in relation to *'Augmentation' in the backdrop of 'Understanding' and 'Applying'* among public and private sector teachers. The results were significant at $t(550)=3.38$, where $p=.001$. Therefore, there exists a significant difference in technology integration between public (Mean=4.07, S.D=0.65) and private (Mean=4.25, S.D=0.76) sector teachers. Results also indicate that private sector teachers (Mean=4.25) have significantly higher competency toward technology integration than public sector teachers (Mean=4.07). The effect size was found at 0.44 which indicates a Medium effect size. Hence, the Null hypothesis **H_{01b}** 'There are no statistical differences among teachers in connection with *'Augmentation'* in the backdrop of *'Understanding'* and *'Applying'* while comparing Sectors' is rejected.

H_{01c} There are no statistical differences among teachers in connection with *'Modification'* in the backdrop of *'Applying'*, *'Analyzing'* and *'Evaluating'* while comparing Sectors.

The following table explains the difference in technology integration scores of faculty members while comparing the sector (Public and Private) in relation to *'Modification'* in the backdrop of *'Applying', 'Analyzing',* and *'Evaluating'*.

Table 4.14

Modification: Applying, Analyzing & Evaluating (Comparison of Public and Private Sector)

Variable	Group (Sector)	n_1	Mean	S.D	*t*	*df*	Sig (2-tailed)	Cohen's d
Modification: *Applying, Analyzing & Evaluating*	Public	340	3.51	0.71	4.77	550	.001*	0.71
	Private	212	3.68	0.66				

* *p<0.05*

Table 4.14 indicates the comparative analysis of teachers' technology integration in relation to *'Modification'* in the backdrop of *'Applying', 'Analyzing'* and *'Evaluating'* among public and private sector teachers. The results were significant at $t(550)=4.77$, where $p=.001$. Therefore, there exists a significant difference in technology integration between public (Mean=3.51, S.D=0.71) and private (Mean=3.68, S.D=0.66) sector teachers. Results also indicate that private sector teachers (Mean=3.68) have significantly higher competency toward technology integration than public sector teachers (Mean=3.51). The effect size was found at 0.71 which indicates a large effect size. Hence, the Null hypothesis **H_{01c}** 'There are no statistical differences among teachers in connection with *'Modification'* in the backdrop of *'Applying', 'Analyzing'* and *'Evaluating'* while comparing Sectors' is rejected.

H_{01d} There are no statistical differences among teachers in connection with *'Redefinition'* in the backdrop of '*Evaluating'* and '*Creating*' while comparing Sectors.

The following table explains the difference in technology integration scores of faculty members while comparing the sector (Public and Private) in relation to *'Redefinition'* in the backdrop of '*Evaluating'* and '*Creating*'.

Table 4.15

Redefinition: Evaluating & Creating (Comparison of Public and Private Sector) (n_1=552)

Variable	Group (Sector)	n_1	Mean	S.D	*t*	*df*	Sig (2-tailed)	Cohen's d
Redefinition: *Evaluating & Creating*	Public	340	3.40	0.73	3.41	550	.001*	0.53
	Private	212	3.61	0.78				

** $p<0.05$*

Table 4.15 indicates the comparative analysis of teachers' technology integration in relation to *'Redefinition'* in the backdrop of '*Evaluating'* and '*Creating*' among public and private sector teachers. The results were found significant at $t(550)=3.41$ where $p=.001$. Therefore, there exists a significant difference in technology integration between public (Mean=3.40, S.D=0.73) and private (Mean=3.61, S.D=0.78) sector teachers. Results also indicate that private sector teachers (Mean=3.61) have significantly higher competency toward technology integration than public sector teachers (Mean=3.40). The effect size was found at 0.53 which indicates a large effect size. Hence, the Null hypothesis **H_{01d}** 'There are no statistical differences among teachers in connection with *'Redefinition'* in the backdrop of '*Evaluating'* and '*Creating*' while comparing Sectors' is rejected.

4.2.2 Gender-Based Comparison of Technology Integration

H_{02} There are no significant differences among teachers' technology integration while comparing Gender.

The following table explains the difference in technology integration scores of faculty members while comparing their gender (Male and Female).

Table 4.16

Technology Integration (Comparison of Male and Female) (n_1=552)

Variable	Group (**Gender**)	n_1	Mean	S.D	*t*	*df*	Sig (2-tailed)	Cohen's d
Technology Integration	Male	355	3.78	0.57	3.98	550	.000*	0.34
	Female	197	3.61	0.71				

**p<0.05*

Table 4.16 indicates the comparative analysis of technology integration on the basis of gender. The test compared the technology integration scores of male and female teachers. The results were found significant at $t(550)=3.98$ where $p=.00$. Therefore, there exists a significant difference in technology integration between male (Mean=3.78, S.D=0.57) and female (Mean=3.61, S.D=0.71) teachers. Results also indicate that male teachers (Mean=3.78) have significantly higher competency toward technology integration than female teachers (Mean=3.61). The effect size was found at 0.34 which indicates a Medium effect size. Hence, hypothesis **H_{02}** 'There are no differences among teachers' technology integration while comparing Gender' is rejected.

H_{02a} There are no statistical differences among teachers in connection with *'Substitution'* in the backdrop of '*Remembering*' while comparing Gender.

The following table explains the difference in technology integration scores of faculty members while comparing the gender (Male and Female) in relation to *'Substitution'* in the backdrop of 'Remembering'.

Table 4.17

Substitution: Remembering (Comparison of Male and Female) (n_1=552)

Variable	Group (Gender)	n_1	Mean	S.D	*t*	*df*	Sig (2-tailed)	Cohen's d
Substitution: *Remembering*	Male	355	4.48	0.73	2.66	550	.001*	0.23
	Female	197	4.30	0.83				

** $p<0.05$*

Table 4.17 indicates the comparative analysis of teachers' technology integration in relation to *'Substitution'* in the backdrop of '*Remembering*' among male and female teachers. The results were significant at $t(550)=2.66$ where $p=.001$. Therefore, there exists a significant difference in technology integration between male (Mean=4.48, S.D=0.73) and female (Mean=4.30, S.D=0.83) teachers. Results also indicate that male teachers (Mean=4.48) have significantly higher competency toward technology integration than female teachers (Mean=4.30). The effect size was found at 0.23 which indicates a Medium effect size. Hence, the Null hypothesis **H_{02a}** 'There are no statistical differences among teachers in connection with *'Substitution'* in the backdrop of 'Remembering' while comparing Gender' is rejected.

H_{02b} There are no statistical differences among teachers in connection with *'Augmentation'* in the backdrop of *'Understanding'* and *'Applying'* while comparing Gender.

The following table explains the difference in technology integration scores of faculty members while comparing the gender (Male and Female) in relation to *'Augmentation'* in the backdrop of *'Understanding'* and *'Applying'*.

Table 4.18

Augmentation: Understanding & Applying (Comparison of Male and Female) (n_1=552)

Variable	Group (Gender)	n_1	Mean	S.D	*t*	*df*	Sig (2-tailed)	Cohen's d
Augmentation: *Understanding & Applying*	Male	355	4.30	0.67	4.66	550	.001*	0.41
	Female	197	4.27	0.75				

* *p<0.05*

Table 4.18 indicates the comparative analysis of teachers' technology integration in relation to the *'Augmentation'* in the backdrop of *'Understanding'* and *'Applying'* among male and female teachers. The results were significant at $t(550)=4.66$ where $p=.001$. Therefore, there exists a significant difference in technology integration between male (Mean=4.30, S.D=0.67) and female (Mean=4.27, S.D=0.75) teachers. Results also indicate that male teachers (Mean=4.30) have significantly higher competency toward technology integration than female teachers (Mean=4.27). The effect size was found at 0.41 which indicates a Medium effect size. Hence, the Null hypothesis **H_{02b}** 'There are no statistical differences among teachers in connection with *'Augmentation'* in the backdrop of *'Understanding'* and *'Applying'* while comparing Gender' is rejected.

H_{02c} There are no statistical differences among teachers in connection with *'Modification'* in the backdrop of *'Applying', 'Analyzing',* and *'Evaluating'* while comparing Gender.

The following table explains the difference in technology integration scores of faculty members while comparing the gender (Male and Female) in relation to *'Modification'* in the backdrop of *'Applying', 'Analyzing',* and *'Evaluating'*.

Table 4.19

Modification: Applying, Analyzing & Evaluating (Comparison of Male and Female)

Variable	Group (Gender)	n_1	Mean	S.D	*t*	*df*	Sig (2-tailed)	Cohen's d
Modification: *Applying, Analyzing & Evaluating*	Male	355	3.71	0.65	3.38	550	.001*	0.29
	Female	197	3.59	0.80				

* *p<0.05*

Table 4.19 indicates the comparative analysis of teachers' technology integration in relation to *'Modification'* in the backdrop of *'Applying', 'Analyzing',* and *'Evaluating'* among male and female teachers. The results were significant at $t(550)=3.38$ where $p=.001$. Therefore, there exists a significant difference in technology integration between male (Mean=3.71, S.D=0.65) and female (Mean=3.59, S.D=0.80) teachers. Results also indicate that male teachers (Mean=3.71) have significantly higher competency toward technology integration than female teachers (Mean=3.59). The effect size was found at 0.29 which indicates a Medium effect size. Hence, the Null hypothesis **H_{02c}** 'There are no statistical differences among teachers in connection with *'Modification'* in the backdrop of *'Applying', 'Analyzing'* and *'Evaluating'* while comparing Gender' is rejected.

H_{02d} There are no statistical differences among teachers in connection with *'Redefinition'* in the backdrop of '*Evaluating'* and '*Creating*' while comparing Gender.

The following table explains the difference in technology integration scores of faculty members while comparing the gender (Male and Female) in relation to *'Redefinition'* in the backdrop of '*Evaluating'* and '*Creating*'.

Table 4.20

Redefinition: Evaluating & Creating (Comparison of Male and Female) (n_1=552)

Variable	Group (Gender)	n_1	Mean	S.D	*t*	*df*	Sig (2-tailed)	Cohen's d
Redefinition: Evaluating & Creating	Male	355	3.44	0.68	2.93	550	.001*	0.25
	Female	197	3.38	0.84				

*$p<0.05$

Table 4.20 indicates the comparative analysis of teachers' technology integration in relation to *'Redefinition'* in the backdrop of '*Evaluating'* and '*Creating*' among male and female teachers. The results were found significant at $t(550)=2.93$ where $p=.001$. Therefore, there exists a significant difference in technology integration between male (Mean=3.44, S.D=0.68) and female (Mean=3.38, S.D=0.84) teachers. Results also indicate that male teachers (Mean=3.44) have significantly higher competency toward technology integration than female teachers (Mean=3.38). The effect size was found at 0.25 which indicates a Medium effect size. Hence, the Null hypothesis **H_{02d}** 'There are no statistical differences among teachers in connection with *'Redefinition'* in the backdrop of '*Evaluating'* and '*Creating*' while comparing Gender' is rejected.

4.2.3 Qualification Based Comparison of Technology Integration

H_{03} There are no statistical differences among teachers' technology integration while comparing Qualifications.

The following table explains the difference in technology integration scores of faculty members while comparing their Qualifications.

Table 4.21a

Technology Integration (Comparison based on Qualification) (n_1=552)

Variable	Group (**Qualification**)	n_1	Mean	S.D	F	Sig (2-tailed)
Technology Integration	M.Phil.	285	3.57	0.48	4.23	0.001*
	Ph.D.	213	3.81	0.53		
	Post Doc.	54	3.74	0.84		

* *p<0.05*

Table 4.21a indicates the analysis of ANOVA-test. The test compared the technology integration scores of teachers regarding their qualifications. The results were significant at $F(549,2)=4.23$ where $p=.001$. Therefore, it can be concluded that there was a significant effect of teachers' qualifications on their competency in technology integration. Hence, hypothesis **H_{03}** 'There are no differences among teachers' technology integration while comparing Qualification', is rejected.

The following table explains the Post Hoc Test analysis to assess the statistical differences among teachers' technology integration with respect to their Qualification groups.

Table 4.21b

Technology Integration (Tukey's Post Hoc Test Based on Qualification) (n_1=552)

Qualification	Groups (Qualification)	Sig (2-tailed)
M.Phil.	Ph.D.	.044*
	Post Doc.	.031*
Ph.D.	M.Phil.	.044*
	Post Doc.	0.22
Post Doc.	M.Phil.	.031*
	Ph.D.	0.22

* *p<0.05*

Table 4.21b shows the Post Hoc Test analysis to assess the statistical differences among teachers' technology integration with respect to their Qualification groups. Results indicated that while comparing technology integration of the participants with respect to their qualifications, a statistically significant difference was found between participants having M.Phil. degree and participants having Ph.D. and Post. Doctoral degree at p-value .044 and .031 respectively.

The table below represents the differences in technology integration scores of faculty members while comparing their Qualification Groups in relation to *'Substitution'* in the backdrop of '*Remembering*'.

H_{03a} There are no statistical differences among teachers in connection with *'Substitution'* in the backdrop of '*Remembering*' while comparing Qualifications.

Table 4.22

Substitution: Remembering (Comparison based on Qualification) (n_1=552)

Variable	Group (Qualification)	n_1	Mean	S.D	F	Sig (2-tailed)
Substitution: *Remembering*	M.Phil.	285	4.23	0.67	1.43	0.22
	Ph.D.	213	4.48	0.68		
	Post Doc.	54	4.34	0.97		

$^{*}p<0.05$

Table 4.22 indicates the analysis of ANOVA-test. The test compared the technology integration scores of teachers regarding their qualification group in relation to *'Substitution'* in the backdrop of '*Remembering*'. The results were found insignificant at $F(549,2)=1.43$ where $p=.22$. Therefore, it can be concluded that there was no significant effect of teachers' qualification on their competency of technology integration in relation to the 'Substitution'. Hence, the Null hypothesis **H_{03a}** 'There are no statistical differences among teachers in connection with *'Substitution'* in the backdrop of 'Remembering' while comparing Qualification' is accepted.

The table below represents the differences in technology integration scores of faculty members while comparing their Qualification Groups in relation to *'Augmentation'* in the backdrop of *'Understanding'* and *'Applying'*.

H_{03b} There are no statistical differences among teachers in connection with *'Augmentation'* in the backdrop of *'Understanding'* and *'Applying'* while comparing Qualifications.

Table 4.23

Augmentation: Understanding & Applying (Comparison based on Qualification) (n_1=552)

Variable	Group (Qualification)	n_1	Mean	S.D	F	Sig (2-tailed)
Augmentation: *Understanding & Applying*	M.Phil.	285	4.14	0.62	.005	0.99
	Ph.D.	213	4.23	0.61		
	Post Doc.	54	4.30	1.01		

$*p<0.05$

Table 4.23 indicates the analysis of ANOVA-test. The test compared the technology integration scores of teachers regarding their qualification group in relation to *'Augmentation'* in the backdrop of *'Understanding'* and *'Applying'*. The results were found insignificant at $F(549,2)=.005$ where $p=.99$. Therefore, it can be concluded that there was no significant effect of teachers' qualification on their competency of technology integration in relation to the 'Augmentation'. Hence, the Null hypothesis **H_{03b}** 'There are no statistical differences among teachers in connection with *'Augmentation'* in the backdrop of *'Understanding'* and *'Applying'* while comparing Qualification' is accepted.

The table below represents the differences in technology integration scores of faculty members while comparing their Qualification Groups in relation to *'Modification'* in the backdrop of *'Applying', 'Analyzing',* and *'Evaluating'*.

H_{03c} There are no statistical differences among teachers in connection with *'Modification'* in the backdrop of *'Applying', 'Analyzing'* and *'Evaluating'* while comparing Qualifications.

Table 4.24a

Modification: Applying, Analyzing & Evaluating (Comparison based on Qualification)

Variable	Group (Qualification)	n_1	Mean	S.D	F	Sig (2-tailed)
Modification: *Applying, Analyzing & Evaluating*	M.Phil.	285	3.57	0.54	4.02	0.00*
	Ph.D.	213	3.64	0.63		
	Post Doc.	54	3.76	0.91		

** p<0.05*

Table 4.24a indicates the analysis of ANOVA-test. The test compared the technology integration scores of teachers regarding their qualification group in relation to *'Modification'* in the backdrop of *'Applying', 'Analyzing',* and *'Evaluating'*. The results were found significant at $F(549,2)=4.02$ where $p=.00$. Therefore, it can be concluded that there was a significant effect of teachers' qualification on their competency of technology integration in relation to the 'Modification'. Hence, the Null hypothesis **H_{03c}** 'There are no statistical differences among teachers in connection with *'Modification'* in the backdrop of *'Applying', 'Analyzing'* and *'Evaluating'* while comparing Qualification' is rejected.

The following table explains the Post Hoc Test analysis to assess the statistical differences among teachers' technology integration with respect to their Qualification groups in relation to the third level of SAMR model i.e. Modification.

Table 4.24b

Modification (Tukey's Post Hoc Test Based on Qualification) (n_1=552)

Qualification	Groups (Qualification)	Sig (2-tailed)
M.Phil.	Ph.D.	0.001**
	Post Doc.	0.042*
Ph.D.	M.Phil.	0.001**
	Post Doc.	0.391
Post Doc.	M.Phil.	0.042*
	Ph.D.	0.391

* *$p<0.05$*

Table 4.24b shows the Post Hoc Test analysis to assess the statistical differences among teachers' technology integration with respect to their Qualification groups in relation to the third level of SAMR model i.e. Modification. Results indicated that while comparing technology integration of the participants with respect to their qualification at Modification level, a statistically significant difference was found between participants having M.Phil. degree and participants having Ph.D. and Post. Doctoral degree at p-value 0.001 and .042 respectively.

The table below represents the differences in technology integration scores of faculty members while comparing their Qualification Groups in relation to *'Redefinition'* in the backdrop of '*Evaluating'* and '*Creating*'.

H_{03d} There are no statistical differences among teachers in connection with *'Redefinition'* in the backdrop of '*Evaluating'* and '*Creating*' while comparing Qualifications.

Table 4.25$_a$

Redefinition: Evaluating & Creating (Comparison based on Qualification) (n_1=552)

Variable	Group (Qualification)	n_1	Mean	S.D	F	Sig (2-tailed)
Redefinition: *Evaluating & Creating*	M.Phil.	285	3.21	0.54	3.02	.001*
	Ph.D.	213	3.43	0.63		
	Post Doc.	54	3.37	0.90		

** p<0.05*

Table 4.25$_a$ indicates the analysis of ANOVA-test. The test compared the technology integration scores of teachers regarding their qualification group in relation to *'Redefinition'* in the backdrop of '*Evaluating'* and '*Creating*'. The results were found significant at $F(549,2)=3.02$ where $p=.001$. Therefore, it can be concluded that there was a significant effect of teachers' qualifications on their competency in technology integration in relation to the 'Redefinition'. Hence, the Null hypothesis **H_{03d}** 'There are no statistical differences among teachers in connection with *'Redefinition'* in the backdrop of '*Evaluating'* and '*Creating*' while comparing Qualification' is rejected.

The following table explains the Post Hoc Test analysis to assess the statistical differences among teachers' technology integration with respect to their Qualification groups in relation to the fourth level of SAMR model i.e. Redefinition.

Table 4.25b

Redefinition (Tukey's Post Hoc Test Based on Qualification) (n_1=552)

Qualification	Groups (Qualification)	Sig (2-tailed)
M.Phil.	Ph.D.	0.003**
	Post Doc.	0.021*
Ph.D.	M.Phil.	0.003**
	Post Doc.	0.151
Post Doc.	M.Phil.	0.021*
	Ph.D.	0.151

* *p<0.05*

Table 4.25b shows the Post Hoc Test analysis to assess the statistical differences among teachers' technology integration with respect to their Qualification groups in relation to the fourth level of SAMR model i.e. Redefinition. Results indicated that while comparing technology integration of the participants with respect to their qualification at Modification level, a statistically significant difference was found between participants having M.Phil. degree and participants having Ph.D. and Post. Doctoral degree at p-value 0.003 and .021 respectively.

4.2.4 Experience-Based Comparison of Technology Integration

H_{04} There are no statistical differences among teachers' technology integration while comparing Teaching Experience.

The following table explains the difference in technology integration scores of faculty members while comparing their Teaching Experience.

Table 4.26_a

Technology Integration (Comparison based on Teaching Experience) (n_1=552)

Variable	Group (**Experience**)	n_1	Mean	S.D	F	Sig (2-tailed)
Technology Integration	< 3 Years	145	3.59	0.55	4.54	.004*
	3–6 Years	182	3.65	0.79		
	7–10 Years	135	3.78	0.52		
	10 < Years	90	3.82	0.61		

* *p<0.05*

Table 4.26_a indicates the analysis of ANOVA-test. The test compared the technology integration scores of teachers regarding their teaching experience. The results were significant at $F(548,3)=4.54$ where $p=.004$. Therefore, it can be concluded that there was a significant effect of teachers' experience on their competency in technology integration. Hence, hypothesis **H_{04}** 'There are no differences among teachers' technology integration while comparing Teaching Experience' is rejected.

The table below explains the Post Hoc Test results to determine the statistical differences among teachers' technology integration with respect to their teaching experience groups.

Table 4.26$_b$

Technology Integration (Tukey's Post Hoc Test Based on Teaching Experience) (n_1=552)

Teaching Experience (Years)	Groups (Teaching Experience)	Sig (2-tailed)
	3–6 Years	.041*
<3 Years	7–10 Years	.001**
	10< Years	.049*
	<3 Years	.041*
3–6 Years	7–10 Years	.048*
	10< Years	.002**
	<3 Years	.001**
7–10 Years	3–6 Years	.048*
	10< Years	0.24
	<3 Years	.049*
10< Years	3–6 Years	.002**
	7–10 Years	0.24

* $p<0.05$

Table 4.26$_b$ shows the Post Hoc Test analysis to assess the statistical differences among teachers' technology integration with respect to their Teaching Experience groups. Results indicated that while comparing technology integration of the participants with respect to their teaching experience, a significant difference was found between participants having less than 3 years of experience and participants having 3 to 6, 7 to 10, and more than 10 years of experience at p-values 0.041, .001 and .049 respectively. A statistically significant difference was also found between participants having three to six years of experience and participants having seven to ten and more than ten years of experience at p-values .048 and .002 respectively.

The table below represents the differences in technology integration scores of faculty members while comparing their Teaching Experience Group in relation to *'Substitution'* in the backdrop of '*Remembering*'.

H_{04a} There are no statistical differences among teachers in connection with *'Substitution'* in the backdrop of '*Remembering*' while comparing Teaching Experience.

Table 4.27

Substitution: Remembering (Comparison based on Teaching Experience) (n_1=552)

Variable	Group (Experience)	n_1	Mean	S.D	F	Sig (2-tailed)
Substitution: *Remembering*	<3 Years	145	4.38	0.62	2.13	.09
	3–6 Years	182	4.41	0.85		
	7–10 Years	135	4.30	0.63		
	10< Years	90	4.48	0.77		

* *p<0.05*

Table 4.27 indicates the analysis of ANOVA-test. The test compared the technology integration scores of teachers regarding their teaching experience group in relation to *'Substitution'* in the backdrop of '*Remembering*'. The results were found insignificant at $F(548,3)=2.13$ where $p=.09$. Therefore, it can be concluded that there was no significant effect of teachers' teaching experience on their competency of technology integration in relation to the 'Substitution'. Hence, the Null hypothesis **H_{04a}** 'There are no statistical differences among teachers in connection with *'Substitution'* in the backdrop of '*Remembering*' while comparing Teaching Experience' is accepted.

The following table explains the difference in technology integration scores of faculty members while comparing their Teaching Experience Group in relation to *'Augmentation'* in the backdrop of *'Understanding'* and *'Applying'*.

H_{04b} There are no statistical differences among teachers in connection with *'Augmentation'* in the backdrop of *'Understanding'* and *'Applying'* while comparing Teaching Experience.

Table 4.28

Augmentation: Understanding & Applying (Comparison based on Teaching Experience)

Variable	Group (Experience)	n_1	Mean	S.D	F	Sig (2-tailed)
Augmentation: *Understanding & Applying*	<3 Years	145	4.17	0.67	1.13	0.34
	3–6 Years	182	4.27	0.76		
	7–10 Years	135	4.20	0.90		
	10< Years	90	4.30	0.76		

$*p<0.05$

Table 4.28 indicates the analysis of ANOVA-test. The test compared the technology integration scores of teachers regarding their teaching experience group in relation to *'Augmentation'* in the backdrop of *'Understanding'* and *'Applying'*. The results were found insignificant at $F(548,3)=1.13$ where $p=.34$. Therefore, it can be concluded that there was no significant effect of teachers' teaching experience on their competency of technology integration in relation to the 'Augmentation'. Hence, the Null hypothesis **H_{04b}** 'There are no statistical differences among teachers in connection with *'Augmentation'* in the backdrop of *'Understanding'* and *'Applying'* while comparing Teaching Experience' is accepted.

The table below represents the differences in technology integration scores of faculty members while comparing their Teaching Experience Group in relation to *'Modification'* in the backdrop of *'Applying', 'Analyzing'* and *'Evaluating'*.

H_{04c} There are no statistical differences among teachers in connection with *'Modification'* in the backdrop of *'Applying', 'Analyzing'* and *'Evaluating'* while comparing Teaching Experience.

Table 4.29$_a$

Modification: Applying, Analyzing & Evaluating (Comparison based on Teaching Experience) (N_1=552)

Variable	Group (Experience)	n_1	Mean	S.D	F	Sig (2-tailed)
Modification: *Applying, Analyzing & Evaluating*	<3 Years	145	3.57	3.58	4.08	.001*
	3–6 Years	182	3.71	0.65		
	7–10 Years	135	3.77	0.74		
	10< Years	90	3.65	0.65		

** p<0.05*

Table 4.29$_a$ indicates the analysis of ANOVA-test. The test compared the technology integration scores of teachers regarding their teaching experience group in relation to *'Modification'* in the backdrop of *'Applying', 'Analyzing'* and *'Evaluating'*. The results were found significant at $F(548,3)=4.08$ where $p=.001$. Therefore, it can be concluded that there was a significant effect of teachers' teaching experience on their competency in technology integration in relation to the 'Modification'. Hence, the Null hypothesis **H_{04c}** 'There are no statistical differences among teachers in connection with *'Modification'* in the backdrop of *'Applying', 'Analyzing'* and *'Evaluating'* while comparing Teaching Experience' is rejected.

The table below represents the Post Hoc Test results to determine the statistical differences among teachers' technology integration with respect to their teaching experience groups in relation to the third level of SAMR model i.e. Modification.

Table 4.29b

Modification (Tukey's Post Hoc Test Based on Teaching Experience) (n_1=552)

Teaching Experience	Groups (Teaching Experience)	Sig (2-tailed)
<3 Years	3–6 Years	.025*
	7–10 Years	.001**
	10< Years	.044*
3–6 Years	<3 Years	.025*
	7–10 Years	.040*
	10< Years	.550
7–10 Years	<3 Years	.001**
	3–6 Years	.040*
	10< Years	.030*
10< Years	<3 Years	.044*
	3–6 Years	.550
	7–10 Years	.030*

* *$p<0.05$*

Table 4.29b shows the Post Hoc Test analysis to assess the statistical differences among teachers' technology integration with respect to their teaching experience groups in relation to the third level of SAMR model i.e. Modification. Results indicated that while comparing technology integration of the participants with respect to their teaching experience at Modification level, a statistically significant difference was found between participants having less than three years of experience and participants having three to ten, seven to ten and more than ten years of experience at p-values .025, .001 and .044 respectively. A statistically significant difference was also found between participants having 3 to 6 years of experience and seven to ten years of experience at a p-value of .040. Furthermore, a statistically significant difference was also found between participants having 7-10 and more than 10 years' experience at p-value .030.

The table below represents the differences in technology integration scores of faculty members while comparing their Teaching Experience Group in relation to *'Redefinition'* in the backdrop of '*Evaluating'* and '*Creating*'.

H_{04d} There are no statistical differences among teachers in connection with *'Redefinition'* in the backdrop of '*Evaluating'* and '*Creating*' while comparing Teaching Experience.

Table 4.30$_a$

Redefinition: Evaluating & Creating (Comparison based on Teaching Experience)

Variable	Group (Experience)	n_1	Mean	S.D	F	Sig (2-tailed)
Redefinition: *Evaluating & Creating*	<3 Years	145	3.30	0.62	4.08	.001*
	3–6 Years	182	3.35	0.72		
	7–10 Years	135	3.44	0.68		
	10< Years	90	3.38	0.91		

* *p<0.05*

Table 4.30$_a$ indicates the analysis of the ANOVA-test. The test compared the technology integration scores of teachers regarding their teaching experience group in relation to *'Redefinition'* in the backdrop of '*Evaluating'* and '*Creating*'. The results were significant at $F(548,3)=4.08$ where $p=.001$. Therefore, it can be concluded that there was a significant effect of teachers' teaching experience on their competency in technology integration in relation to the 'Redefinition'. Hence, the Null hypothesis **H_{04d}** 'There are no statistical differences among teachers in connection with *'Redefinition'* in the backdrop of '*Evaluating'* and '*Creating*' while comparing Teaching Experience' is rejected.

The table below explains the Post Hoc Test analysis to assess the statistical differences among teachers' technology integration with respect to their teaching experience groups in relation to the fourth level of SAMR model i.e. Redefinition.

Table 4.30$_b$

Redefinition (Tukey's Post Hoc Test Based on Teaching Experience) (n_1=552)

Teaching Experience	Groups (Teaching Experience)	Sig (2-tailed)
<3 Years	3–6 Years	.020*
	7–10 Years	.001**
	10< Years	.046*
3–6 Years	<3 Years	.020*
	7–10 Years	.004**
	10< Years	.033*
7–10 Years	<3 Years	.001**
	3–6 Years	.004**
	10< Years	.15
10< Years	<3 Years	.046*
	3–6 Years	.033*
	7–10 Years	.15

* *$p<0.05$*

Table 4.30$_b$ shows the Post Hoc Test analysis to assess the statistical differences among teachers' technology integration with respect to their teaching experience groups in relation to the fourth level of SAMR model i.e. Redefinition. Results indicated that while comparing technology integration of the participants with respect to their teaching experience at Modification level, a statistically significant difference was found between participants having less than three years of experience and participants having three to ten, seven to ten and more than ten years of experience at p-values .020, .001 and .046 respectively. A statistically significant difference was also found between participants having three to six years of experience and seven to ten and more than ten years of experience at p-value .004 and .033 respectively.

4.2.5 Designation-Based Comparison of Technology Integration

H_{05} There are no statistical differences among teachers' technology integration while comparing Designations.

The following table explains the difference in technology integration scores of faculty members while comparing their Professional Designation.

Table 4.31a

Technology Integration (Comparison based on Designation) (n_1=552)

Variable	Group (**Designation**)	n_1	Mean	S.D	F	Sig (2-tailed)
Technology Integration	Professor	69	3.63	0.55	4.55	0.004*
	Associate Prof.	84	3.92	0.62		
	Assistant Prof.	191	3.85	0.53		
	Lecturer	208	3.79	0.79		

** p<0.05*

Table 4.39a indicates the analysis of the ANOVA-test. The test compared the technology integration scores of teachers regarding their professional designation. The results were found significant at $F(548,3)=4.55$ where $p=.004$. Therefore, it can be concluded that there was a significant effect of teachers' designation on their competency in technology integration. Hence, hypothesis **H_{05}** 'There are no differences among teachers' technology integration while comparing Designation' is rejected.

The table below explains the Post Hoc Test analysis to assess the statistical differences among teachers' technology integration with respect to their Designation groups.

Table 4.31b

Technology Integration (Tukey's Post Hoc Test Based on Designation) (n_1=552)

Designation	Groups (Designation)	Sig (2-tailed)
Prof.	Associ. Prof.	.045*
	Assist. Prof.	.001**
	Lect.	.002**
Associ. Prof.	Prof.	.045*
	Assist. Prof.	.084
	Lect.	.002**
Assist. Prof.	Prof.	.001**
	Associ. Prof.	.084
	Lect.	.051
Lect.	Prof.	.002**
	Associ. Prof.	.002**
	Assist. Prof.	.051

* *p<0.05*

Table 4.39_b shows the Post Hoc Test analysis to assess the statistical differences among teachers' technology integration with respect to their Designation groups. Results indicated that while comparing technology integration of the participants with respect to their designation, a statistical difference was determined between professors and participants having the designation of associate professor, assistant professor and lecturers at p-values of 0.045, .001 and .002 respectively. A statistical difference was also determined between associate professors and participants having the designation of lecturers at a p-value of .002.

The table below represents the differences in technology integration scores of faculty members while comparing their Designation Group in relation to *'Substitution'* in the backdrop of '*Remembering*'.

H_{05a} There are no statistical differences among teachers in connection with *'Substitution'* in the backdrop of '*Remembering*' while comparing Designations.

Table 4.32

Substitution: Remembering (Comparison based on Designation) (n_1=552)

Variable	Group (Designation)	n_1	Mean	S.D	F	Sig (2-tailed)
Substitution: *Remembering*	Professor	69	4.30	0.65	2.19	.08
	Associate Prof.	84	4.47	0.74		
	Assistant Prof.	191	4.40	0.59		
	Lecturer	208	4.33	0.88		

$* p<0.05$

Table 4.32 indicates the analysis of the ANOVA-test. The test compared the technology integration scores of teachers regarding their designation group in relation to *'Substitution'* in the backdrop of '*Remembering*.' The results were found insignificant at $F(548,3)=2.19$ where $p=.08$. Therefore, it can be concluded that there was no significant effect of teachers' designation on their competency of technology integration in relation to the 'Substitution.' Hence, the Null hypothesis **H_{05a}** 'There are no statistical differences among teachers in connection with *'Substitution' in the backdrop of 'Remembering'* while comparing Designation' is accepted.

The table below represents the differences in technology integration scores of faculty members while comparing their Designation Group in relation to *'Augmentation'* in the backdrop of *'Understanding'* and *'Applying'*.

H_{05b} There are no statistical differences among teachers in connection with *'Augmentation'* in the backdrop of *'Understanding'* and *'Applying'* while comparing Designations.

Table 4.33

Augmentation: Understanding & Applying (Comparison based on Designation) (n_1=552)

Variable	Group (Designation)	n_1	Mean	S.D	F	Sig (2-tailed)
Augmentation: *Understanding & Applying*	Professor	69	4.18	0.62	1.13	0.35
	Associate Prof.	84	4.32	0.68		
	Assistant Prof.	191	4.29	1.06		
	Lecturer	208	4.25	0.67		

$*p<0.05$

Table 4.33 indicates the analysis of ANOVA-test. The test compared the technology integration scores of teachers regarding their designation group in relation to *'Augmentation'* in the backdrop of *'Understanding'* and *'Applying'*. The results were insignificant at $F(548,3)=1.13$, where $p=0.35$. Consequently, it can be determined that there was no significant effect of teachers' designation on their competency in technology integration in relation to the 'Augmentation'. Hence, the Null hypothesis **H_{05b}** 'There are no statistical differences among teachers in connection with *'Augmentation' in the backdrop of 'Understanding' and 'Applying'* while comparing Designation' is accepted.

The table below represents the differences in technology integration scores of faculty members while comparing their Designation Group in relation to *'Modification'* in the backdrop of *'Applying', 'Analyzing',* and *'Evaluating'*.

H_{05c} There are no statistical differences among teachers in connection with *'Modification' in the backdrop of 'Applying', 'Analyzing' and 'Evaluating'* while comparing Designations.

Table 4.34_a

Modification: Applying, Analyzing & Evaluating (Comparison based on Designation)

Variable	Group (Designation)	n_1	Mean	S.D	F	Sig (2-tailed)
Modification: *Applying, Analyzing & Evaluating*	Professor	69	3.50	0.76	3.72	0.001*
	Associate Prof.	84	3.75	0.77		
	Assistant Prof.	191	3.70	0.67		
	Lecturer	208	3.68	0.89		

* $p<0.05$

Table 4.34_a indicates the analysis of the ANOVA-test. The test compared the technology integration scores of teachers regarding their designation group in relation to *'Modification'* in the backdrop of *'Applying', 'Analyzing',* and *'Evaluating'*. The results were found significant at $F(548,3)=3.72$ where $p=.001$. Therefore, it can be concluded that there was a significant effect of teachers' designation on their competency in technology integration in relation to the 'Modification'. Hence, the Null hypothesis **H_{05c}** 'There are no statistical differences among teachers in connection with *'Modification' in the backdrop of 'Applying', 'Analyzing' and 'Evaluating'* while comparing Designation' is rejected.

The following table explains the Post Hoc Test analysis to assess the statistical differences among teachers' technology integration with respect to their designation groups in relation to the third level of SAMR model i.e. Modification.

Table 4.34b

Modification (Tukey's Post Hoc Test Based on Designation) (n_1=552)

Designation	Groups (Designation)	Sig (2-tailed)
Prof.	Associ. Prof.	.048*
	Assist. Prof.	.001**
	Lect.	.004**
Associ. Prof.	Prof.	.048*
	Assist. Prof.	.09
	Lect.	.004**
Assist. Prof.	Prof.	.001**
	Associ. Prof.	.09
	Lect.	.053
Lect.	Prof.	.004**
	Associ. Prof.	.004**
	Assist. Prof.	0.53

* *$p<0.05$*

Table 4.34b shows the Post Hoc Test analysis to assess the statistical differences among teachers' technology integration with respect to their designation groups in relation to the third level of SAMR model i.e. Modification. Results indicated that while comparing technology integration of the participants with respect to their designation at Modification level, a statistical difference was determined between professors and participants having the designation of associate professors, assistant professor, and lecturers at p-values .048, .001 and .004 respectively. A statistical difference was also determined between associate professors and lecturers at a p-value of .004.

The table below represents the differences in technology integration scores of faculty members while comparing their Designation Group in relation to *'Redefinition'* in the backdrop of '*Evaluating'* and '*Creating*'.

H_{05d} There are no statistical differences among teachers in connection with *'Redefinition' in the backdrop of 'Evaluating' and 'Creating'* while comparing Designations.

Table 4.35$_a$

Redefinition: Evaluating & Creating (Comparison based on Designation) (n_1=552)

Variable	Group (Designation)	n_1	Mean	S.D	F	Sig (2-tailed)
Redefinition: *Evaluating & Creating*	Professor	69	3.25	0.63	3.39	.001*
	Associate Prof.	84	3.40	0.77		
	Assistant Prof.	191	3.36	0.85		
	Lecturer	208	3.29	0.62		

** $p<0.05$*

Table 4.35$_a$ indicates the analysis of the ANOVA-test. The test compared the technology integration scores of teachers regarding their designation group in relation to *'Redefinition'* in the backdrop of '*Evaluating'* and '*Creating*'. The results were significant at $F(548,3)=3.39$ where $p=.001$. Therefore, it can be concluded that there was a significant effect of teachers' designation on their competency in technology integration in relation to the 'Redefinition'. Hence, the Null hypothesis **H_{05d}** 'There are no statistical differences among teachers in connection with *'Redefinition' in the backdrop of 'Evaluating' and 'Creating'* while comparing Designation' is rejected.

The table below represents Post Hoc Test analysis to assess the statistical differences among teachers' technology integration with respect to their designation groups in relation to the fourth level of SAMR model, i.e. Redefinition.

Table 4.35b

Redefinition (Tukey's Post Hoc Test Based on Designation) (n_1=552)

Designation	Groups (Designation)	Sig (2-tailed)
Prof.	Associ. Prof.	.081
	Assist. Prof.	.001**
	Lect.	.045*
Associ. Prof.	Prof.	.081
	Assist. Prof.	.040
	Lect.	.015
Assist. Prof.	Prof.	.001**
	Associ. Prof.	.040
	Lect.	.054
Lect.	Prof.	.045*
	Associ. Prof.	.015
	Assist. Prof.	.054

* *p<0.05*

Table 4.35b shows the Post Hoc Test analysis to assess the statistical differences among teachers' technology integration with respect to their designation groups in relation to the fourth level of the SAMR model, i.e. Redefinition. Results indicated that while comparing technology integration of the participants with respect to their designation at Modification level, a statistical difference was found between professors and assistant professors and lecturers at p-values of .001 and .045 respectively.

4.2.6 Discipline-Based Comparison of Technology Integration

H_{06} There are no statistical differences among teachers' technology integration while comparing Disciplines.

The following table explains the difference in technology integration scores of faculty members while comparing their Disciplines (Social Sciences and Management Sciences).

Table 4.36

Technology Integration (Comparison of Disciplines) (n_1=552)

Variable	Group (**Discipline**)	n_1	Mean	S.D	*t*	*df*	Sig (2-tailed)	Cohen's d
Technology Integration	Social Sci.	220	3.79	0.72	3.99	550	.000*	0.35
	Management Sci.	332	3.92	0.58				

* $p<0.05$

Table 4.36 indicates the comparative analysis of technology integration on the basis of discipline. The test compared the technology integration scores of SS and MS teachers. The results were found significant at $t(550)=3.99$ where $p=.000$. Therefore, there exists a significant difference in technology integration between SS (Mean=3.79, S.D=0.72) and MS (Mean=3.92, S.D=0.58) teachers. Results also indicate that MS teachers (Mean=3.92) have significantly higher competency toward technology integration than SS teachers (Mean=3.79). The effect size was found at 0.35, which indicates a Medium effect size. Hence, the hypothesis **H_{06}** 'There are no differences among teachers' technology integration while comparing Discipline' is rejected.

H_{06a} There are no statistical differences among teachers in connection with *'Substitution'* in the backdrop of '*Remembering*' while comparing Disciplines.

The following table explains the difference in technology integration scores of faculty members while comparing the Disciplines (Social Sciences and Management Sciences) in relation to *'Substitution'* in the backdrop of '*Remembering*'.

Table 4.37

Substitution: Remembering (Comparison of Disciplines) (n_1=552)

Variable	Group (Discipline)	n_1	Mean	S.D	*t*	*df*	Sig (2-tailed)	Cohen's d
Substitution: *Remembering*	Social Sci.	220	4.40	0.84	2.67	550	.001*	0.25
	Management Sci.	332	4.49	0.74				

* *p<0.05*

Table 4.37 indicates the comparative analysis of *'Substitution'* in the backdrop of '*Remembering*' regarding teachers' discipline. The test compared the teachers' technology integration in relation to the first level of the SAMR model i.e. Substitution among SS and MS teachers. The results were significant at *t*(550)=2.67, where *p=.001*. Therefore, there exists a significant difference in technology integration between SS (Mean=4.40, S.D=0.84) and MS (Mean=4.49, S.D=0.74) teachers. Results also indicate that MS teachers (Mean=4.49) have significantly higher competency toward technology integration than SS teachers (Mean=4.40). The effect size was found at 0.25 which indicates a Medium effect size. Hence, the Null hypothesis **H_{06a}** 'There are no statistical differences among teachers in connection with *'Substitution'* in the backdrop of '*Remembering*' while comparing Discipline' is rejected.

H_{06b} There are no statistical differences among teachers in connection with *'Augmentation'* in the backdrop of *'Understanding'* and *'Applying'* while comparing Disciplines.

The following table explains the difference in technology integration scores of faculty members while comparing the Disciplines (Social Sciences and Management Sciences) in relation to *'Augmentation'* in the backdrop of *'Understanding'* and *'Applying.'*

Table 4.38

Augmentation: Understanding & Applying (Comparison of Disciplines) (n_1=552)

Variable	Group (Discipline)	n_1	Mean	S.D	*t*	*df*	Sig (2-tailed)	Cohen's d
Augmentation: *Understanding & Applying*	Social Sci.	220	4.18	0.76	4.67	550	.001*	0.42
	Management Sci.	332	4.29	0.68				

* *p<0.05*

Table 4.38 indicates the comparative analysis of *'Augmentation'* in the backdrop of *'Understanding'* and *'Applying'* regarding teachers' discipline. The test compared the teachers' technology integration in relation to the second level of SAMR model i.e. Augmentation among SS and MS teachers. The results were significant at *t*(550)=4.67, where *p=.001*. Therefore, there exists a significant difference in technology integration between SS (Mean=4.18, S.D=0.76) and MS (Mean=4.29, S.D=0.68) teachers. Results also indicate that MS teachers (Mean=4.29) have significantly higher competency toward technology integration than SS teachers (Mean=4.18). The effect size was found at 0.42 which indicates a Medium effect size. Hence, the Null hypothesis **H_{06b}** 'There are no statistical differences among teachers in connection with *'Augmentation'* in the backdrop of *'Understanding'* and *'Applying'* while comparing Discipline' is rejected.

H_{06c} There are no statistical differences among teachers in connection with *'Modification' in the backdrop of 'Applying', 'Analyzing' and 'Evaluating'* while comparing Disciplines.

The following table explains the difference in technology integration scores of faculty members while comparing the Disciplines (Social Sciences and Management Sciences) in relation to *'Modification'* in the backdrop of *'Applying', 'Analyzing'* and *'Evaluating'*.

Table 4.39

Modification: Applying, Analyzing & Evaluating (Comparison of Disciplines) (n_1=552)

Variable	Group (Discipline)	n_1	Mean	S.D	*t*	*df*	Sig (2-tailed)	Cohen's d
Modification: *Applying, Analyzing & Evaluating*	Social Sci.	220	3.60	0.81	3.39	550	.001*	0.30
	Management Sci.	332	3.72	0.66				

** p<0.05*

Table 4.39 indicates the comparative analysis of *'Modification'* in the backdrop of *'Applying', 'Analyzing'* and *'Evaluating'* regarding teachers' discipline. The test compared the teachers' technology integration in relation to the second level of the SAMR model i.e. Modification among SS and MS teachers. The results were significant at $t(550)=3.39$, where $p=.001$. Therefore, there exists a significant difference in technology integration between SS (Mean=3.60, S.D=0.81) and MS (Mean=3.72, S.D=0.66) teachers. Results also indicate that MS teachers (Mean=3.72) have significantly higher competency toward technology integration than SS teachers (Mean=3.60). The effect size was found at 0.30, which indicates a Medium effect size. Hence, the Null hypothesis **H_{06c}** 'There are no statistical differences among teachers in connection with *'Modification' in the backdrop of 'Applying', 'Analyzing' and 'Evaluating'* while comparing Discipline' is rejected.

H_{06d} There are no statistical differences among teachers in connection with *'Redefinition' in the backdrop of 'Evaluating' and 'Creating'* while comparing Disciplines.

The following table explains the difference in technology integration scores of faculty members while comparing the Disciplines (Social Sciences and Management Sciences) in relation to *'Redefinition'* in the backdrop of '*Evaluating'* and '*Creating*'.

Table 4.40

Redefinition: Evaluating & Creating (Comparison of Disciplines) (n_1=552)

Variable	Group (Discipline)	n_1	Mean	S.D	*t*	*df*	Sig (2-tailed)	Cohen's d
Redefinition: *Evaluating & Creating*	Social Sci.	220	3.39	0.85	2.95	550	.001*	0.26
	Management Sci.	332	3.44	0.69				

* $p<0.05$

Table 4.40 indicates the comparative analysis of *'Redefinition'* in the backdrop of '*Evaluating'* and '*Creating*' regarding teachers' discipline. The test compared the teachers' technology integration in relation to the second level of SAMR model i.e. Redefinition among SS and MS teachers. The results were significant at $t(550)=2.95$, where $p=.001$. Therefore, there exists a significant difference in technology integration between SS (Mean=3.39, S.D=0.85) and MS (Mean=3.44, S.D=0.69) teachers. Results also indicate that MS teachers (Mean=3.44) have significantly higher competency toward technology integration than SS teachers (Mean=3.39). The effect size was found at 0.26, which indicates a Medium effect size. Hence, the Null hypothesis **H_{06d}** 'There are no statistical differences among teachers in connection with *'Redefinition' in the backdrop of 'Evaluating' and 'Creating'* while comparing Discipline' is rejected.

4.2.7 Age-Based Comparison of Technology Integration

H_{07} There are no statistical differences among teachers' technology integration while comparing Age.

The following table explains the difference in technology integration scores of faculty members while comparing their Ages.

Table 4.41_a

Technology Integration (Comparison based on Age) (n_1=552)

Variable	Group (**Age**)	n_1	Mean	S.D	F	Sig (2-tailed)
Technology Integration	< 30	105	3.86	0.53	3.34	.001*
	31 – 40	240	3.92	0.48		
	41 – 50	187	3.69	0.59		
	50<	20	3.51	0.95		

* $p<0.05$

Table 4.41_a indicates the analysis of ANOVA-test. The test compared the technology integration scores of teachers regarding their age. The results were significant at $F(548,3)=3.34$, where $p=.001$. Therefore, it can be concluded that there was a significant effect of teachers' age on their competency in technology integration. Hence, hypothesis **H_{07}** 'There are no differences among teachers' technology integration while comparing Age,' is rejected.

The table below explains the Post Hoc analysis to assess the statistical differences among teachers' technology integration with respect to their Age groups.

Table 4.41b

Technology Integration (Tukey's Post Hoc Test Based on Age) (n_1=552)

Age (Years)	Groups (Age)	Sig (2-tailed)
	31 – 40	.041*
<30	41 – 50	.001**
	50<	.001**
	< 30	.041*
31 – 40	41 – 50	.033*
	50<	.049*
	< 30	.001**
41 – 50	31 – 40	.033*
	50<	.06
	< 30	.001**
50<	31 – 40	.049*
	41 – 50	.06

* *$p<0.05$*

Table 4.41b shows the Post Hoc analysis to assess the statistical differences among teachers' technology integration with respect to their age groups. Results indicated that while comparing technology integration of the participants with respect to their age, a statistically significant difference was found between participants having ages ranging from upto 30 and participants having ages ranging from 31-40, 41-50 and more than 50 years at p-values 0.041, .001 and .001 respectively. A statistically significant difference was also found between participants having ages ranging from 31-40 and those ranging from 41-50 and more than 50 years at p-values of .033 and .049 respectively.

The table below represents the differences in technology integration scores of faculty members while comparing their Age Groups in relation to *'Substitution'* in the backdrop of '*Remembering*'.

H_{07a} There are no statistical differences among teachers in connection with *'Substitution' in the backdrop of 'Remembering'* while comparing Age.

Table 4.42

Substitution: Remembering (Comparison based on Age) (n_1=552)

Variable	Group (Age)	n_1	Mean	S.D	F	Sig (2-tailed)
Substitution: *Remembering*	< 30	105	4.35	0.73	2.11	0.08
	31 – 40	240	4.49	0.73		
	41 – 50	187	4.48	0.74		
	50<	20	4.31	1.01		

* *p<0.05*

Table 4.42 indicates the analysis of ANOVA-test. The test compared the technology integration scores of teachers regarding their age group in relation to *'Substitution'* in the backdrop of '*Remembering*'. The results were insignificant at $F(548,3)=2.11$, where $p=0.08$. Consequently, it can be determined that there was no significant effect of teachers' age on their competency in technology integration in relation to the 'Substitution.' Hence, the Null hypothesis **H_{07a}** 'There are no statistical differences among teachers in connection with *'Substitution' in the backdrop of 'Remembering'* while comparing Age' is accepted.

The table below represents the differences in technology integration scores of faculty members while comparing their Age Groups in relation to *'Augmentation'* in the backdrop of *'Understanding'* and *'Applying'*.

H_{07b} There are no statistical differences among teachers in connection with *'Augmentation' in the backdrop of 'Understanding' and 'Applying'* while comparing Age.

Table 4.43

Augmentation: Understanding & Applying (Comparison based on Age) (n_1=552)

Variable	Group (Age)	n_1	Mean	S.D	F	Sig (2-tailed)
Augmentation: *Understanding & Applying*	< 30	105	4.15	0.66	1.12	0.33
	31 – 40	240	4.32	0.67		
	41 – 50	187	4.27	1.06		
	50<	20	4.08	0.62		

$* p<0.05$

Table 4.43 indicates the analysis of ANOVA-test. The test compared the technology integration scores of teachers regarding their age group in relation to *'Augmentation'* in the backdrop of *'Understanding'* and *'Applying'*. The results were insignificant at $F(548,3)=1.12$ where $p=0.33$. Consequently, it can be determined that there was no significant effect of teachers' age on their competency in technology integration in relation to the 'Augmentation'. Hence, the Null hypothesis **H_{07b}** 'There are no statistical differences among teachers in connection with *'Augmentation' in the backdrop of 'Understanding' and 'Applying'* while comparing Age' is accepted.

The table below represents the differences in technology integration scores of faculty members while comparing their Age Groups in relation to *'Modification'* in the backdrop of *'Applying', 'Analyzing',* and *'Evaluating'*.

H_{07c} There are no statistical differences among teachers in connection with *'Modification' in the backdrop of 'Applying', 'Analyzing' and 'Evaluating'* while comparing Age.

Table 4.44$_a$

Modification: Applying, Analyzing & Evaluating (Comparison based on Age) (n_1=552)

Variable	Group (Age)	n_1	Mean	S.D	F	Sig (2-tailed)
Modification: *Applying, Analyzing & Evaluating*	< 30	105	3.70	0.60	3.76	.001*
	31 – 40	240	3.77	0.55		
	41 – 50	187	3.62	0.68		
	50<	20	3.54	1.06		

* *p<0.05*

Table 4.44$_a$ indicates the analysis of ANOVA-test. The test compared the technology integration scores of teachers regarding their age group in relation to *'Modification'* in the backdrop of *'Applying', 'Analyzing',* and *'Evaluating'*. The results were significant at $F(548,3)=3.76$, where $p=.001$. Therefore, it can be concluded that there was a significant effect of teachers' age on their competency in technology integration in relation to the 'Modification'. Hence, the Null hypothesis **H_{07c}** 'There are no statistical differences among teachers in connection with *'Modification' in the backdrop of 'Applying', 'Analyzing' and 'Evaluating'* while comparing Age' is rejected.

The table below represents the Post Hoc results to determine the statistical differences among teachers' technology integration with respect to their designation groups in relation to the third level of the SAMR model, i.e. Modification.

Table 4.44_b

Modification (Tukey's Post Hoc Test Based on Age) (n_1=552)

Age (Years)	Groups (Age)	Sig (2-tailed)
	31 – 40	.033*
< 30	41 – 50	.041*
	50<	.001**
	< 30	.033*
31 – 40	41 – 50	.048*
	50<	.001**
	< 30	.041*
41 – 50	31 – 40	.048*
	50<	.045*
	< 30	.001**
50<	31 – 40	.001**
	41 – 50	.045*

* *p<0.05*

Table 4.44_b shows the Post Hoc analysis to assess the statistical differences among teachers' technology integration with respect to their age groups in relation to the third level of the SAMR model i.e. Modification. Results indicated that a statistically significant difference was found between participants having ages ranging from upto 30 and participants having their age ranging from 31-40, 41-50 and more than 50 years at p-values .033, .041 and .001 respectively. A statistically significant difference was also found between participants having ages ranging from 31-40 and participants having ages ranging from 41-50 and more than 50 years at p-value .048 and .001 respectively. Furthermore, a statistically significant difference was also found between participants having their ages ranging from 41-50 and more than 50 years at a p-value of .045.

The table below represents the differences in technology integration scores of faculty members while comparing their Age Groups in relation to *'Redefinition'* in the backdrop of '*Evaluating'* and '*Creating*'.

H_{07d} There are no statistical differences among teachers in connection with *'Redefinition' in the backdrop of 'Evaluating' and 'Creating'* while comparing Age.

Table 4.45$_a$

Redefinition: Evaluating & Creating (Comparison based on Age) (n_1=552)

Variable	Group (Age)	n_1	Mean	S.D	F	Sig (2-tailed)
Redefinition: *Evaluating & Creating*	< 30	105	3.37	0.65	4.51	.001*
	31 – 40	240	3.44	0.51		
	41 – 50	187	3.32	0.70		
	50<	20	3.28	0.95		

** p<0.05*

Table 4.45$_a$ indicates the analysis of ANOVA-test. The test compared the technology integration scores of teachers regarding their age group in relation to *'Redefinition'* in the backdrop of '*Evaluating'* and '*Creating*.' The results were significant at $F(548,3)=4.51$, where $p=.001$. Therefore, it can be concluded that there was a significant effect of teachers' age on their competency in technology integration in relation to the 'Redefinition'. Hence, the Null hypothesis **H_{07d}** 'There are no statistical differences among teachers in connection with *'Redefinition' in the backdrop of 'Evaluating' and 'Creating'* while comparing Age' is rejected.

The table below represents the Post Hoc results to determine the statistical differences among teachers' technology integration with respect to their age groups in relation to the fourth level of SAMR model, i.e. Redefinition.

Table 4.45$_b$

Redefinition (Tukey's Post Hoc Test Based on Age) (n_1=552)

Age	Groups (Age)	Sig (2-tailed)
< 30	31 – 40	.040*
	41 – 50	.049*
	50<	.001**
31 – 40	< 30	.040*
	41 – 50	.045*
	50<	.001**
41 – 50	< 30	.049*
	31 – 40	.045*
	50<	.046*
50<	< 30	.001**
	31 – 40	.001**
	41 – 50	.046*

$^*p<0.05$

Table 4.45$_b$ shows the Post Hoc analysis to assess the statistical differences among teachers' technology integration with respect to their age groups in relation to the fourth level of the SAMR model i.e. Redefinition. Results indicated that a statistically significant difference was found between participants having ages ranging from up to 30 and participants having ages ranging from 31-40, 41-50 and more than 50 years at p-values .040, .049 and .001 respectively. A statistically significant difference was also found between participants having ages ranging from 31-40 and those ranging from 41-50 and more than 50 years at p-value .045 and .001 respectively. Furthermore, a statistically significant difference was also found between participants' ages ranging from 41-50 and more than 50 years at a p-value of .046.

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Section IV:

4.3 Thematic Analysis

Objective 3- To explore the views of heads regarding faculty competence towards technology integration.

4.3.1 Teachers' Technology Integration in Classroom

Interview Question 1-How do you describe your teachers' technology integration in their classroom? Considering the SAMR Model as a guide.

Substitution: Using Word processing software to replace paper work etc.

Augmentation: Creating lessons using digital tools etc.

Modification: Using Blog/LMS to give feedback on writing etc.

Redefinition: Using video conferencing tools etc.

4.3.1.1 Themes Emerged

Through analysis and coding of interview question 1, the following themes have emerged.

Teachers' Meaning of the SAMR Levels

The first obtained theme was the subjective interpretation of the model. Participants were of the view that Redefinition is the highest level but teachers are not required to design each lesson at that level. The choice of the level depends on the teachers' expectation and their instructional practices.

One of the heads from Public Sector University mentioned that:

"Faculty may require relevant professional support and training to use any pedagogical model in a proper way. Teachers are sometimes not adequately prepared. For SAMR…there is a chance that faculty may not use appropriate tools for any particular level. Mainly teachers use technology at the substitution and augmentation levels…"

One of the department heads from Private Sector University mentioned that:

"To me… SAMR model seems complex in a way that….all instructors must start progressing towards Redefinition. Substitution or Augmentation represents 50% of their

effort which is merely the enhancement phase. I think instructors may feel a disappointed if they don't achieve modification or redefinition. I am also sure instructors don't understand the importance of Redefinition level. If they don't achieve the upper level, then there might be a feeling of failure. Anyways I observe the modification level clearly here…."

Greater Learning at the higher Levels (M&R)

Participants mentioned that SAMR model is an ongoing process that provides better instructional options for the students. The tech-savvy learners can engage themselves in more meaningful ways. The consensus of the participants was that SAMR model enables a growth mindset for faculty and students.

In the public sector university, one of the department heads mentioned that

"My views about the SAMR are slightly different… If teachers frequently refer to the model, I think they will lose focus. Therefore, the model should be the impression of; what teachers can do better. How can they continue to go next level up? I think teachers are at the modification level…."

One Head of Private Sector indicated that

"My prior attention is that faculty may see redefinition level as the final destination. It is good for the students to perform the tasks that they couldn't do without integrating the technology. But, this is not the end. Our teachers are proficient in practicing at modification and redefinition levels while integrating technology while teaching…."

Increased Student and Teacher Motivation

Participants felt that the appropriate selection and integration of digital tools can increase the motivation level of the students and teachers. The following factors were obtained through the analysis:

- Increased student motivation
- Increased teacher motivation

- Motivation is based on the type of technology

Another public sector Head mentioned that

"I believe that SAMR model adds worth and progress to instructors' thinking pattern in using technology while teaching. For many others, it is a conceptual shift in the teaching process….. In my understanding, the model provides a concise way of presenting the prospects of instruction and technology usage. Faculty in my opinion, is at the augmentation level…"

Whereas a head from private sector mentioned that

"Technology-driven instructional activities can provide diverse learning opportunities, and students can engage in various activities to learn the same concept. Technology integration depends on the level and ability of the students…. However, in my opinion, the post-graduate level requires more technology integration that transfers the whole practice into the transformation phase…"

Student and Teachers Engagement

Student engagement is often referred to as students displaying behaviors critical for learning or the practices that influence their learning (Finn & Pannozzo, 2004). During the interview participants indicated the proper engagement of the students and teachers when technology is utilized.

One of the department heads from Public Sector University claimed that

"The common purpose for teachers is to utilize and integrate the technology, whether at enhancement or transformation phases. The enhancement level can also allow differentiated instruction and a reasonable pace for the students with sufficient technological resources…"

Another department head from Public Sector University asserted that

"Senior Teachers can teach without the technology and be fine. However, teachers

understand that technology can keep the students more engaged and some students are more interested and can learn more when digital resources are utilized the classroom activity. Normally teachers seem to be working at the augmentation level…"

Student Participation

Student participation increases or decreases when a specific type of technology is used. Now student engagement depends on their level of participation.

In a public sector university, one department head reported that

"I would say that with classroom and assignment activities, we can only get to augmentation and substitution level. While the subjects demand more technology, the Modification level can also be achieved. Again it depends on the course requirement, learners' participation and the mode of communication…"

In a private sector university, one department head revealed that

"Our students can also take the outsourcing projects simultaneously with their studies. Creating presentations are making reports for their projects. Teachers are knowledgeable enough regarding technology integration…"

Relevance to students' Career

Technology also increases the relevance of the course to students' careers. Participants mentioned that the 21st century is the century of competition and technology is playing an active role.

In the public sector, a department head informed that

"In my opinion, teachers are working more at the Substitution stage. I wish it is higher. In most cases, the courses required technology integration, especially in online classes. Technology support is often required to assist the smooth functioning and content delivery and future support for career...

One of the heads pointed out that

"We do have research webinars with the collaboration of international researchers around the world. Our departments are researching and collaborating to make students more expert for their field. I believe it could be the combinations of a couple of SAMR levels. This combination could vary from Enhancement to transformation…"

Ease and Accessibility of technology

Another factor of technology integration indicated by participants was the ease and accessibility of proper resources. Technology opens more ways to access the available resources.

Head from Public Sector University informed that

"On a routine basis…, our teachers employ technology-driven educational activities within classrooms. These instructional activities probably fall in the modification and redefinition levels based on the situation…"

Another private sector head disclosed that

"The common purpose for teachers is to utilize and integrate the technology, whether at enhancement or transformation phases. The enhancement level can also allow differentiated instruction and a reasonable pace for the students with sufficient technological resources…"

Ease of finding appropriate resources

In addition to the access to relevant resources, participants also reported that technology also helps the teacher to find relevant resources to deliver different concepts of learning.

One of the heads from Public Sector University mentioned that

"Technology-driven instructional activities can provide diverse learning opportunities, and students can engage in various activities to learn the same concept. Technology integration depends on available resources the level and ability of the

students….”

One of the department heads from Private Sector University mentioned that

“Mostly teachers utilize technology-driven educational activities within their online classrooms using appropriate technology. Routinely the teachers implement the Enhancement level, i.e., Substitution or Augmentation. Implementing the technology in instructional activities at higher two levels requires more knowledge to integrate the technology within classrooms successfully…”

Improved Instruction

The qualitative data also showed that participants believe technology allows teachers to differentiate instruction easily. Through which they can easily reach individualized student learning and it also allows greater access to the content.

In the public sector university, one of the department heads mentioned that

“I can express my beliefs of the framework as “it is concurrent with the instructional process…” I feel that as the instruction proceeds, faculty members can choose to modify the technology integration according to the need of the students.”

One Head of Private Sector indicated that

“I observe that SAMR model is exceptionally valuable for our institution. As you know…these days, institutions pay attention to learner-based and skill-based instruction and use of technology. This tool provides teachers at higher education level opportunities to propagate, equip and monitor the learners…”

Ability to monitor student progress

Participants indicated that online learning had opened many ways of technology integration. Teachers can monitor learners’ progress through a tool provided by the learning management system.

Another public sector Head mentioned that

"The model is valuable in the sense that we can lead teachers to increasing use of digital tools in educational settings. Moreover, the better deployment of the digital tools would ultimately lead to improved learning outcomes and student progress…"

Whereas a head from private sector mentioned that

"Teachers seem comfortable staying at substitution and augmentation level. It ultimately justifies their assessment criteria. In teachers' evaluation form at the end of term…there is one checkbox that says "Use of technology and ICT in teaching".

Reaching more students

Through the enhancement of lessons, realistic pictures, and better and larger presentation of the content teachers can reach more students including online learners. Technology also provides various opportunities for greater learning of the content for teachers and learners.

One of the department heads from Public Sector University claimed that

"I would like to comment that…., teachers under my supervision who assign technology-driven work also give an alternative assignment for those learners who do not have hands on experience of appropriate digital tools. For example, in pandemics, remote area students face various technology-related problems. For those students, less interactive sessions are organized…"

Another department head from Public Sector University asserted that

"Technology adoption is challenging for some teachers. The SAMR is viable for utilizing digital tools in the instructional /learning process and assessing the tool usage. With the suitable technology teachers can cope up with individual differences among students…"

Enhanced Content Presentation

Through the integration of various digital tools, it is now easier for the educators to present the content in more productive ways. Technology such as Smartboards, multi-media, digital cameras etc. also allows online students to view the same learning material simultaneously.

In a public sector university, one department head reported that

"SAMR is a feasible tool for instructors who have rare experience of using digital tools in their teaching. The tool provides with a path from where to start and where to go. I mean it can give them something tangible that they can say "Teachers can understand they proceed with instructional material and as far as they integrate digital tools…"

In a private sector university, one department head revealed that

"According to my experience teachers can work at the modification level but in some cases, the redefinition level is also achieved. This model I would say…. "Can be helpful for teachers' self-assessment and debate related to enriching learning through technology…"

Increased access to the curriculum

Technology allows increased availability to the course content for learners with different abilities. Incorporating technology during lectures allows learners to engage in the instructional process, thereby providing more access to the curriculum.

In the public sector, a department head informed that

"In my opinion…. as teachers get towards transformation phase of model, they can create more authentic teaching-learning material for students. This allows greater engagement of the students and genuine practice of 21st century skills…"

One of the heads pointed out that

"The SAMR framework is an exceptional apparatus for tutors assessing their practices. It precisely links to the technology usage in teaching. The majority of teachers integrate technology at first two levels of the model. It mainly serves the purpose. Technology is normally used for the sake of use or because it is enjoyable for the students."

Figure 18: Word-Cloud for Teachers' Technology Integration

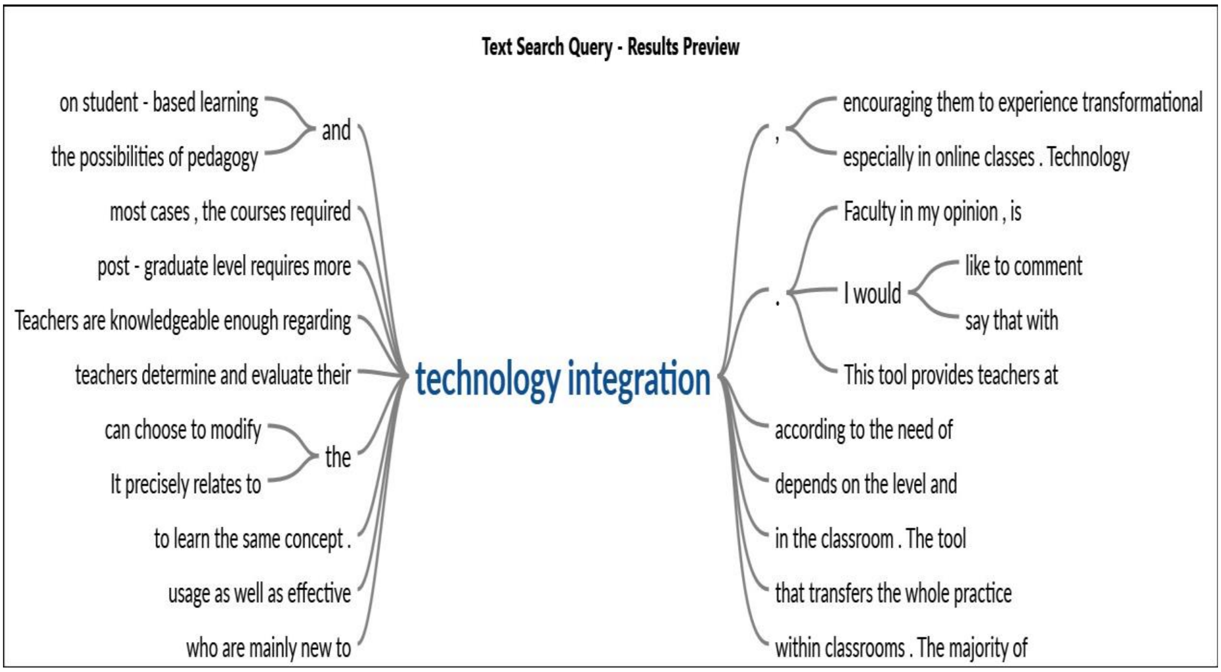

Figure 19: Word Tree for Teachers' Technology Integration

Figure 18 and 19 indicate the NVivo query results for word cloud and word tree for the responses of heads regarding teachers' technology integration in their classroom at higher education level.

4.3.2 Transformation of Teachers' Practices

Interview Question 2- How does technology integration transform teachers' instructional practices?

4.3.2.1 Themes emerged

Through analysis and coding of interview question 2, the following themes have emerged

Concerns with the SAMR model

The theme that emerged from participants' views is their concern with the model. The participants think that the SAMR model can measure the growth of learning. SAMR model depicts necessity to achieve transformation in learning. Integration of technology can also predict the competencies of the teachers.

One of the heads from Public Sector University mentioned that

"I feel like….adoption of the SAMR model somehow needs additional training and support for the teachers to use it properly. Teachers sometimes are not suitably prepared. My concern is that teachers may integrate technology at a level that may not be suitable for the goals of the particular course unit."

One of the department heads from Private Sector University commented that

"I would like to say…… that teachers may integrate technology according to the lesson requirement but achieving the Redefinition level may not always be suitable. Redefinition level …..In my opinion…. Is not suitable for learning new material and new skills. It is probably more suitable and appropriate when a learner is dealing with already learned material."

Correct Use of SAMR

The SAMR model demands reasonable competency of the faculty to use digital tools in learning process. The framework holds reservations about its proper use. In most cases, implementation of SAMR can only be possible with the proper structure of the educational settings.

In the public sector university, one of the department heads mentioned that

"I think……training before adopting a new model could help with technology integration. Probably….. through training, teachers may efficiently integrate technology in a more meaningful way."

One Head of Private Sector indicated that

"If I had a question about how SAMR model can transform teachers' technology integration……, I would immediately know that training is a necessary element before they start with the model. Just like the old-fashioned technique of instruction….. not every faulty member is aware of the transition from concrete to abstract."

Various Uses of Technology

Another theme that developed from the heads' views was various purposes for using technology. Teachers these days are using various technologies to accomplish their tasks. The type of digital tool is linked with content area, the objectives of the unit/lesson, and the grouping of the learners. For example websites and software like SPSS, FastMath, EViews, NNivo, Stata etc.

Another public sector Head mentioned that

"Teacher in lockdown due to COVID-19 are very much engaged with technology e.g. using Google Docs, Zoom, Google Meets, etc. these days teachers are utilizing digital tools at advanced phases of the SAMR, because of the improved instruction. Documents are frequently shared online. In my opinion, the basic usage of any Google application can be placed at augmentation. They can be doing their work on paper or on a spreadsheet that is shared among others. Few teachers prefer the substitution level because it allows simple ways to integrate technology."

Whereas a head from private sector mentioned that

"The most common type of technology integration is substitution. But these days the COVID pandemic has changed the scenario. Majority of teachers prefer working on digital worksheets and posting the learning material on LMS. Now teachers are putting their effort into a digital manner. Teachers prefer digital platforms."

Ways of Learning about technology

The usage of technology requires a little bit of awareness and learning about the digital tool that teachers are dealing with. The ways teachers can learn about the usage or incorporation of technology are through training, communication and collaboration with colleagues, and self-teaching (tutorials etc.).

One of the department heads from Public Sector University claimed that

"In my experience, when teachers think about making a lesson plan, they simultaneously think about the activities to integrate with the lesson, and the type of skills involved. What actually essential is all about the traditional learning requirements. I think these days there is so much burden on the instructors to use digital media in their instruction. Mainly instructors prefer augmenting but in online teaching, the middle two levels are involved…"

Another department head from Public Sector University asserted that

"Before online learning, the most common technology utilization was at the augmentation stage. The first stage of model is the basic level teachers mostly use just to meet the subject demand. For example, PowerPoint, Google Docs etc. have already replaced the traditional ways to use digital means. In recent teaching climate, it is essential for instructors to use technology…"

Self-Teaching

Participants mentioned that teachers mostly learn about the new technology through exploring that particular technology. Teachers spend time outside the institution researching ways to incorporate technology in their teaching.

In a public sector university, one department head reported that

"Todays' technology integration has really transformed instructional practices in higher education. The use of LMS these days can easily provide room for integrating the technology. The resources these days can easily allow teachers to move up to the next level when needed."

In a private sector university, one department head revealed that

"In my view, teachers in my department are competent enough to use technology. I must indicate that they feel comfy integrating digital tools at transformation level. It also has transformed their practices and given them enough expertise to use the technological resources in different ways…"

Self-Motivation

The technology integration process increases the teachers' self-motivation toward the learning process that encourages digital tools. When a new technology or new website comes out, teachers often seem curious about exploring that technology.

In the public sector, a department head informed that

"In most cases, teachers in the online classroom are working at a style that matches the redefinition level because their teaching is more focused on student-centered activities. However, they are not strictly trained to adopt the SAMR model but they are practicing it very well. Most teachers have one-to-one technology experience but they never really focused on any model specifically. I personally think that they are proficiently working with digital tools…"

One of the heads pointed out that

"In my opinion, teachers' state of comfort with technology may rarely be aligned with age and years of experience. These days project-based and student-centered learning

allow technology integration at Redefinition level."

Collaboration with Colleagues

Collaboration with colleagues is also the theme that emerged from the participants' views. It also became the most common method of learning about new technologies. To master the use of particular digital tool teachers often proceed to other colleagues.

Head from Public Sector University informed that

"The substitution level is the natural practice that teachers perform nowadays. Mostly teachers are comfortable at each level. The redefinition level allows instructors to shift the teaching practice in a more meaningful way. Technology integration is more in practice than ever before. Teachers are eager to share their technology experiences with colleagues…"

Another private sector head disclosed that

"Teachers are seem comfortable working with first two phases. Substitution is the most accessible and redefinition is more technical and interesting to work with. Teachers are motivated to integrate technology in educational settings. Technology plays greater role in horizontal and vertical collaboration and communication…"

Professional Development

With the arrival of new technologies, professional development opportunities also increase. Teachers can take part in workshops and informative sessions to increase their understanding of new technology and to assess where they are standing. In most cases, teachers prefer to learn the usage from the tutorials on the internet.

One of the heads from Public Sector University mentioned that

"In my experience…., mostly substitution and rarely augmentation level is utilized by the teachers. Further, it is clear to me that most teachers need more professional development that could gear towards technology learning, technology usage as well as

effective technology integration."

One of the department heads from Private Sector University mentioned that

"Most of the faculty members have inadequate approach towards 21st century teaching and learning areas…an ordinary focus on the content doesn't have any effect on the degree of incorporating technology. In every content, there is wider room for 21st-century skills…but they were not often developed and integrated….the skills may be integrated to the future teachers' professional development and learners' content."

Strategies of Teaching

Strategies of teaching also change with the arrival of new technology. Teachers mainly try to use the traditional method with the technology. However, a specific technology demands a specific skills and methodology of teaching. Participants were of the view that technology also places a greater effect on the instructional methodology.

In the public sector university, one of the department heads mentioned that

"Teachers may need desired amount of time to plan the lesson according to the technology requirement of the level they have chosen for the unit. There should be enough support in terms of resources and infrastructure for teachers to adequately integrate the technology…"

One Head of Private Sector indicated that

"I believe that SAMR model offers a shared and appropriate mechanism that allows teachers to discuss their expertise more efficiently…… I like the model….. it provides a better opportunities to provide a shared path among the learner and the teacher. I see the SAMR framework….. as a resource to design lesson plans, as well as a apparatus to improve the teaching practice."

Grouping of Learners

Participants expressed that the grouping of students may increase their understanding of the lesson unit when there is technology involved in it. However, in an online scenario, the process is different. Every student has to learn according to their own pace.

Another public sector Head mentioned that

"So If I am correct…. Then I feel that every course units may not require Redefinition level. While searching material from internet or performing assignments, a lower level of technology integration can server the purpose. So, there is no hustle to "teach up" every unit, as per the requirements of transformation phase. Making groups of students may improve the content delivery."

Whereas a head from private sector mentioned that

"If we talk about transformation, in some cases for example, while teaching algebra, teachers can only be able to integrate technology at the augmentation level. But for other courses, it can proceed to the next level. In some cases teachers can easily integrate technology at the upper two levels. For example, the teacher is teaching the concept that requires group assignment etc."

Purpose of Lesson with Technology

Participants described that technology integration could serve different purposes depending on how it is incorporated into the lesson. Some of the purposes are assessment, reinforcement of content, reviewing of content as well as the teaching of the content.

One of the department heads from Public Sector University claimed that

"I have enough understanding of necessary digital tools. It is essential with my job. We also had training on how to use various software into teaching. I feel many teachers here are working and feeling comfortable at the modification level. The use of digital tools revolve around demand of the curriculum. Teachers here never hesitate while integrate technology with traditional lessons…."

Another department head from Public Sector University asserted that

"Teachers working under my supervision have expertise of using digital tools ..... at the augmentation level. In my opinion, the level of the audience matters a lot. The SAMR model helps teachers to get their learners engaged in instructional settings. But teachers also put their effort to achieve a Redefinition where the creativity happens."

Teacher Expertise with technology

Teachers these days have different expertise related to the technology they are using. Therefore, teachers also hold a separate level of comfort with certain technology. Teachers' expertise and preference for technology in the lesson can influence how teachers incorporate technology in the lesson.

In a public sector university, one department head reported that

"I believe suitable technology offers an appropriate evaluations tool for student learning. [But] it is clear that where any model could be misinterpreted by [the] administrators or [a] teacher. Every teacher is not capable of integrating the technology at the desired rate. That doesn't mean that they are not a successful, or the rate of student learning in lower."

In a private sector university, one department head revealed that

"The model is a guiding force but apparently model seems to be both a "good servant" and a "bad master". The full fledge application of SAMR is only possible with a proper revolution of the infrastructure. To transform the teaching there is very much necessary for teachers to use the SAMR model properly."

Figure 20: Word-Cloud for Transformation of Instructional Practices

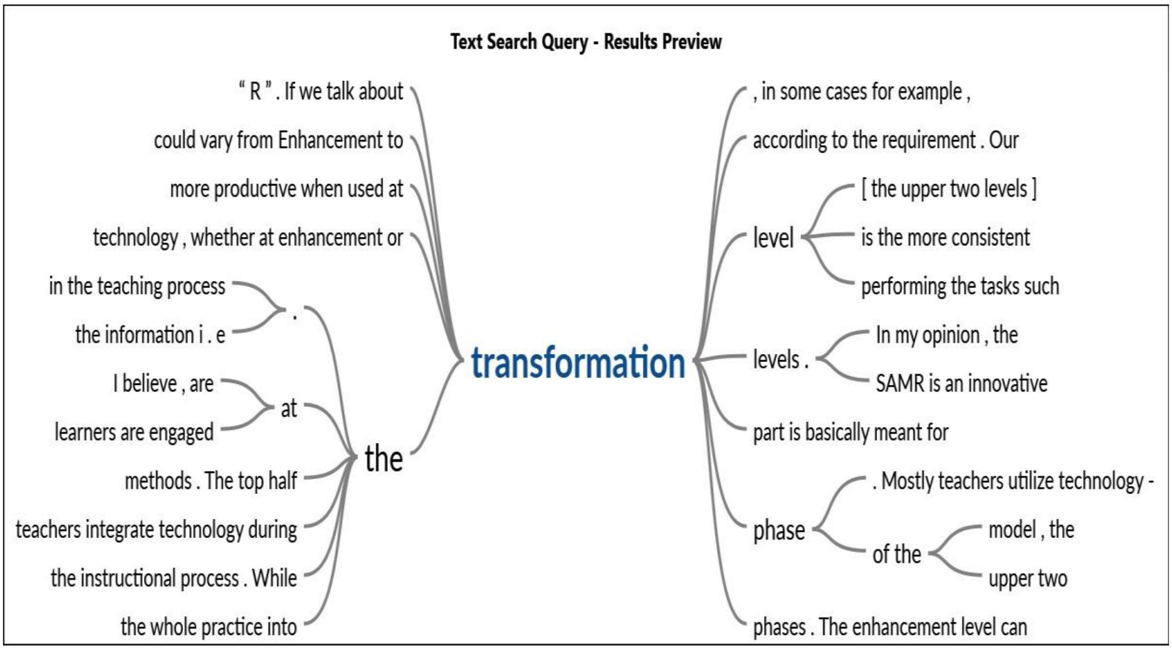

Figure 21: Word-Tree for Transformation of Instructional Practices

Figure 20 and 21 indicate the NVivo query results for word cloud and word tree for the responses of heads regarding transformation of technology integration practices at higher education level.

4.3.3 Technology as an Instructional Tool

Interview Question 3-What are your views on technology as an educational tool?

4.3.3.1 Themes emerged

Through analysis and coding of interview question 3, the following themes have emerged.

Technology as Enhancement

The first theme i.e. technology as enhancement, provided more insight into technology as an enhancement tool. Respondents indicated that instructors use digital tools to enhance their instructional process. Heads mentioned that teachers mostly use Google Classrooms, PowerPoint, GoogleMeet, Khan Academy and YouTube etc.

One of the heads from Public Sector University commented that

"These days in Online Learning, teachers are enthusiastically involved in using LMS and Google Classroom to teach students. The remote learning concept has evolved in the pandemic situation. Most of the teachers incorporate informative videos from YouTube and Khan Academy into their online lectures. Teachers can also record their lectures to serve both asynchronous and synchronous learning. Teachers also prefer converting the PowerPoint slides into Google Slides so they would be compatible with Google applications."

One of the department heads from Private Sector University mentioned that

"Teachers are very much familiar with digital technology nowadays. This is the parameter that we especially address while hiring the faculty for our department. In remote learning [online learning] teachers are frequently making PowerPoints and use Google add-on, voiceover tools, and more importantly visual presentations, and believe me….. when I enter their Zoom Class to assess their teaching, in my opinion, they are becoming more proficient in delivering the actual concept of the study concept"

Technology as Transformation

The second most important theme obtained from the study was a technology as transformation. It means digital tools can be incorporated at the upper two levels of SAMR to reshape the instruction in a meaningful way. SAMR effectively represents a threshold where technology proceeds from enhancement to transformation.

In the public sector university, one of the department heads mentioned that

"Through the Campus's Learning Management System (LMS), teachers can effectively communicate with their students. It is due to the easy interface of the LMS. Teachers feel comfortable providing students the assignments. Again it is effortless to assess the performance of the students when they submit their work back to their teachers. Some of the teachers have the firsthand experience with the online learning and they are finding it more convenient, which ultimately transform their teaching…"

One Head of Private Sector indicated that

"The frequent use of technology increases the learning management skills of the teachers. The online learning also helps students to organize their material for the current study week. LMS also provides the opportunity to schedule the quizzes, assignments, and projects for the students. The remote learning is also feasible because it allows learners to organize their work on Google Sheets…."

Professional training

Another developed theme was the professional training of the teachers. To achieve the transformation level in SAMR and to transform the learning process, reasonable training for teachers is felt necessary. One-time training is insufficient to master the teachers for every aspect of the SAMR model or technology integration.

Another public sector Head mentioned that

"I feel my subordinates are comfortable working at the modification level. In most

cases, many teachers seem comfortably integrate technology at the lower two levels. But for the majority, it is the modification [level]. It again depends on the interest and ability of the teacher, their professional development and technological resources."

Whereas a head from private sector reported that

"The SAMR integration level .....as you already found.....that teachers are more comfortable with.... is varied among the teachers and it includes all four levels of the model. In my opinion, there will be very few teachers who are comfortable with each level of the model. And again very few probably working with the Redefinition level. It again depends on the available resources, infrastructure and most importantly the training of the teachers."

Curriculum integration

Curriculum integration as a theme also appeared in data. Participants mentioned that the use of technology must be compatible with the curriculum. There must be a linkage between the curriculum and instructional technology.

One of the department heads from Public Sector University claimed that

"Teachers here.... Seem expert using technology at the enhancement phase. Teachers always try to add technical functionality to a traditional unit of the course. At the substitution level, teachers don't seem to get many benefits from the model. For most teachers suitable level... in my opinion is modification. Rather using paper, teachers' are working on online excel, they use live digital documents to share and acquire information."

Another department head from Public Sector University asserted that

"Digital tools have definitely reformed the instructional process. Teachers can easily conduct review sessions with their students. Mostly teachers engaged the students in more productive activities during the review sessions. The unit assessment also became easy in the online classes. The assignments of the students are being completed in a timely

manner with the help of LMS."

Curriculum mapping

A continuous process that teachers utilize to enhance the instructional process is called curriculum mapping (Archambault & Masunaga, 2015). Curriculum mapping is a significant theme that obtained from data. Participants mentioned that teachers need to review and revise the curriculum to align the instructional practices with the technology being used.

In a public sector university, one department head reported that

"Teachers utilize the technology in every possible way taking keynotes, using LMS, Google Classroom, Zoom, etc. These practices are widely considered at the enhancement level. Since the start of online learning, teachers can integrate the technology at higher levels. Teachers can create dynamic presentations using Prezi and PearDeck, appealing presentation tools to involve learners in instruction."

In a private sector university, one department head revealed that

"Faculty…… frequently align the content and instructional practices with technology. Students are required to accomplish their assignments and share them as GoogleDocs in the google classroom. Few teachers prefer to upload their pre-recorded lecturers and allow students to take notes and share their views in google classroom. Faculty also instructs the students to use different software/s e.g. SPSS, EViews, Stata, NVivo etc."

Technology coaches

Participants mentioned that the better use of digital tools also faces the disconnection between digital tools and teachers' capacity/competence to use technology in the learning process. So there is a need for recruiting coaches to provide teachers ongoing support for technology integration.

In the public sector, a department head informed that

"Though the course outlines are there teachers have limited time to deploy each and every aspect of classroom management. Focus of the teachers is to complete the course contents and prepare the students for good grades. Most teachers use digital tools to enhance the productivity of the lesson but few of them feel it overwhelming and time-demanding when they utilize digital tools. Technology coaches can play greater role to support teachers…"

One of the heads pointed out that

"When teachers use digital tools, the students seem more interested in the content. The traditional methods for the lesson are less time-consuming they say. The major challenge that teachers face is to integrate the technology at a higher level as well as simultaneously complete the syllabus. Sometimes the content provides less opportunity to integrate technology with the lesson. Here the technology coaches from ICT departments can help…"

Resources and Existing Infrastructure

"Existing infrastructure and resources must support the smooth transformation of learning activities using appropriate digital tools. Participants also focused on the steering of the remote learning process. Teachers are visiting campuses to avail online teaching facilities and to benefit from unique capabilities of technology. So there must be a suitable infrastructure for technology integration."

Head from Public Sector University informed that

"Digital tools are more beneficial when the instructor sees the connection of the curriculum with the technology. Some courses rarely provide an opportunity to indicate where and how digital tools can be utilized to reshape the educational process. The adequate resources are necessary for proper integration…"

Another private sector head disclosed that

"When online learning was initiated entirely due to the COVID pandemic, I was a faculty member at that time. I didn't receive the training but only to use the campus LMS. While collaborating and communicating with my colleagues, I could work with technology more effectively. In my opinion, some teachers still require more resources and infrastructure to take advantage of available digital resources."

Plan for technological professional training

Participants mentioned that technology integration with suitable digital tools could enhance teaching and learning. Plan for the PD is essential to foster individualized technology training for the teachers.

One of the heads from Public Sector University mentioned that

"In some cases, teachers think that the pre-service or job-embedded training that they have received is not sufficient and didn't enable them to use digital tools and technology-mediated instruction to transform their learning. Training is the major factor that keeps some teachers away from technology. ICT department in our university offer training at the start of each semester. I suggest that personalized and ongoing training can help the teacher to foster technology-mediated instruction which ultimately transform the learning process."

One of the department heads from Private Sector University mentioned that

"Digital tools are very handy in the instructional process. But some teachers are not fond of technology so they are sometimes overwhelmed by some digital devices that they should be taking benefit from. The huge challenge to effectively use digital tools is the access to adequate training. While dealing with technology integration some institutions may require comprehensive planning for professional training/development."

Technological changes

Participants mentioned that in the era of technology, frequent changes are happening in the technology domain. Teachers must learn the skills to synchronize each study component into the digital tools.

In the public sector university, one of the department heads mentioned that

"Prior to online learning majority of teachers were comfortable with traditional learning. The technology training at that time was not up to the mark and relatable. Most of the teachers needed fundamental support in technology integration before they started using various digital tools. While in hybrid or online environment, the instructors practiced delivering their lectures using GoogleDocs presentations and taking class on GoogleMeet or in Google classroom."

One Head of Private Sector indicated that

"The technology integration training seems to be minimal. The reason behind this is that it is expected for every teacher to be technologically sound enough to deliver the lecture with the help of digital tools. The emphasis is however placed on technology integration at the Faculty Development Programs after the initial induction process. The professional training is more fixated on the development of the content, models of practices and reading across the curriculum…"

Self-reflection of teachers

Self-reflection is another major theme that emerged from data analysis. As teachers, it is essential for them to communicate and collaborate in a critical way to make an informed decision about the teaching and learning process.

Another public sector Head mentioned that

"Online teaching provides various ways to integrate technology into the instructional process. However, many students found playing games or using social media

very frequently in an online learning session. The teachers frequently measure on-task behavior. Digital devices easily allow users to switch from one application to another. Students can easily distract from learning."

Whereas a head from private sector mentioned that

"Teachers more often highlight different factors that prevent them from integrating digital tools and devices at a higher level of SAMR model. Sometimes they intimidate by technology or sometimes they need training. Being more proficient with technology also depends upon teachers' self-assessment etc."

Technology as a distraction

Participants mentioned that improper integration of technology could distract the learners, which may reduce teachers' technology acceptance and performance of students.

One of the department heads from Public Sector University claimed that

"Digital tools can easily be used during the learning enhancement phases to enhance the instructional settings. The digital tools help teachers foster 21st-century learning skills. But in some cases, the passion for social media and gaming makes it hard to utilize digital tools to enhance student learning …"

Another department head from Public Sector University asserted that

"The teachers frequently use LMS to post lectures, assignments, quizzes and conduct chat discussions. Students are able to create a video tutorial of the task they have performed and share the video in the WhatsApp groups of the class as well as on YouTube. However, the social media applications may distract students' attention from actual learning… Sometimes, teachers ask students to pay attention. Even then, they try to fool around with their devices."

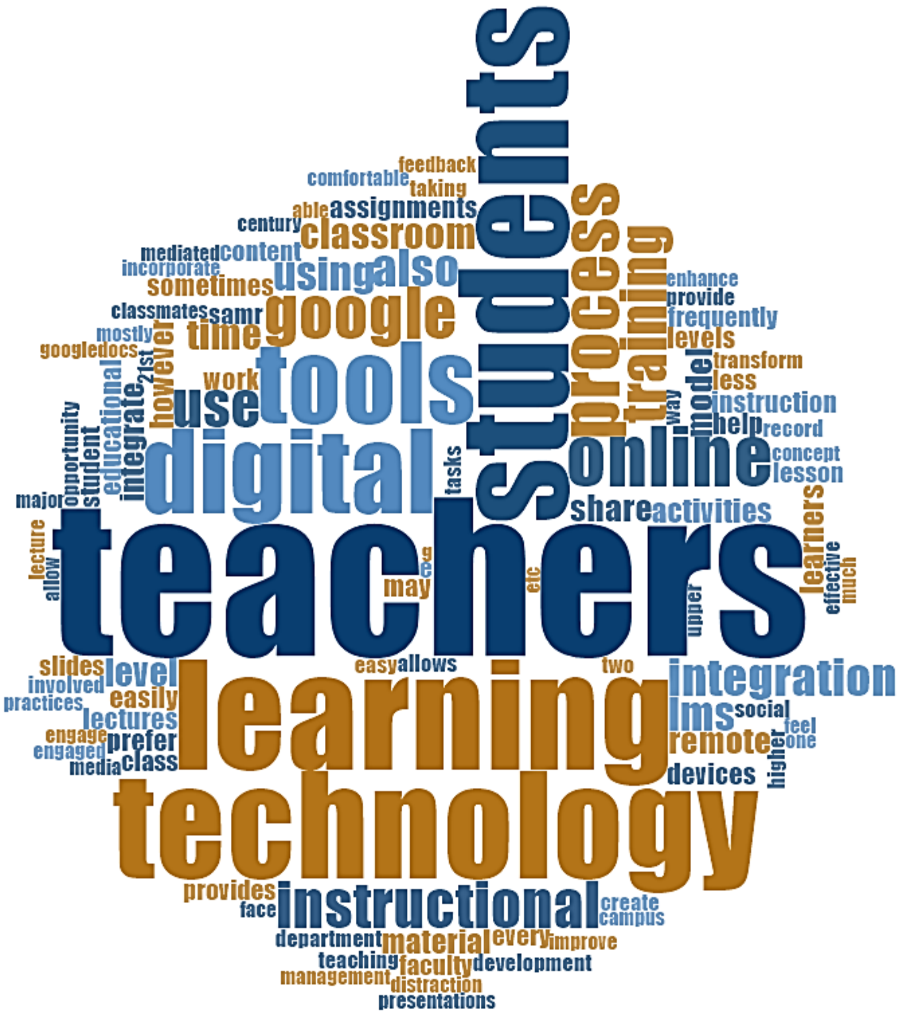

Figure 22: Word-Cloud for Technology as an Educational Tool

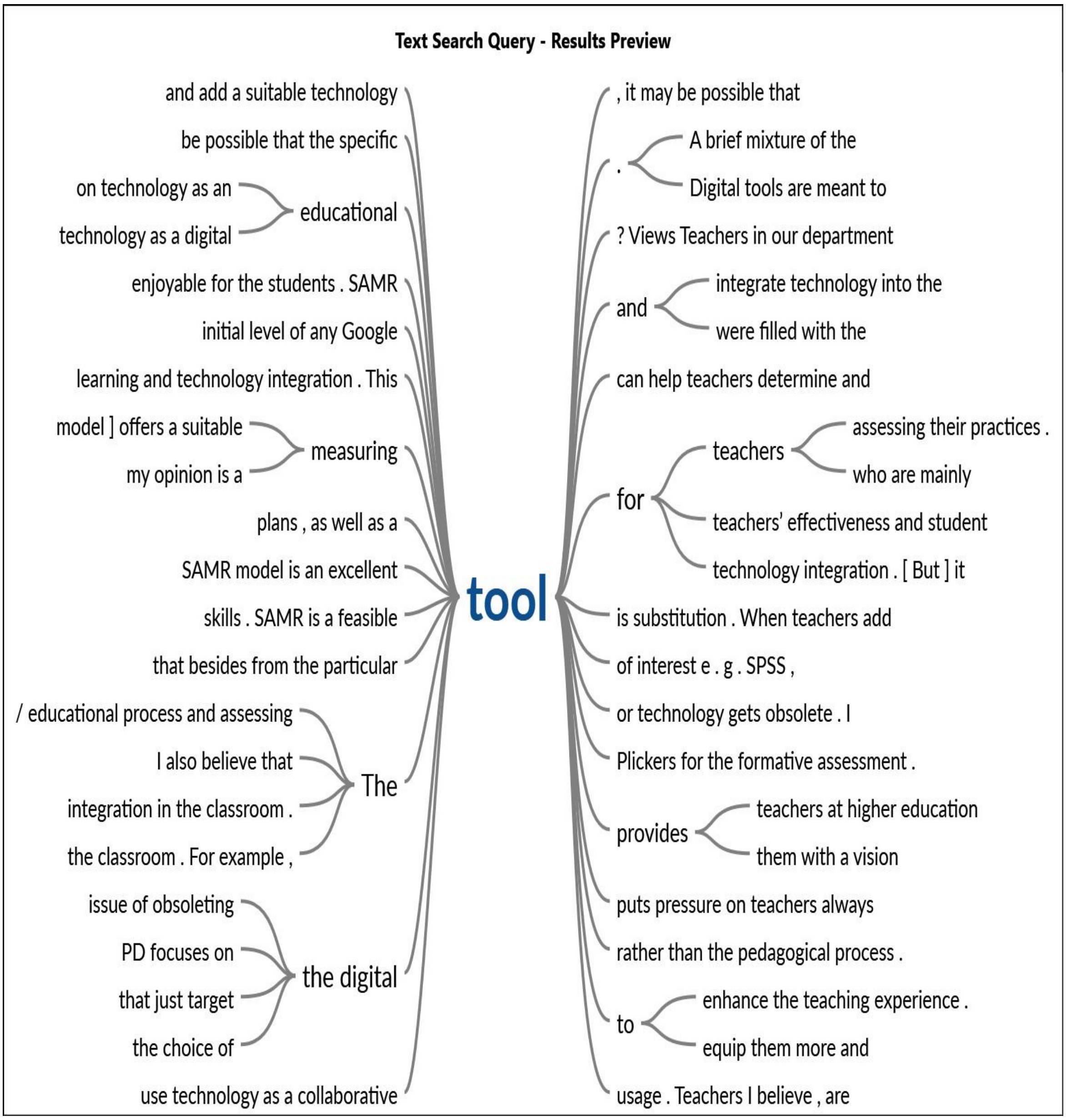

Figure 23: Word-Tree for Technology as an Educational Tool

Figure 22 and 23 indicate the NVivo query results for word cloud and word tree for the responses of heads regarding technology as an educational tool at higher education level.

4.3.4 Technology Integration as a Challenge

Interview Question 4-What challenges can teachers encounter with the implementation of instructional activities based on the SAMR model?

4.3.4.1 Themes emerged

Through analysis and coding of interview question 4, the following themes have emerged

Making it relevant

Relevancy of the SAMR model with instructional activities is the challenge indicated by the participants. Instant feedback process from teachers' side can assure it. To appropriately use digital tools in learning process, teachers must change their instructional practices.

One of the heads from Public Sector University revealed that

"Before the online learning took place teachers were inconsistent with the technology incorporation at the upper levels of SAMR. The teachers frequently use LMS to post lectures, assignments, quizzes and conduct chat discussions. Students are able to create a video tutorial of the task they have performed and share the video in the WhatsApp groups of the class as well as on YouTube."

One of the department heads from Private Sector University mentioned that

"The transformation level is the more consistent level for teachers in this regard. Before the online learning, the scholars were analyzing data through MS Excel, and submit a printed assignment. But now they are able to record the whole process and upload their solutions on YouTube for public view. In remote learning, the learners are engaged at the transformation level performing the tasks such as sharing the GoogleSlides with teachers for their feedback."

Giving up control

The SAMR model demands more activity from teachers and students. Providing more control of learning to the students is also a challenge. Teachers can send additional supporting material to the students. This process can support students' concepts in various ways. Teachers can provide students some control instead of standing and lecturing

In the public sector university, one of the department heads mentioned that

"During online learning, the interaction between teachers and students remains intact. LMS allowed students to access the real-time instructional material on their laptops/devices. It is ensured by the ICT department to generate a login for every registered candidate. The attendance of students is up to the mark. Teachers can prompt the questions regarding the submitted work of the students."

One Head of Private Sector indicated that

"We also encouraged teachers to share the scholarly effort with other students and teachers on campus. Before remote learning, the allied mathematics teachers use GeoGebra to create graphs and equations. Now they prefer using Google Docs for sharing purposes."

Moving to the next level

Teachers can rate themselves in their level of comfort, for example, augmentation. Moving to the next level with suitable technology is a challenge for teachers. For example, moving the learning from a textbook to an iPad. Using the device they can research quickly to find the desired answer. While moving to the next level, teachers need to adjust their practices in relation to the available technology.

Another public sector Head revealed that

"I think the transformation phase is a desirable phase to utilize digital tools. But I don't think every content or lesson should be taught at this level. While relating to the teaching practices and lesson goals, the teacher may integrate any of the suitable levels of SAMR. Some of the teaching activities related to the lower two levels…. in my opinion, can be taught without technology."

Whereas a head from private sector mentioned that

"In most cases, the teacher may be unaware of achieving the redefinition level or they don't know about what the end product looks like at all. Redefinition level is I think the revolution of technology integration. But revolution is different. R level basically demands that you transform the learning. I believe….redefinition level is structurally, difficult for many teachers. While SMA levels are just enhancing the learning."

Complicated interface of software

Getting familiar with the interface of a new device can become a challenge for the learners and instructors. At the same time, taking instruction to the next level or introducing learners to new learning devices. Teachers can design a manual or give students some time to adjust themselves to the new interface they are dealing with.

One of the department heads from Public Sector University claimed that

"Students and teachers sometimes get intimidated by the complicated interface of the software. Faculty also instructs the students to use different software/s e.g. SPSS, EViews, Stata, NVivo etc. through online tutorials or by just taking the screen control using the TeamViewer software."

Another department head from Public Sector University asserted that

"All LMS environments are not the same regarding interface…..Teachers should utilize the technology in every possible way taking keynotes, using LMS, Google Classroom, Zoom, etc. These practices are widely considered at the enhancement level. Teachers may create dynamic presentations using Prezi and PearDeck, appealing presentation tools to involve learners in instruction."

Starting from the basics

Since the technology has enhanced instructional practices, dealing with technology in classroom, the model suggests that teachers can start from the first level of SAMR model and then proceed to the desired level. For some teachers starting from the basics is a challenge due to time constraints or relevancy. Instead of it, a teacher can rather target the desired level of technology integration. Teacher has to plan before integrating technology into the lecture.

In a public sector university, one department head reported that

"The major challenge, in my opinion, is to choose the suitable technology for a particular model. Because they do not realize when and which application to use to perform a particular task. Students can easily distract from lessons while using internet-enabled devices. Students in online learning normally swap their fingers on their social media accounts instead of listening to the lecture."

In a private sector university, one department head revealed that

"Teachers sometimes find themselves trapped in a situation where troubleshooting arises related to the technology they are using. Sometimes if the LMS is not working properly, students lose attention and it is challenging for teachers to get them involved again. If the laptop freezes or for example, there is an issue with the Wi-Fi. If technology integration doesn't work properly then teachers are at a loss. Furthermore, they just try to push any button on the laptop and hope that it will start working."

Inappropriate use

The SAMR model represents a hierarchical approach but the learning process is cyclical. The use of model in appropriate way could become a challenge for some teachers. Teacher can choose certain levels directly and the resources and infrastructure must support the level they are choosing. Model supports individualized learning and student-centered learning.

In the public sector, a department head informed that

"The flipped model was not more successful because students rarely watch the videos prior to class. Most of the teachers scrapped the model after the first trimester. They

felt it was less effective. However, the SAMR model on the other hand, seems handier and provides more control over the learning process."

One of the heads pointed out that

"Digital tools are meant to eventually transform the instructional process, but it sometimes reduces the process. It may cause a distraction for the students. The continuous internet facility may cause distractions in the learning climate. Students may get involved in counterproductive activities. It may happen when the lecture being presented is not engaging or not more interesting. Students may start activities such as gaming and instant messaging…"

Rigidity

The rigidity makes innovation very difficult. Teachers normally try to stay on using traditional ways the first two levels of the model, because they feel comfortable working there. But implementing the Redefinition level requires expertise and is not easy to implement in every institutional structure.

Head from Public Sector University informed that

"The SAMR model adoption with its appropriate level must relate to the methodology and philosophy of the teacher. The teacher-centered classroom just only requires lower levels of Bloom and SAMR. In this case, they face significant challenges while integrating the technology into the learning process. The teacher dealing with a student-centered classroom need a few changes in the method and philosophy to easily and meaningfully integrate the technology at higher levels…"

Another private sector head disclosed that

"It is very appropriate for instructors to utilize any suitable level of SAMR at any time in the lecture. It is a simultaneous process. If students are working at Redefinition level, they also work at substitution level. They are not handwriting their tasks. They are

performing them on their device using a laptop or a tablet. It is appropriate and feasible for students to substitute the technology at any point in time."

Job-Embedded training

Effectively using technology into the instructional process can be thought-provoking and overwhelming for some instructors. Job-embedded training sometimes is not more relevant to the requirements of the educators' training. Ongoing job training can provide specific ways to incorporate technology into the instructional process.

One of the heads from Public Sector University revealed that

"Students should be intrinsically motivated to achieve higher levels. Naturally, creative students rarely feel any difficulty with the technology. Traditional learning is prescriptive. Teachers who are familiar to comprehensive rubrics and traditional evaluations may need some additional support and training…"

One of the department heads from Private Sector University mentioned that

"Technology can increase learner engagement and increase learning opportunities. However, distraction could be caused in the educational process. I have experienced that students can switch screens in a blink of an eye since they have several tasks open simultaneously. Although it is challenging to engage students in remote learning, teachers must actively monitor student activities during class time… in-service training for teachers may reduce this challenge…"

Technological resources

A different challenge that participants have mentioned is the availability of the required resources. Institutions must upgrade their technology as required. Professional development related to technology integration can be specified. Hiring additional technology specialists to inform teachers about the use of Apps and software required in remote learning.

One of the heads from Public Sector University mentioned that

"In my opinion, the first two levels of SAMR can vary from time to time, Modification is easy to implement. Redefinition depends on the resources and infrastructure and is the hardest level…"

One of the department heads from Private Sector University mentioned that

"The flexibility and availability of the digital tools to provide unique prospects is the drive to enhance the motivation and involvement of the students. Students who are straight in obtaining knowledge tend to be more involved in the process…."

Hierarchical approach of the Model

The SAMR model is hierarchical model for the utilization of technology but the instructional method is cyclical. Few participants mentioned that as a challenge. Because teachers have to develop the learning objectives before moving towards SAMR model and choosing an appropriate level. Choosing the best fit SAMR level for the lesson is a careful process. Participants further indicated that the interplay between the learning objectives and the SAMR model is the most appropriate way of using it.

In the public sector university, one of the department heads mentioned that

"It is obvious to me that the levels in SAMR framework are ranked bottom up and the learning process is cyclical. The process in my understanding proceeds in two phases; the first teacher decides on learning objectives. Secondly, they turn to the model to design lessons based on the objectives."

One Head of Private Sector indicated that

"The challenge in my opinion is the comparison of the learning paradigm and the SAMR model. The learning is actually cyclical but the model represents itself in a hierarchical way. The model is also parallel to Bloom's taxonomy. It is obvious that instruction get perplexing as the model goes up. The misconception may occur for some

teachers when they think that each time they have to work for achieving the fourth level."

Time constraints

An additional theme that emerged from participants' views is Time constraints. Time constraints normally inhibit teachers from implementing any model successfully. Teachers seem overloaded and find it difficult to learn and blend the new digital tool into their pedagogy.

Another public sector Head mentioned that

".... In online learning, it takes more time to monitor the activities of the students. The second challenge [in technology integration or online learning] for teachers is to keep engaging their students.."

Whereas a head from private sector revealed that

"The challenge for teachers is to integrate the model into it. Separate training may be required for teachers to get along with the model. In the past the projectors were very famous invention that saved so much time of the teachers, they didn't necessarily write everything on the board. The SAMR must support the teachers in a meaningful way because time is a very important asset for the teachers."

Content Relevance

The most prevalent theme mentioned by the participants was the relevance of the SAMR model to the curriculum content. In that case, they have to shift back to the traditional pedagogy. Once teachers think that any digital tool is not compatible with the learning process, they shift their paradigm because they normally have very less time to replace the digital tool or have fewer resources.

One of the department heads from Public Sector University claimed that

"Teachers using digital tools can easily create manuals for step-by-step guidance of software usage e.g. IBM SPSS manual for research students. Teachers share the material

on LSM and Google Classroom. Teachers also illustrate how to convert any MS Office document into google docs and Google slides to improve the compatibility of the documents with Google Classroom."

Another department head from Public Sector University asserted that

"Teachers have already practiced how to record their lectures with a screen recording application or an add-on, "Screencastify." Teachers can make Google slides and record themselves explaining the concepts through Google Screencastify. Then the final presentation in Google classroom."

Student negligence

This theme is more linked with students' behavior and sense of responsibility. Few participants mentioned that teachers sometimes find it difficult to support technology integration. The reasons can be different such as students in some cases, are less interested in dealing with one-to-one technology. This theme can negatively impact teachers' ability to implement technology integration.

In a public sector university, one department head reported that

"….In classrooms with fewer students, it is easy to comprehend the activities they are involved in. Off-task students are uncontrolled in classrooms with enormous students. During online learning, it is challenging for instructors to observe the screen of every learner…"

In a private sector university, one department head revealed that

"Digital devices easily allow users to switch from one application to another. Students can easily distract from learning. Sometimes, teachers ask students to pay attention. Even then, they try to fool around with their devices. The passion for social media and gaming makes it hard to use digital resources to optimize the learning process."

Personal discomfort with technology

One more theme that acquired from data was the discomfort of some teachers with digital innovations. In that case, teachers will be reluctant to utilize digital tools in educational settings. Young instructors seem more willing to use digital tools.

In the public sector, a department head informed that

"Few teachers, e.g. senior teachers, prefer to use traditional teaching methods because they feel comfortable with that. They rarely take part in any technology-related training. However, the process of virtual/remote learning provided them with a new outlook on the essence of digital tools integration in the teaching."

One of the heads pointed out that

"Mostly teachers are used to working at Substitution level. Majority of teachers prefer a paper textbook rather than a digital textbook. Teachers who prefer passing handouts will rarely encourage students to open the notes on any device during the lecture. During online learning, it is necessary for teachers to digitally collaborate with the students. Only a few senior teachers are allowed to interact with students through WhatsApp groups. Taking it to the next level is a challenge for the teachers using Google Docs."

Lack of Access to technology

Overwhelmingly some participants mentioned that the lack of access to the appropriate technology could become a challenge for teachers to avail themselves of blended learning. According to the participants, the meager availability of particular equipment sometimes makes it difficult to integrate technology into the lecture.

Head from Public Sector University informed that

"Few teachers think that they can still deliver the concept without the technology. In most cases HEIs are well versed with the digital infrastructure and resources. The challenge is to take benefit of distinctive capabilities of technology, where the resources and

content goals are so tight."

Another private sector head disclosed that

"Since the technology we have here, rarely supports group work unless it is… you know, a smartboard lecture and they are discussing in their groups about it…. Teachers have their own laptops but students stay passive in the process of learning. Online classes these days give teachers less opportunity to interact with learners. In some cases where the class is gathered for on-campus practical activity. There is a space issue for students….like 3 or 4 students working on a single computer."

Lack of differentiation

Participants noted that differentiation in using the digital tools is necessary to improve the commitment and involvement of the learners. The SAMR model also suggests variation in the digital tools to achieve a certain level. If there is less variation in the content to accommodate technology, it becomes a challenge for teachers to keep their students on track.

Another public sector Head mentioned that

"The digital tools can be used to transform instructional activities in a more effective way when the educational settings are student-centered. The successful implementation of technology integration demands a learner-centered environment. Technology can be a distraction in remote learning when learners are not guided on how to handle digital tools as instructional tools."

Whereas a head from private sector stated that

"….Students can easily be distracted and teachers mostly confiscate students' phones and devices. Teachers should integrate more activities into the lesson to engage the students. During online learning, short tasks and quizzes can help the student to stay engaged with the learning."

Learning curve

Participants mentioned that if teachers find technology difficult to learn or require more time to implement the SAMR model. They will rarely use it inside the educational settings. Therefore, the training and PD sessions must train teachers more accurately to easily implement them.

One of the heads from Public Sector University revealed that

"In our case, most of the lessons are related to the opportunities for critical thinking and problem-solving…..but not all teachers are engaged and involved in the process. The teachers do not seem to provide sufficient time for the students to involve in meaningful communication and critical thinking opportunities."

One of the department heads from Private Sector University mentioned that

"During the face-to-face learning, there was much less opportunity for students to engage with online tasks. However, this model was not more successful because students rarely watch the videos prior to class. Most of the teachers scrapped the model after the first trimester. They felt it was less effective. However, the SAMR model on the other hand, seems handier and provides more control over the learning process."

Limited impact of PD

A more projecting but very significant theme obtained from the participants' views was the limited impact of professional development that teachers received in using digital tools in classroom. Sometimes, training opportunity can place lesser effect on pedagogical choices of teachers, related to technology integration.

In the public sector university, one of the department heads mentioned that

"The technology integration training seems to be minimal. The reason behind this is that it is expected for every teacher to be technologically sound enough to deliver the lecture with the help of digital tools. The emphasis is however placed on technology

integration at the Faculty Development Programs after the initial induction process. The professional training is more fixated on the development of the content, models of practices and reading across the curriculum."

One Head of Private Sector indicated that

"I feel like….adoption of the SAMR model somehow needs additional training and support for the teachers to use it properly. Teachers sometimes are not suitably prepared. My concern is that teachers may integrate technology at a level that may not be suitable for the goals of the particular course unit."

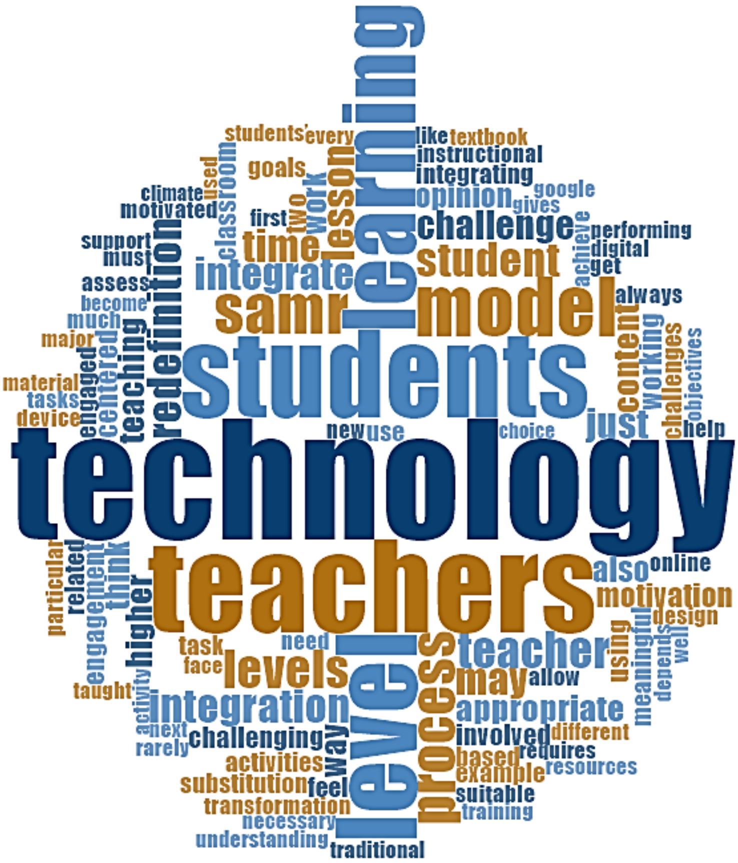

Figure 24: Word-Cloud for Technology as an Educational Tool

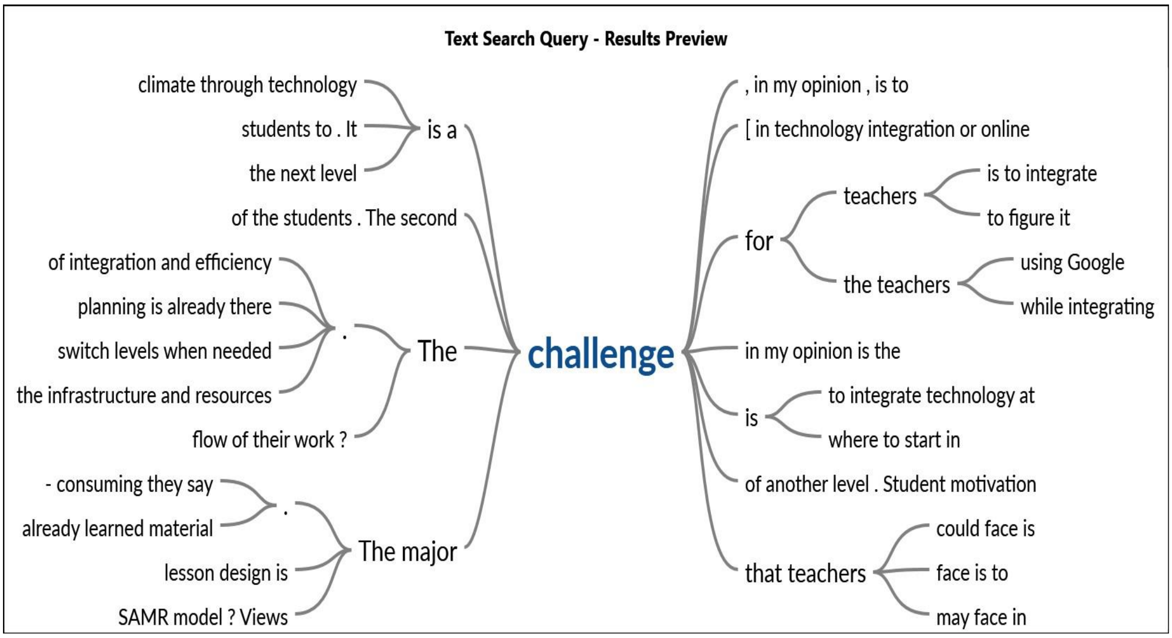

Figure 25: Word-Tree for Technology as an Educational Tool

Figure 24 and 25 indicate the NVivo query results for word cloud and word tree for the responses of heads regarding technology as an educational tool at higher education level.

4.3.5 Technology Integration and Professional Development

Interview Question 5-How technology integration can influence teachers' professional development needs?

4.3.5.1 Themes emerged

Through analysis and coding of interview question 5, the following themes have emerged.

Content Area connections

A significant theme that emerged from the data is the content area connection. Professional development opportunities can focus on this aspect carefully. Participants felt that this is a needing factor that should address through the professional development of teachers. While integrating the digital tools, teachers keep in mind the interplay between appropriate tool and its connection with the content.

One of the heads from Public Sector University revealed that

"The PD must provide differentiation to make the sessions more valuable for the teachers. Few PD sessions may appear less appealing to the teachers because teachers may have an understanding of basic concepts being taught, or there might be a session that teachers feel is hard to understand. Therefore, harmony in differentiation is necessary. Technology versus content can be addressed in particular sessions."

One of the department heads from Private Sector University mentioned that

"The number of possibilities of performing a task through digital tools can also increase the frustration level of the students. The PD can play an important role here by providing goal-related strategies to the teachers to enhance their focus."

Another Head opined that

"The PD must provide differentiation to make the sessions more valuable for the teachers. Distinguish practice related to the technology should be discussed in the sessions because that is what teachers do in everyday classrooms. Few PD sessions may appear less

appealing to the teachers because teachers may have an understanding of basic concepts being taught, or there might be a session that teachers feel is hard to understand."

Online Learning

Participants mentioned that since the pandemic online learning has taken over. This rapid change was new for some teachers. Teachers with limited training and manuals of LMS proceeded and started online teaching. However, online teaching is a vast field and without properly availing of the technology, teachers can rarely fulfill their objectives of student learning. From now on PD opportunities must integrate training on online teaching and learning. For example, teacher training for web-related instructional activities etc.

In a public sector institution, one of the department heads mentioned that

"Key area on which the PD can focus is patterns of instructional strategies with technology, digital instruction and digital content, relativeness of online learning and modern-day content."

One Head of Private Sector indicated that

"Online teaching and learning skills are necessary for every PD to be included. Teachers should be trained in teaching web-based teaching activities, and how to customize a web-based lesson or make it compatible with the content outline provided by the campus. Instructors are able to use web-based learning material in teaching. Online task-based activities may be integrated into the instruction."

Instructional settings and digital content

Participants indicated that instructional settings must be compatible with the digital content. Teachers can get in-service training on the use of digital resources to reinforce the instruction. Moreover, raining on which digital content will be suitable for certain types of instructional settings.

Another public sector Head declared that

"PD may provide training on skills such as how to use instructional software, frequent transition during lectures, selection of information through valid digital resources, utilization of social-based activities (wikis, cooperative learning etc.), digital literacy and choice of the students".

Whereas a head from private sector mentioned that

"Teachers in the training sessions may be guided in the skills such as searching and evaluating the relevant information through digital media, exploring real-life problems and authentic issues related to the instruction. Teachers may assign projects to explore information and cite the references. Teachers can provide training related to content selection through digital resources."

Pedagogical preferences

Another theme was the pedagogical preferences of the teachers. In most cases, teachers prefer their teaching strategies already tested by them. Thus, teachers, who prefer using traditional approaches will appear to be unwilling to integrate technology in lectures. Therefore, professional development must provide easy and proficient ways for senior teachers, so they can get along with technology.

One of the department heads from Public Sector University claimed that

"Teachers and students are normally at different levels of using and knowing technology in the classroom. The PD opportunities must be differentiated to teachers' ability and level of understanding. Most teachers are apt to PD opportunities and try to implement what they learned. PD may also be differentiated in a way to group the teachers with similar skill levels."

Another department head from Public Sector University asserted that

"It is an instructional climate in which technology is flawlessly integrated to answer real-life questions in association with higher education and the industry. Learning has

transformed through digital tools. PD may focus on training teachers to let the students access the information and propose solutions to real-world problems."

Relevance of PD

Participants indicated that ongoing job-embedded training might present reasonable connections of the content with the latest digital tools. Technology-related professional development must present the usefulness of the content so that teachers can enhance their teaching strategies and beliefs.

In a public sector university, one department head reported that

"PD for teachers must address the digital era needs. This generation of learners is the digital generation, teachers while designing the technology integration lessons may focus on the digital audience. Teachers may be provided training to use media-rich teaching resources in their instruction."

In a private sector university, one department head revealed that

"The significant barrier for teachers and students is the usage of innovative technology. Students lose attention when they are stuck somewhere in between and depend on their teacher to help them. The PD sessions can equip teachers to cope with these types of situations."

Format of PD

An additional theme obtained from the respondents' views is the suitability of the program/format of the PD. The format must follow some guidelines to make the training interesting and activity based. An appealing format can enhance the worth of professional development by equipping the teachers with technology skills.

In the public sector, a department head informed that

"The PD can allow teachers to go back and review the concept they are teaching. Teachers can be taught how to place their material online using any cloud service e.g.

Google Docs and access and review the material whenever they need it. PD can train teachers to create their groups with online peers. Teachers can create their professional learning network through LinkedIn or Twitter, which can allow them to keep up with updated digital tools and instructional strategies."

One of the heads pointed out that

"The technology-focused PD can play a significant role. The plan of PD can address more specific aspects of technology integration. The valuable elements can be added to improve teachers' competencies such as the relevance of the practices with their content. The PD may address the targeted audience by selecting the content from their specialized curriculum and talk about integrating technology into it."

21st century Trends in Education

Furthermore, the theme that emerged from participants' views is the focus of professional development on 21st-century trends. Most teachers have the desire to stay ahead of the trends. Technology-based training must focus on the modern-day needs of the instructional process.

Head from Public Sector University informed that

"The 21st-century classroom is more of a student-centered classroom. It is an instructional climate in which technology is flawlessly integrated to answer real-life questions in association with higher education and the industry. Learning has transformed through digital tools. PD may focus on training teachers to let the students access the information and propose solutions to real-world problems."

Another private sector head disclosed that

"Teachers occasionally use technology to add extra material and information to the content, streamline the administrative functions and present teacher-centered lectures to the students. PD in 21st century may offer the use of academic software, instructional

strategies, digital skill reinforcement, and model the technology for the content."

Impact of the Presenter/Resource Person

Another theme obtained from data was the presenter's impact on the trainees. Participants mentioned that presenters in the PD can have a positive impact on trainees by choosing the activities that are intriguing to the trainees. The presenter can engage and allow the trainees to work more on their skills.

One of the heads from Public Sector University stated that

"The presenter of the PD must be from the same discipline and hold the suitable competency of the technology and can effectively deliver the phenomenon. Most of the teachers like to attend the PD and they are most interested in the profile of the resource person. The experience and the knowledge of the presenter grab the attention of the trainees."

One of the department heads from Private Sector University mentioned that

"The PD in technology integration is a very careful area. The expertise and engagement of the presenter are necessary. The participants are usually able to judge their particular PD experience and feelings about the resource person. The resource person must keep in mind the 21st-century demands of the classroom."

Another head stated that

"PD may involve the embedded activities in the training sessions, proficient and knowledgeable resource person, and targeted topics can increase the value of the professional training. The training participants can also share their views regarding the embedded practices."

Choice of learning opportunities

The more valuable theme that further emerged was that the choice of learning opportunities for the PD could enhance its value. This theme also aligns with the theme of relevance. However, in a particular way teachers prefer the more involving PD and offer activities that meet their expectations. Technology PD can be more beneficial if there is more time to perform what is being delivered.

In the public sector university, one of the department heads mentioned that

"The choice of selecting the appropriate PD can help teachers to get them to train according to their needs. The second most important aspect that relates to the resource person is the appropriateness of the training according to the level of teachers' competency."

One Head of Private Sector indicated that

"Distinguish practice related to the technology should be discussed in the sessions because that is what teachers do in everyday classrooms. Teachers in most cases, have the ultimate desire to stay ahead of the new trends. While few express fear of moving forward. That is why most teachers like to attend PD seminars. The technology-based PD should be updated and compatible with the curriculum. PD also needs to balance the instructional needs of the teachers and the required digital tools. Most teachers feel unsatisfied when PD focuses on the digital tool rather than the pedagogical process."

Ongoing support in learning

Moreover, another noteworthy theme was the ongoing learning support. This idea has emerged in different ways. Participants believed that the professional development that allows trainees to share their views with peers could be more beneficial. Online PD can allow teachers to go back and review their concepts when needed, increasing their ability to implement the technology in the learning process effectively.

Another public sector Head revealed that

"Once a PD is offered the teachers can also make professional learning groups with PD cohorts. These groups can allow teachers to discuss achievements and hindrances they

are experiencing in the educational settings. Teachers can benefit very much from the ongoing PDs and can get help with integrating digital tools and technology into the teaching practice."

Whereas a head from private sector mentioned that

"The best PD practices are short and to the point. The learning curve of technology integration must be concise and short. Teachers must be provided a brief instruction regarding the technology and let them practice in a real-time environment. Before adding another layer they may practice the already learned practices. This process can help them foster their technology integration practices."

Figure 26: Word-Cloud for Technology Integration and PD

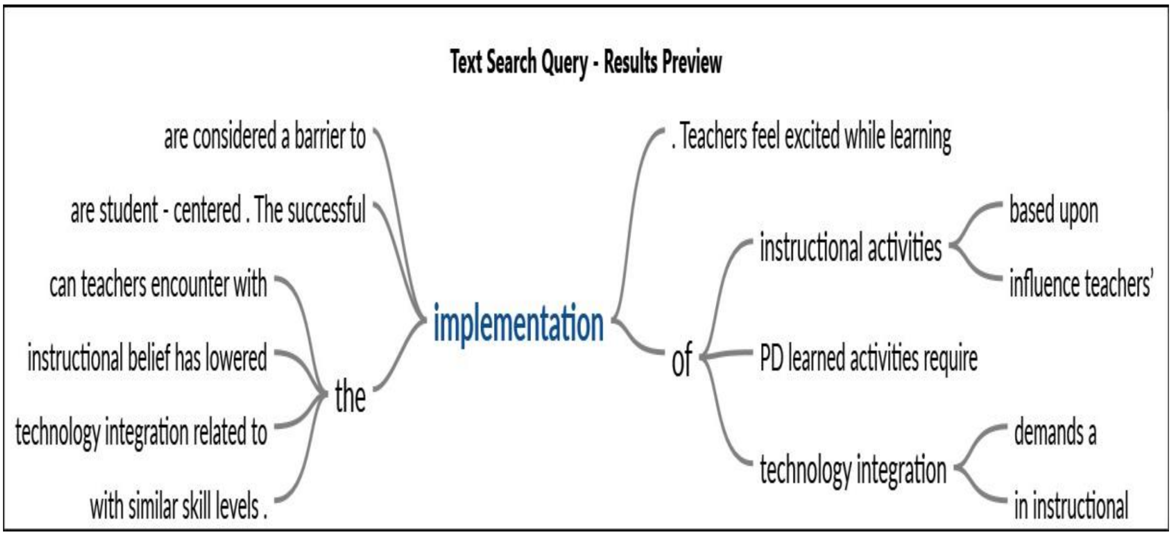

Figure 27: Word-Tree for Technology Integration and PD

Figure 26 and 27 indicate the NVivo query results for word cloud and word tree for the responses of heads regarding technology as an educational tool at higher education level.

Section V: Comparison of Results

4.4 Comparison of Quantitative & Qualitative Analysis

This section deals with the requirement of convergent parallel design (Creswell, 2012), i.e., the comparison of quantitative and qualitative data analysis. The outcomes determined from qualitative and quantitative tools are compared to strengthen the data analysis.

Quantitative scores of a questionnaire responded by many individuals supply strengths to reduce the weakness of qualitative responses of an interview responded by few individuals (Creswell, 2012).

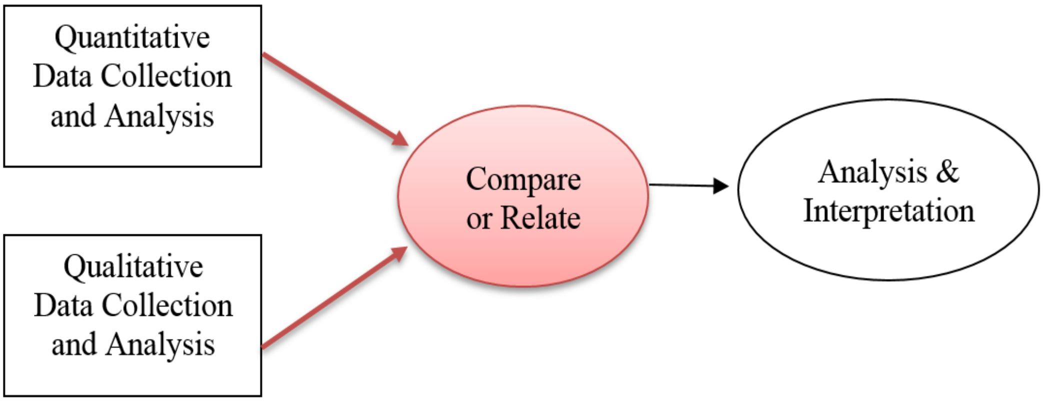

Figure 28: Comparison of Results (Creswell, 2012, p. 541)

The quantitative data was based on four objectives and seven null hypotheses, results revealed that the ICT learning activities were mostly utilized at the augmentation and modification level. The faculty members seemed to use technology in the second and third phases of the model in the teaching and learning process. The COVID-19 pandemic had an interesting impact on the teaching process at all levels of education. Especially at the higher education level most of the learning activities were performed online as shown in table 4.10c.

Inferential statistics revealed significant differences in teachers' technology integration in public and private sectors. As compared to other levels, the substitution level has shown a lower effect size and modification level has shown a large effect size for private sector. Statistical differences existed among teachers' views regarding their competency in technology integration based on gender. The augmentation level has shown a larger effect size as compared to the other levels of technology integration.

The study further exposed statistical differences between faculty members' technology integration based on their qualifications. Mean scores of M.Phil. faculty members were higher as compared to others. Modification and Redefinition levels revealed statistical differences among teachers' competency in technology integration based on their qualifications. The study also revealed a significant difference between teachers based on their experience. The mean score of teachers with 7-10 years' experience was higher than other levels of experience. While analyzing the experience of teachers, a significant difference between teachers' competency was found at the upper two levels of SAMR model.

The research additionally uncovered statistical differences between faculty members based on their designation. The mean competency score of Associate professors was found higher compared to other designations. Furthermore, the first two levels substitution and augmentation have shown no statistical difference between teachers' competency. The Post Hoc test analyzed the upper two levels (modification and redefinition) to apply the multiple comparisons. Statistical difference was observed between teachers based on their disciplines. The mean scores of management science teachers were found higher as compared to social sciences. This difference was also observed at the modification and redefinition levels. Quantitative results further indicated that there existed a statistical difference between teachers' mean scores of technology integration based on the age groups.

Mean score of teachers with age ranges from 31-40 years was higher as compared to other ranges of participants' age. The same difference was also found at the upper two levels of the model.

The qualitative data analysis was based on five semi-structured questions those questions were asked by the heads of the departments to strengthen the quantitative results. The responses to the first question indicated that teachers in social sciences were practicing the technology integration at the augmentation level of the SAMR model but in a few cases, they used substitution level. In management sciences, teachers were found practicing and utilizing the ICT tools at modification level. The major themes that emerged from the first question were teachers' understanding of SAMR model and greater learning opportunities at higher levels of SAMR model. The model also increases the motivational level of students and teachers.

The interview analysis further revealed that the use of SAMR model could transform the learning practices and technology integration competency of the teachers. The major themes that emerged from the thematic analysis were the greater concerns of the teachers with the SAMR model, and the correct use of the model. Furthermore, the model can open various ways of learning and using the technology. The model offers different opportunities related to self-teaching. In a student-centered environment, it increases the self-motivation of the students. The thematic analysis further revealed that teachers use digital technology as an instructional tool. The themes that emerged from the third question were technology as an enhancement tool and technology as a transformative tool. It further indicates the requirement of professional training to integrate technology into the curriculum successfully. Technology coaches can guide teachers about the usage of digital tools. Curriculum mapping is felt necessary by the heads.

The qualitative content analysis indicated several challenges related to technology integration. For instance, the major themes included making the model relevant to the learning process, giving control to the students, moving from one level to the next, interface of the digital tool or software, inappropriate use of the technology, and rigidity in the teaching process etc. The analysis further indicated that the implementation of technology integration also influences the professional development needs of the teachers. The major themes obtained from question five included the professional development needs related to content area connections, online learning, educational settings and digital content and pedagogical preferences of the teachers etc.

Table 4.46

Major Results (Quantitative n_1=552 & Qualitative n_2=30)

Quantitative Outcomes	Qualitative Outcomes
Descriptive statistics: *Substitution* (High Faculty Scores) *Augmentation* (High Faculty Scores) *Modification* (Medium Faculty Scores) *Redefinition* (low Faculty Scores)	The themes that emerged from the first interview question included teachers' meaning of the SAMR levels, greater learning at the higher levels, increased student and teacher motivation, student and teachers engagement, student participation, relevance to students' careers, ease and accessibility of technology, ease of finding appropriate resources, improved instruction, ability to monitor student progress, reaching more students, enhanced content presentation, increased access to the curriculum.
SAMR Matrix Results: Most of Instructional Activities at Substitution and Augmentation levels.	The themes that emerged from second interview question included teachers' concerns with the SAMR model, teachers' correct use of SAMR, use of various technologies to accomplish the tasks, teachers can learn about the usage or incorporation of technology are training, communication and collaboration with

Quantitative Outcomes	Qualitative Outcomes
Checklist Results: Most of Instructional Activities at Substitution and Augmentation level. Usage of Online Medium in most cases than face-to-face or hybrid.	colleagues, and self-teaching (tutorials etc.), self-teaching through exploring, self-motivation, collaboration with colleagues, professional development, strategies of teaching, grouping of students, Technology can serve different purposes depending on how it is incorporated in the lesson, teachers' expertise with technology.
Inferential Statistics: Sig. Diff. Public & Private Faculty & Medium Competency of both sector Sig. Diff. Male & Female Faculty & Medium Competency of both gender	The themes emerged from third interview question included technology as an enhancement tool for teachers, Technology as a transformative, instructional tool to reshape and remodel the instruction, professional training for teachers, curriculum compatibility and integration, curriculum mapping with instructional practices, technology coaches, resources and existing infrastructure, plan for technological professional training, technological changes, self-reflection of teachers, technology as a distraction. The challenges emerged from fourth interview question were the relevancy of the SAMR model with instructional

Quantitative Outcomes	Qualitative Outcomes
Inferential Statistics: Sig. Diff. based on Qualification, & Medium Competency, Mean scores Ph.D.>Post Doc>M.Phil. Major Sig. Diff. at Modification & Redefinition. Sig. Diff. based on Experience, & Medium Competency, Mean scores have direct proportion with experience. Major Sig. Diff. at Modification & Redefinition.	activities, giving up control to the students, moving to the next level of the model with suitable technology, complicated interface of software, while dealing with technology starting from the basics or fundamental level of the model, inappropriate use, rigidity makes innovation difficult, job-embedded training, technological resources in the institution, hierarchical approach of the model, time constraints normally inhibit teachers from implementing any model, relevance, student negligence, personal discomfort with technology, lack of access to technology, lack of differentiation, learning curve, limited impact of professional development.
Sig. Diff. based on Designation, & Medium Competency, Mean scores have direct proportion with designation except senior faculty possess slightly lower mean. Major Sig. Diff. at Modification & Redefinition.	The themes emerged from the fifth interview question were that while integrating the technology, teachers focus on the interplay between technology and its connection with the content. PD opportunities must integrate training on online teaching and learning. Instructional settings must be compatible with the digital

Quantitative Outcomes	Qualitative Outcomes
Inferential Statistics: Sig. Diff. based on Discipline, & Medium Competency, Mean scores MS>SS. Major Sig. Diff. at Modification & Redefinition. Sig. Diff. based on Age, & Medium Competency, Mean scores of age rage 31-40 is greater as compare to younger and more senior teachers. Major Sig. Diff. at Modification & Redefinition.	content. Professional development may provide easy and proficient ways for senior teachers so they can get along with technology. Technology- related professional development must present the usefulness of the content so that teachers can enhance their teaching strategies and beliefs. An appealing format of PD can enhance the worth of the professional development by equipping the teachers with technology skills. Technology related professional development must focus on the 21st century learning needs of the instructional process. Presenter in the PD can place positive impact on trainees by choosing the activities that are intriguing to the trainees. Teachers prefer the PD that is more involving and offer activities that meet their expectation. The professional development that allows trainees to share their views with peers can be more beneficial.

4.4.1 Major Results (Integration)

Technology integration is being practiced in higher education institutions in Pakistan. Education policies also indicated the importance of ICT in the instructional process. According to GoP (2018), information and communication technology provides various means to enhance learning skills and teaching abilities. The results indicated that teachers' technology integration could be placed at first two levels of the SAMR model i.e. substitution and augmentation levels of the model. Results further revealed that most of the respondents were practicing ICT learning activities at the first two levels of the SAMR model. For instance, research activities were performed by the teachers through the integration of digital tools at the augmentation level. Additionally, results indicated significant differences among teachers' technology integration based on the sector, gender, qualification, experience, designation, disciplines and ages. The modification and redefinition levels have shown a larger effect size. Modification and Redefinition levels revealed statistical differences among teachers' competency in technology integration based on each demographic variable. Several challenges are involved in this context especially the relevancy of the SAMR model with instructional activities, giving up control to the students, and moving to the next level of the model with suitable technology. Professional development may play an important role in enhancing the technology integration competency of the teachers.

Summary

In this chapter detailed analysis of data were presented in the form of tables, figures and the relevant description. The descriptive tests included frequency, percentage, mean and standard deviation and the inferential test included t-test, Cohen's D, ANOVA and Post-Hoc Tests. Furthermore, the interview transcripts were analyzed through thematic analysis taking account of themes.

Table 4.47

Summary of Statistical Analysis (n_1=552 & n_2=30)

Sr#	Objectives	Hypotheses	Research Question	Description	Table No.
1	To examine the faculty perceptions regarding their competence towards technology integration at higher education level with reference to SAMR model in the backdrop of Bloom's taxonomy.	----	What are the faculty perceptions regarding their competence towards technology integration with respect to SAMR Model and Bloom's Taxonomy?	Descriptive statistics is most commonly used to assess the average performance (Frequency, percentage, Mean), spread out of scores, and whether the scores are relatively closer or spread around the mean (S.D). (Creswell & Creswell, 2017)	4.1 to 4.10$_c$
2	To identify the differences in faculty competence towards technology integration at higher education level based on sector, gender, qualifications, experience, designations, disciplines and ages.	**$H_{01\ to\ 07}$**: There are no statistical differences among teachers' technology integration while comparing Sectors, gender, qualifications, experience, designations, disciplines, and ages.	Does a statistical difference exist between survey scores of technology competency of university teachers?	T-test is the inferential statistics commonly used to compare the average performance between two groups. Here we start by inferring the properties of a probability distribution (Prudon, 2015). Analysis of variance (ANOVA) is the type of inferential statistics that analyzes the level of variance within groups and tells whether differences among groups are statistically significant (Creswell, & Poth, 2016).	4.11 to 4.45$_{a,b}$
3	To explore the views of heads regarding faculty competence towards technology integration.	----		Thematic Analysis is the process of coding the qualitative responses and grouping the codes that later become variables of the researcher's interest in understanding a phenomenon (Saldaña, 2021; Creswell, & Poth, 2016; Yin, 2015).	Heading 4.3
4	To propose a model for technology integration based on gaps identified through research.	----		Based on findings, conclusions, and recommendations a model was developed for technology integration in Pakistan.	Chapter 5

CHAPTER 5

SUMMARY, FINDINGS, DISCUSSIONS, CONCLUSIONS AND RECOMMENDATIONS

Previously, the study has shown the comprehensive data analysis of both quantitative and qualitative aspects. This chapter provides conclusions in the light of the research findings. Additionally, it contains the discussion section that presents the similarities and contradictions with the findings of related studies in the field of technology integration. Moreover, it proposes some recommendations in the light of findings and discussion. Future research possibilities are also presented.

5.1 Summary

The current study was conducted to explore the technology integration competencies of university teachers on the basis of conceptual framework which unified SAMR model and Bloom's revised taxonomy. Main objectives of the study were to examine the faculty perceptions regarding their competence towards technology integration at higher education level with reference to SAMR model in the backdrop of Bloom's taxonomy, and to identify the differences in faculty competence towards technology integration at higher education level based on sector, gender, qualification, experience, designation, disciplines and age, to explore the views of heads regarding faculty competence towards technology integration, and to propose a model for technology integration based on research. A self-developed questionnaire based on SAMR model and Bloom's revised taxonomy, a standardized checklist and semi-structured interview were utilized to collect the information from university teachers and department heads. The questionnaire had two main sections, firstly the demographic information and secondly, eight sections based on the framework of the study i.e the coupling of SAMR model and Bloom's revised taxonomy. The concepts of SAMR model and Bloom's revised taxonomy were combined in a single instrument to test technology integration. The questionnaire was called Technology integration questionnaire. The questionnaire was consisted of 48 statements with a 5-point rating scale. The validity and reliability of the measures were established through pilot testing. The questionnaire was found valid by the field experts and reliable through Cronbach's Alpha coefficient. Population of the study was heads and teachers of 79 public and private sector universities in Punjab. The study was delimited to two disciplines (Social Sciences, and Management Sciences). Researcher has selected 32 universities in Punjab and the targeted population contained 4233 faculty members and 380 heads of Social Sciences, and Management Sciences, teaching in 32 public and private sector universities in Punjab. The population was divided in two major strata, i.e., public and private sector universities. To indicate appropriate representation to each stratum, 14% of both sectors were selected for the sample from faculty members. Therefore, the sample consisted 593 teaching faculty (358 public sector and 235 private sector). For qualitative sample the researcher conducted 30 interviews with heads from both public and private universities (13 heads from public sector and 17 heads from private sector). Total of 552 questionnaire were filled properly, thus the overall response rate was 93%. Qualitative data were collected in two phases with 100% response rate. Quantitative and qualitative analysis separately with suitable tests. The quantitative results were obtained through SPSS and qualitative results were obtained through thematic analysis. During pandemic, numerous faculty members were compelled to use technologies they were uncomfortable with, such as online-conferencing software and online assignment submission methods. The findings of this research may be used to assist in-service teachers in preparing for technology integration in a post-COVID instructional framework.

5.2 Findings

The findings of the study are presented as under:

Objective 1- To examine the faculty perceptions regarding their competence towards technology integration at higher education level with reference to SAMR model in the backdrop of Bloom's taxonomy.

1. Self-perception score of faculty members regarding their competence of technology integration indicated that Substitution indicates high mean scores (Mean=4.51). The second dimension, i.e., Augmentation, indicated high mean scores (Mean=4.33). The third dimension, i.e., Modification, indicates medium mean scores (Mean=3.78). The fourth dimension i.e., Redefinition, indicates low mean scores (Mean=3.45). Results of mean scores indicate that most faculty members practice technology integration at Substitution and Augmentation levels (Table 4.9).
2. The results of SAMR evaluation matrix indicated that most of the faculty possess the skill to integrate the technology at the substitution and augmentation levels of the SAMR model (Table 4.10a).
3. The checklist response indicated that most respondents practiced ICT learning activities at the first two levels of the SAMR model. For instance, the Note-taking task was performed by the teachers through digital tools with 50% integration of digital tools at substitution level. Also for instance, the Content Creation activity was mostly dealt with at Modification level. Results also indicate that Research activity was also mainly performed at first two levels of the model with 48% at substitution and 32% at augmentation level (Table 4.10b).
4. The second part of the checklist responses indicated that most respondents practiced ICT learning activities in Online Teaching. For instance, Note-taking task was performed by the teachers through digital tools with 75% integration of online digital

tools. Also, for instance, the Content Creation activity was mostly dealt with online i.e. 85%. Results also indicate that Research activity was also mainly performed online with 80% and 16% at the hybrid mode of teaching (Table 4.10c).

Objective 2- To identify the differences in faculty competence towards technology integration at higher education level based on sector, gender, qualifications, experience, designations, disciplines and ages.

H_{01} There are no statistical differences among teachers' technology integration while comparing Sectors.

5. The results showed a significant difference in technology integration between public and private sector teachers. The results were found significant at $t(550)=3.95$ where $p=.00$. Private sector teachers (Mean=3.90) have significantly higher competency towards technology integration than public sector teachers (Mean=3.71). The hypothesis **H_{01}** 'There are no statistical differences among teachers' technology integration while comparing Sectors' is rejected (Table 4.11).

H_{01a} There are no statistical differences among teachers in connection with *'Substitution' in the backdrop of 'Remembering'* while comparing Sector.

6. The comparative analysis of *'Substitution'* in the backdrop of '*Remembering*' regarding teachers' sector of institution indicated that the results were significant at $t(550)=2.64$ where $p=.001$. Therefore, there exists a significant difference in technology integration between public (Mean=4.24) and private (Mean=4.45) sector teachers. Results also indicate that private sector teachers (Mean=4.45) have significantly higher competency toward technology integration than public sector teachers (Mean=4.24). The hypothesis **H_{01a}** 'There are no statistical differences among teachers in connection with *'Substitution' in the backdrop of 'Remembering'* while comparing Sector' is rejected (Table 4.12).

H_{01b} There are no statistical differences among teachers in connection with *'Augmentation' in the backdrop of 'Understanding' and 'Applying'* while comparing Sector.

7. The comparative analysis of *'Augmentation'* in the backdrop of *'Understanding'* and *'Applying'* regarding the teachers' sector of institution indicated that the results were significant at $t(550)=3.38$ where $p=.001$. Therefore, there exists a significant difference in technology integration between public (Mean=4.07) and private (Mean=4.25) sector teachers. Results also indicate that private sector teachers (Mean=4.25) have significantly higher competency toward technology integration than public sector teachers (Mean=4.07). The hypothesis **H_{01b}** 'There are no statistical differences among teachers in connection with *'Augmentation' in the backdrop of 'Understanding' and 'Applying'* while comparing Sector' is rejected (Table 4.13).

H_{01c} There are no statistical differences among teachers in connection with *'Modification' in the backdrop of 'Applying', 'Analyzing' and 'Evaluating'* while comparing Sector.

8. The comparative analysis of *'Modification'* in the backdrop of *'Applying', 'Analyzing',* and *'Evaluating'* regarding teachers' sector of institution indicated that the results were significant at $t(550)=4.77$ where $p=.001$. Therefore, there exists a significant difference in technology integration between public (Mean=3.51) and private (Mean=3.68) sector teachers. Results also indicate that private sector teachers (Mean=3.68) have significantly higher competency toward technology integration than public sector teachers (Mean=3.51). The hypothesis **H_{01c}** 'There are no statistical differences among teachers in connection with *'Modification' in the backdrop of 'Applying', 'Analyzing' and 'Evaluating'* while comparing Sector' is rejected (Table 4.14).

H_{01d} There are no statistical differences among teachers in connection with *'Redefinition' in the backdrop of 'Evaluating' and 'Creating'* while comparing Sector.

9. The comparative analysis of *'Redefinition'* in the backdrop of '*Evaluating'* and '*Creating*' regarding the teachers' sector of the institution indicated that the results were significant at $t(550)=3.41$ where $p=.001$. Therefore, there exists a significant difference in technology integration between public (Mean=3.40) and private (Mean=3.61) sector teachers. Results also indicate that private sector teachers (Mean=3.61) have significantly higher competency toward technology integration than public sector teachers (Mean=3.40). The hypothesis **H_{01d}** 'There are no statistical differences among teachers in connection with *'Redefinition' in the backdrop of 'Evaluating' and 'Creating'* while comparing Sector' is rejected (Table 4.15).

H_{02} There are no significant differences among teachers' technology integration while comparing Gender.

10. The comparative analysis of technology integration scores of male and female teachers indicated that The results were found significant at $t(550)=3.98$ where $p=.00$. Therefore, there exists a significant difference in technology integration between males (Mean=3.78) and females (Mean=3.61) teachers. Results also indicate that male teachers (Mean=3.78) have significantly higher competency toward technology integration than female teachers (Mean=3.61). The hypothesis **H_{02}** 'There are no differences among teachers' technology integration while comparing Gender,' is rejected (Table 4.16).

H_{02a} There are no statistical differences among teachers in connection with *'Substitution' in the backdrop of 'Remembering'* while comparing Gender.

11. The comparative analysis of *'Substitution'* in the backdrop of '*Remembering*'

regarding teachers' gender indicated that the results were significant at *t*(550)=2.66 where *p=.001*. Therefore, there exists a significant difference in technology integration between male (Mean=4.48) and female (Mean=4.30) teachers. Results also indicate that male teachers (Mean=4.48) have significantly higher competency toward technology integration than female teachers (Mean=4.30). The hypothesis **H_{02a}** 'There are no statistical differences among teachers in connection with *'Substitution' in the backdrop of 'Remembering'* while comparing Gender' is rejected (Table 4.17).

H_{02b} There are no statistical differences among teachers in connection with *'Augmentation' in the backdrop of 'Understanding' and 'Applying'* while comparing Gender.

12. The comparative analysis of *'Augmentation'* in the backdrop of *'Understanding'* and *'Applying'* regarding teachers' gender indicated that the results were significant at *t*(550)=4.66 where *p=.001*. Therefore, there exists a significant difference in technology integration between male (Mean=4.30) and female (Mean=4.27) teachers. Results also indicate that male teachers (Mean=4.30) have significantly higher competency toward technology integration than female teachers (Mean=4.27). The hypothesis **H_{02b}** 'There are no statistical differences among teachers in connection with *'Augmentation' in the backdrop of 'Understanding' and 'Applying'* while comparing Gender' is rejected (Table 4.18).

H_{02c} There are no statistical differences among teachers in connection with *'Modification' in the backdrop of 'Applying', 'Analyzing' and 'Evaluating'* while comparing Gender.

13. The comparative analysis of *'Modification'* in the backdrop of *'Applying', 'Analyzing'* and *'Evaluating'* regarding teachers' gender indicated that the results were significant at *t*(550)=3.38 where *p=.001*. Therefore, there exists a significant difference in

technology integration between male (Mean=3.71) and female (Mean=3.59) teachers. Results also indicate that male teachers (Mean=3.71) have significantly higher competency toward technology integration than female teachers (Mean=3.59). The hypothesis **H_{02c}** 'There are no statistical differences among teachers in connection with *'Modification' in the backdrop of 'Applying', 'Analyzing' and 'Evaluating'* while comparing Gender' is rejected (Table 4.19).

H_{02d} There are no statistical differences among teachers in connection with *'Redefinition' in the backdrop of 'Evaluating' and 'Creating'* while comparing Gender.

14. The comparative analysis of *'Redefinition'* in the backdrop of '*Evaluating'* and '*Creating*' regarding teachers' gender indicated that the results were significant at $t(550)=2.93$ where $p=.001$. Therefore, there exists a significant difference in technology integration between male (Mean=3.44) and female (Mean=3.38) teachers. Results also indicate that male teachers (Mean=3.44) have significantly higher competency toward technology integration than female teachers (Mean=3.38). The hypothesis **H_{02d}** 'There are no statistical differences among teachers in connection with *'Redefinition' in the backdrop of 'Evaluating' and 'Creating'* while comparing Gender' is rejected (Table 4.20).

H_{03} There are no statistical differences among teachers' technology integration while comparing Qualification.

15. The ANOVA test found significant at $F(549,2)=4.23$ where $p=.001$. Therefore, it can be concluded that there was a significant effect of teachers' qualifications on their competency of technology integration. The hypothesis **H_{03}** "There are no differences among teachers' technology integration while comparing Qualifications" is rejected (Table 4.21_a).

16. The Post Hoc Test assessed the statistical differences among teachers' technology integration with respect to their Qualification groups. It indicated that a statistically significant difference was found between participants having M.Phil. degree and participants having Ph.D. and Post. Doctoral degree at p-value 0.044 and .031 respectively (Table 4.21_b).

H_{03a} There are no statistical differences among teachers in connection with *'Substitution' in the backdrop of 'Remembering'* while comparing Qualification.

17. The ANOVA test compared the technology integration scores of teachers regarding their qualification group in relation to *'Substitution'* in the backdrop of '*Remembering*'. The results were found insignificant at $F(549,2)=1.43$ where $p=.22$. The Null hypothesis **H_{03a}** 'There are no statistical differences among teachers in connection with *'Substitution' in the backdrop of 'Remembering'* while comparing Qualification' is accepted (Table 4.22).

H_{03b} There are no statistical differences among teachers in connection with *'Augmentation' in the backdrop of 'Understanding' and 'Applying'* while comparing Qualification.

18. The ANOVA test compared the technology integration scores of teachers regarding their qualification group in relation to *'Augmentation'* in the backdrop of *'Understanding'* and *'Applying'*. The results were found insignificant at $F(549,2)=.005$ where $p=.99$. The hypothesis **H_{03b}** 'There are no statistical differences among teachers in connection with *'Augmentation' in the backdrop of 'Understanding' and 'Applying'* while comparing Qualification' is accepted (Table 4.23).

H_{03c} There are no statistical differences among teachers in connection with *'Modification' in the backdrop of 'Applying', 'Analyzing' and 'Evaluating'* while comparing Qualification.

19. The ANOVA test compared the technology integration scores of teachers regarding their qualification group in relation to *'Modification'* in the backdrop of *'Applying', 'Analyzing'* and *'Evaluating.'* The results were found significant at $F(549,2)=4.02$ where $p=.00$. The Null hypothesis **H_{03c}** 'There are no statistical differences among teachers in connection with *'Modification' in the backdrop of 'Applying', 'Analyzing' and 'Evaluating'* while comparing Qualification' is rejected (Table 4.24_a).

20. The Post Hoc Test assessed the statistical differences among teachers' technology integration with respect to their Qualification groups in relation to the third level of SAMR model, i.e., Modification. Results indicated that a statistically significant difference was found between participants having M.Phil. degrees and participants having Ph.D. and Post. Doctoral degree at p-value 0.001 and .042 respectively (Table 4.24_b).

H_{03d} There are no statistical differences among teachers in connection with *'Redefinition' in the backdrop of 'Evaluating' and 'Creating'* while comparing Qualification.

21. The ANOVA test compared the technology integration scores of teachers regarding their qualification group in relation to *'Redefinition'* in the backdrop of '*Evaluating'* and '*Creating*'. The results were significant at $F(549,2)=3.02$ where $p=.001$. The Null hypothesis **H_{03d}** 'There are no statistical differences among teachers in connection with *'Redefinition' in the backdrop of 'Evaluating' and 'Creating'* while comparing Qualification' is rejected (Table 4.25_a).

22. The Post Hoc Test assessed the statistical differences among teachers' technology

integration with respect to their Qualification groups in relation to the fourth level of SAMR model, i.e., Redefinition. Results indicated that a statistically significant difference was found between participants having M.Phil. degree and participants having Ph.D. and Post. Doctoral degree at p-value 0.003 and .021 respectively (Table 4.25_b).

H_{04} There are no statistical differences among teachers' technology integration while comparing Teaching Experience.

23. The ANOVA test compared the technology integration scores of teachers regarding their teaching experience. The results were significant at $F(548,3)=4.54$ where $p=.004$. Therefore, it can be concluded that there was a significant effect of teachers' experience on their competency of technology integration. Hence, the hypothesis **H_{04}** 'There are no differences among teachers' technology integration while comparing Teaching Experience' is rejected (Table 4.26_a).
24. The Post Hoc test assessed the statistical differences among teachers' technology integration with respect to their Teaching Experience groups. Results indicated a significant difference between participants having less than 3 years of experience and participants having 3 to 6, 7 to 10 and more than 10 years of experience at p-values of 0.041, .001 and .049 respectively. A statistically significant difference was also found between participants having three to six years of experience and participants having seven to ten and more than ten years of experience at p-values of .048 and .002 respectively (Table 4.26_b).

H_{04a} There are no statistical differences among teachers in connection with *'Substitution' in the backdrop of 'Remembering'* while comparing Teaching Experience.

25. The ANOVA test compared the technology integration scores of teachers regarding

their teaching experience group in relation to the first level of SAMR model, i.e., Substitution. The results were found insignificant at $F(548,3)=2.13$ where $p=.09$. The hypothesis $\mathbf{H_{04a}}$ 'There are no statistical differences among teachers in connection with *'Substitution' in the backdrop of 'Remembering'* while comparing Teaching Experience' is accepted (Table, 4.27).

$\mathbf{H_{04b}}$ There are no statistical differences among teachers in connection with *'Augmentation' in the backdrop of 'Understanding' and 'Applying'* while comparing Teaching Experience.

26. The ANOVA test compared the technology integration scores of teachers regarding their teaching experience group in relation to *'Augmentation'* in the backdrop of *'Understanding'* and *'Applying'*. The results were found insignificant at $F(548,3)=1.13$ where $p=.34$. Therefore, the hypothesis $\mathbf{H_{04b}}$ 'There are no statistical differences among teachers in connection with *'Augmentation' in the backdrop of 'Understanding' and 'Applying'* while comparing Teaching Experience' is accepted (Table 4.28).

$\mathbf{H_{04c}}$ There are no statistical differences among teachers in connection with *'Modification' in the backdrop of 'Applying', 'Analyzing' and 'Evaluating'* while comparing Teaching Experience.

27. The ANOVA test compared the technology integration scores of teachers regarding their teaching experience group in relation to *'Modification'* in the backdrop of *'Applying', 'Analyzing'* and *'Evaluating'*. The results were significant at $F(548,3)=4.08$, where $p=.001$. Therefore, hypothesis $\mathbf{H_{04c}}$ 'There are no statistical differences among teachers in connection with *'Modification' in the backdrop of 'Applying', 'Analyzing' and 'Evaluating'* while comparing Teaching Experience' is rejected (Table 4.29_a).

28. The Post Hoc Test assessed the statistical differences among teachers' technology integration with respect to their teaching experience groups in relation to the third level of SAMR model, i.e., Modification. Results indicated that a statistically significant difference was found between participants having less than three years of experience and participants having three to ten, seven to ten and more than ten years of experience at p-values .025, .001 and .044 respectively. A statistically significant difference was also found between participants having 3 to 6 years of experience and seven to ten years of experience at a p-value of .040. Furthermore, a statistically significant difference was also found between participants having 7-10 and more than 10 years' experience at a p-value of .030 (Table, 4.29_b).

H_{04d} There are no statistical differences among teachers in connection with *'Redefinition' in the backdrop of 'Evaluating' and 'Creating'* while comparing Teaching Experience.

29. The ANOVA test compared the technology integration scores of teachers regarding their teaching experience group in relation to *'Redefinition'* in the backdrop of '*Evaluating'* and '*Creating*'. The results were significant at $F(548,3)=4.08$ where $p=.001$. Therefore, the hypothesis **H_{04d}** 'There are no statistical differences among teachers in connection with *'Redefinition' in the backdrop of 'Evaluating' and 'Creating'* while comparing Teaching Experience' is rejected (Table, 4.30_a).

30. The Post Hoc Test assessed the statistical differences among teachers' technology integration with respect to their teaching experience groups in relation to the fourth level of SAMR model, i.e., Redefinition. Results indicated that a statistically significant difference was found between participants having less than three years of experience and participants having three to ten, seven to ten and more than ten years of experience at p-values .020, .001 and .046 respectively. A statistically significant

difference was also found between participants having three to six years of experience and seven to ten and more than ten years of experience at p-value .004 and .033 respectively (Table, 4.30$_b$).

H_{05} There are no statistical differences among teachers' technology integration while comparing Designation.

31. The ANOVA test compared the technology integration scores of teachers regarding their professional designation. The results were significant at $F(548,3)=4.55$, where $p=.004$. Therefore, the hypothesis **H_{05}** 'There are no differences among teachers' technology integration while comparing Designation,' is rejected (Table, 4.31$_a$).
32. The Post Hoc Test assessed the statistical differences among teachers' technology integration with respect to their Designation groups. Results indicated that a statistical difference was determined between professors and participants having designation of associate professor, assistant professor, and lecturers at p-values of 0.045, .001 and .002 respectively. A statistical difference was also determined between associate professors and participants having the designation of lecturers at p-values.002 (Table, 4.31$_b$).

H_{05a} There are no statistical differences among teachers in connection with *'Substitution' in the backdrop of 'Remembering'* while comparing Designation.

33. The ANOVA test compared the technology integration scores of teachers regarding their designation group in relation to *'Substitution'* in the backdrop of 'Remembering'. The results were found insignificant at $F(548,3)=2.19$ where $p=.08$. Therefore, the hypothesis **H_{05a}** 'There are no statistical differences among teachers in connection with *'Substitution' in the backdrop of 'Remembering'* while comparing Designation' is accepted (Table, 4.32).

H_{05b} There are no statistical differences among teachers in connection with *'Augmentation' in the backdrop of 'Understanding' and 'Applying'* while comparing Designation.

34. The ANOVA test compared the technology integration scores of teachers regarding their designation group in relation to *'Augmentation'* in the backdrop of 'Understanding' and *'Applying'*. The results were insignificant at $F(548,3)=1.13$ where $p=0.35$. Consequently, the hypothesis **H_{05b}** 'There are no statistical differences among teachers in connection with *'Augmentation' in the backdrop of 'Understanding' and 'Applying'* while comparing Designation' is accepted (Table, 4.33).

H_{05c} There are no statistical differences among teachers in connection with *SAMR's 'Modification' in the backdrop of Bloom's 'Applying', 'Analyzing' and 'Evaluating'* while comparing Designation.

35. The ANOVA test compared the technology integration scores of teachers regarding their designation group in relation to *SAMR's 'Modification'* in the backdrop of Bloom's *'Applying', 'Analyzing'* and *'Evaluating'*. The results were significant at $F(548,3)=3.72$, where $p=.001$. Therefore, hypothesis **H_{05c}** 'There are no statistical differences among teachers in connection with *'Modification' in the backdrop of 'Applying', 'Analyzing' and 'Evaluating'* while comparing Designation' is rejected (Table, 4.34_a).

36. The Post Hoc Test assessed the statistical differences among teachers' technology integration with respect to their designation groups in relation to the third level of SAMR model, i.e., Modification. Results indicated that a statistical difference was determined between professors and participants having the designation of associate

professors, assistant professor and lecturers at p-values .048, .001 and .004 respectively. A statistical difference was also determined between associate professors and lecturers at a p-value of .004 (Table, 4.34_b).

H_{05d} There are no statistical differences among teachers in connection with *'Redefinition' in the backdrop of 'Evaluating' and 'Creating'* while comparing Designation.

37. The ANOVA test compared the technology integration scores of teachers regarding their designation group in relation to *SAMR's 'Redefinition'* in the backdrop of Bloom's '*Evaluating'* and '*Creating*'. The results were significant at $F(548,3)=3.39$ where *p=.001.* Therefore, the hypothesis **H_{05d}** 'There are no statistical differences among teachers in connection with *'Redefinition' in the backdrop of 'Evaluating' and 'Creating'* while comparing Designation' is rejected (Table, 4.35_a).

38. The Post Hoc Test assessed the statistical differences among teachers' technology integration with respect to their designation groups in relation to the fourth level of SAMR model, i.e., Redefinition. Results indicated that while comparing technology integration of the participants with respect to their designation at Modification level, a statistical difference was found between professors and assistant professors and lecturers at p-values of .001 and .045 respectively (Table, 4.35_b).

H_{06} There are no statistical differences among teachers' technology integration while comparing Disciplines.

39. The comparative analysis of technology integration scores of SS and MS teachers indicated that The results were found significant at $t(550)=3.99$ where *p=.00.* Therefore, there exists a significant difference in technology integration between SS (Mean=3.79) and MS (Mean=3.92) teachers. Results also indicate that MS teachers

(Mean=3.92) have significantly higher competency toward technology integration than SS teachers (Mean=3.79). The hypothesis **H_{06}** 'There are no differences among teachers' technology integration while comparing Discipline' is rejected (Table 4.36).

H_{06a} There are no statistical differences among teachers in connection with *'Substitution' in the backdrop of 'Remembering'* while comparing Discipline.

40. The comparative analysis of *'Substitution'* in the backdrop of '*Remembering*' regarding teachers' discipline indicated that the results were significant at $t(550)=2.67$ where $p=.001$. Therefore, there exists a significant difference in technology integration between SS (Mean=4.40) and MS (Mean=4.49) teachers. Results also indicate that MS teachers (Mean=4.49) have significantly higher competency toward technology integration than SS teachers (Mean=4.40). The hypothesis **H_{06a}** 'There are no statistical differences among teachers in connection with *'Substitution' in the backdrop of 'Remembering'* while comparing Discipline' is rejected (Table, 4.37).

H_{06b} There are no statistical differences among teachers in connection with *'Augmentation' in the backdrop of 'Understanding' and 'Applying'* while comparing Discipline.

41. The comparative analysis of *'Augmentation'* in the backdrop of *'Understanding'* and *'Applying'* regarding teachers' discipline indicated that the results were significant at $t(550)=4.67$ where $p=.001$. Therefore, there exists a significant difference in technology integration between SS (Mean=4.18) and MS (Mean=4.29) teachers. Results also indicate that MS teachers (Mean=4.29) have significantly higher competency toward technology integration than SS teachers (Mean=4.18). The hypothesis **H_{06b}** 'There are no statistical differences among teachers in connection with *'Augmentation' in the backdrop of 'Understanding' and 'Applying'* while comparing

Discipline' is rejected (Table, 4.38).

H_{06c} There are no statistical differences among teachers in connection with *'Modification' in the backdrop of 'Applying', 'Analyzing' and 'Evaluating'* while comparing Discipline.

42. The comparative analysis of *'Modification'* in the backdrop of *'Applying', 'Analyzing',* and *'Evaluating'* regarding teachers' discipline indicated that the results were significant at $t(550)=3.39$ where $p=.001$. Therefore, there exists a significant difference in technology integration between SS (Mean=3.60) and MS (Mean=3.72) teachers. Results also indicate that MS teachers (Mean=3.72) have significantly higher competency toward technology integration than SS teachers (Mean=3.60). The hypothesis **H_{06c}** 'There are no statistical differences among teachers in connection with *'Modification' in the backdrop of 'Applying', 'Analyzing' and 'Evaluating'* while comparing Discipline' is rejected (Table, 4.39).

H_{06d} There are no statistical differences among teachers in connection with *'Redefinition' in the backdrop of 'Evaluating' and 'Creating'* while comparing Discipline.

43. The comparative analysis of *'Redefinition'* in the backdrop of '*Evaluating'* and '*Creating*' regarding teachers' discipline indicated that the results were significant at $t(550)=2.95$ where $p=.001$. Therefore, there exists a significant difference in technology integration between SS (Mean=3.39) and MS (Mean=3.44) teachers. Results also indicate that MS teachers (Mean=3.44) have significantly higher competency toward technology integration than SS teachers (Mean=3.39). The hypothesis **H_{06d}** 'There are no statistical differences among teachers in connection with *'Redefinition' in the backdrop of 'Evaluating' and 'Creating'* while comparing Discipline' is rejected (Table, 4.40).

H_{07} There are no statistical differences among teachers' technology integration while comparing Age.

44. The ANOVA test compared the technology integration scores of teachers regarding their age. The results were significant at $F(548,3)=3.34$, where $p=.001$. Therefore, the hypothesis **H_{07}** 'There are no differences among teachers' technology integration while comparing Age' is rejected (Table, 4.41_a).

45. The Post Hoc test assessed the statistical differences among teachers' technology integration with respect to their age groups. Results indicated that a statistically significant difference was found between participants having ages ranging from 21-30 and participants having their age ranging from 31-40, 41-50, and more than 50 years at p-values of 0.041, .001 and .001 respectively. A statistically significant difference was also found between participants having ages ranging from 31-40 and those ranging from 41-50 and more than 50 years at p-values of .033 and .049 respectively (Table, 4.41_b).

H_{07a} There are no statistical differences among teachers in connection with *'Substitution' in the backdrop of 'Remembering'* while comparing Age.

46. The ANOVA test compared the technology integration scores of teachers regarding their age group in relation to *'Substitution'* in the backdrop of '*Remembering*'. The results were insignificant at $F(548,3)=2.11$ where $p=0.08$. Consequently, the hypothesis **H_{07a}** 'There are no statistical differences among teachers in connection with *'Substitution' in the backdrop of 'Remembering'* while comparing Age' is accepted (Table, 4.42).

H_{07b} There are no statistical differences among teachers in connection with *'Augmentation' in the backdrop of 'Understanding' and 'Applying'* while comparing Age.

47. The ANOVA test compared the technology integration scores of teachers regarding their age group in relation to *SAMR's 'Augmentation'* in the backdrop of Bloom's *'Understanding'* and *'Applying'*. The results were insignificant at $F(548,3)=1.12$, where $p=0.33$. Consequently, the hypothesis **H_{07b}** 'There are no statistical differences among teachers in connection with *'Augmentation' in the backdrop of 'Understanding' and 'Applying'* while comparing Age' is accepted (Table, 4.43).

H_{07c} There are no statistical differences among teachers in connection with *'Modification' in the backdrop of 'Applying', 'Analyzing' and 'Evaluating'* while comparing Age.

48. The ANOVA test compared the technology integration scores of teachers regarding their age group in relation to *'Modification'* in the backdrop of *'Applying', 'Analyzing'* and *'Evaluating'*. The results were significant at $F(548,3)=3.76$, where $p=.001$. Therefore, hypothesis **H_{07c}** 'There are no statistical differences among teachers in connection with *'Modification' in the backdrop of 'Applying', 'Analyzing' and 'Evaluating'* while comparing Age' is rejected (Table, 4.44_a).

49. The Post Hoc test assessed the statistical differences among teachers' technology integration with respect to their age groups in relation to the third level of SAMR model i.e. Modification. Results indicated that a statistically significant difference was found between participants having ages ranging from 21-30 and participants having ages ranging from 31-40, 41-50 and more than 50 years at p-values .033, .041 and .001 respectively. A statistically significant difference was also found between participants

having ages ranging from 31-40 and those ranging from 41-50 and more than 50 years at p-value .048 and .001 respectively. Furthermore, a statistically significant difference was also found between participants having ages ranging from 41-50 and more than 50 years at a p-value of .045 (Table, 4.44_b).

H_{07d} There are no statistical differences among teachers in connection with *'Redefinition' in the backdrop of 'Evaluating' and 'Creating'* while comparing Age.

50. The ANOVA test compared the technology integration scores of teachers regarding their age group in relation to *'Redefinition'* in the backdrop of '*Evaluating'* and '*Creating*'. The results were significant at $F(548,3)=4.51$, where $p=.001$. Therefore, it can be concluded that the hypothesis **H_{07d}** 'There are no statistical differences among teachers in connection with *'Redefinition' in the backdrop of 'Evaluating' and 'Creating'* while comparing Age' is rejected (Table, 4.45_a).

51. The Post Hoc test assessed the statistical differences among teachers' technology integration with respect to their age groups in relation to the fourth level of SAMR model, i.e., Redefinition. Results indicated that a statistically significant difference was found between participants having ages ranging from 21-30 and participants having ages ranging from 31-40, 41-50 and more than 50 years at p-values .040, .049 and .001 respectively. A statistically significant difference was also found between participants having ages ranging from 31-40 and participants having ages ranging from 41-50 and more than 50 years at p-value .045 and .001 respectively. Furthermore, a statistically significant difference was also found between participants ages ranging from 41-50 and more than 50 years at a p-value of .046 (Table, 4.45_b).

Section IV:

Objective 3- To explore the views of heads regarding faculty competence towards technology integration.

52. While describing teachers' technology integration level, heads of the department identified different aspects. Themes emerged from interview were teachers' meaning of the SAMR levels, greater learning at the higher levels (M&R), increased student and teacher motivation, student and teachers engagement, student participation, relevance to students' career, ease and accessibility of technology, ease of finding appropriate resources, improved instruction, ability to monitor student progress, reaching more students, enhanced content presentation, and increased access to curriculum.
53. During an interview about the transformation of technology integration practices, heads of the department identified different aspects. Themes that emerged from interview were concerns with the SAMR model, correct use of SAMR, various uses of technology, ways of learning about technology, self-teaching, self-motivation, collaboration with colleagues, professional development, strategies of teaching, grouping of students, purpose of lesson with technology and teacher expertise with technology.
54. However, describing the technology as an educational tool, heads of the department identified different aspects. Themes emerged from interview were technology as an enhancement tool, technology as a transformative instructional tool, professional training, curriculum integration, curriculum mapping, technology coaches, resources and existing infrastructure, plan for technological professional training, technological changes, self-reflection of teachers and technology as a distraction.
55. Mentioning the challenges of technology integration, heads of the department

identified different challenges. Themes emerged from interview were making it relevant, giving up control, moving to the next level, complicated interface of software, starting from the basics, inappropriate use, rigidity, job-embedded training, technological resources, hierarchical approach of the model, time constraints, relevance, student negligence, personal discomfort with technology, lack of access to technology, lack of differentiation, learning curve, and, limited impact of PD.

56. While describing teachers' technology integration can influence teachers' professional development, heads of the department identified different aspects. Themes emerged from interview were content area connections, online learning, instructional settings and digital content, pedagogical preferences, relevance of PD, format of PD, 21st century trends in education, impact of the presenter, choice of learning opportunities, and ongoing support in learning.

Section V: Comparison of Results

57. Inferential statistics revealed significant differences in teachers' technology integration in public and private sectors. Compared to other levels, the substitution level has shown smaller effect size and modification level has shown large effect size for private sector. Statistical differences existed among teachers' competency in technology integration based on gender. The augmentation level has shown a larger effect size compared to the other levels of technology integration.

58. The study further exposed that there were statistical differences between faculty members' technology integration based on their qualifications. Mean score of Ph.D. faculty members was higher as compared to others. Modification and Redefinition levels revealed statistical differences among teachers' competency in technology integration based on their qualifications. The study also revealed a significant difference between teachers based on their experience. Mean score of teachers with 7-

10 years' experience was higher as compared to other levels of experience. While analyzing the experience of teachers, a significant difference between teachers' competency was found at the upper two levels of SAMR model.

59. The research additionally uncovered statistical differences between faculty members based on their designation. The mean competency score of Associate professors was found to be higher than other designations. Furthermore, the first two levels substitution and augmentation, have shown no statistical difference between teachers' competency. The Post Hoc test analyzed the upper two levels (modification and redefinition) to apply the multiple comparisons. Statistical difference was observed between teachers based on their disciplines. The mean scores of Management Sciences teachers were higher than social sciences. The augmentation level has shown a larger effect size compared to the other levels of technology integration. Quantitative results further indicated that there existed a statistical difference between teachers' mean scores of technology integration based on the age groups. The mean score of teachers with age ranges from 31-40 years was higher than other ranges of participants' age. The same difference was also found at the upper two levels of the model.

60. The quantitative data analysis was based on five semi-structured questions. Those questions were asked from the heads of the departments to strengthen the quantitative results. The responses to the first question indicated that teachers in social sciences were practicing the technology integration at substitution level of the SAMR model. However, in a few cases, they used augmentation level. In Management Sciences teachers were found practicing and utilizing the ICT tools at augmentation and modification levels. The major themes that emerged from the first question were teachers' understanding of SAMR model and greater learning opportunities at higher levels of SAMR model. The model also increases the motivational level of students

and teachers.

61. The interview analysis further revealed that the use of SAMR model could transform the learning practices and technology integration competency of the teachers. The major themes that emerged from the thematic analysis were the greater concerns of the teachers with the SAMR model, the correct use of the model. Furthermore, the model can open various ways of learning and using the technology. The model offers different opportunities related to self-teaching. In a student-centered environment, it increases the self-motivation of the students. The thematic analysis further revealed that teachers use digital technology as an instructional tool. The themes that emerged from the third question were technology as an enhancement tool and technology as a transformative tool. It further indicates the requirement of professional training to integrate technology into the curriculum successfully. Technology coaches can guide teachers about the usage of digital tools. Curriculum mapping is felt necessary by the heads.

5.3 Discussions

First section of the study dealt with examining the faculty competence towards the technology integration at higher education level by keeping the focus on four sub-phases of the technology integration derived from the SAMR model, which were substitution (using technology as a substitute), augmentation (using technology as a direct substitute but with functional improvement), modification (Significant redesign of the task through appropriate technology) and redefinition (task those could not be done without technology). Results of the present study revealed that university teachers were practicing technology integration in the teaching and learning process. A study by Kilty (2019) determined the technology integration competencies among teachers and found similar results. Kilty found that teachers use content-specific technology and are knowledgeable about the content and pedagogical linkage of the technology being used. The study also suggests ways to prepare teachers to design and develop course units that facilitate technology integration in the classroom. Kilty also found that technology varies by type and user. Teachers were found using student-centered pedagogical technology. The type of technology has a more significant impact on STEM (Science, Technology Engineering, and Mathematics) disciplines. The way teachers integrate technology strategies and ideas impacts student learning. Results are also in line with the study conducted by Tietjen (2020) which shows that teachers mainly use a diffusion of innovation and purposeful design and technology. Tietjen discussed the views of administrators. Administrators were asked about their role as technology leaders. Participants understanding of technology integration changed due to the intervention of professional learning. Tietjen also found that professional development is the possible means of obtaining the proximal outcome and increased technology-related self-efficacy of administrators.

Present study has shown that Teachers use different ICT teaching and learning activities which include simulations, augmented reality, gaming, WebQuests, Blogging, data analysis software, content creation, group collaboration, research communication, and note taking, etc. Teachers were using these activities mainly in online teaching. These findings are in line with the study conducted by Martin (2020). Martin found that teachers were familiar with the technology and its use in the instruction process. Teachers were using various types of technology in educational settings. The practices reflected that teachers were on the substitution or augmentation levels of the SAMR model. Few teachers know exactly how to enhance their instruction to achieve the modification and redefinition levels. Martin also found that teachers have the same self-efficacy for technology regardless of the subject they are teaching.

Study further found that teachers were very much familiar with digital technology.

In online learning, teachers frequently make presentations using Google docs, voiceover tools and visual presentations. Teachers were using technology to enhance the teaching and learning process. Teachers were found actively engaged with LMS and Google classroom to provide the instruction. Li (2020) studied technology use and integration by trained teachers. To gain in-depth knowledge of teachers' competencies in using digital tools, the instructional practices were thoroughly described. Meaningful technology integration was observed in many of the participants' practices. Li also found that some participants do not have a clear vision of technology usage. Hence understanding the role of technology does not mean that teachers are capable of meaningful integration of technology. Wasilko (2020) conducted a study to explore technology implementation through student-centered learning. Wasilko found that student-centered classrooms have an overwhelming feeling associated with it. Teachers were enthusiastic about the content and technology tools and wanted to encourage their students to use digital tools. Wasilko further found that very few training opportunities were offered to teachers to integrate technology in the classroom.

The quantitative results showed that teachers could integrate technology at substitution and augmentation levels in the instruction process. Technology is used as an enhancement tool for instructional process. Before online learning teachers were inconsistent with technology integration. Results indicated that teachers have considerable knowledge in dealing with digital tools in the learning process and they frequently use technology to acquire and prepare the learning material. Teachers believed that ICT helped them to obtain information and relevant data quicker than a library. Teachers feel comfortable using the E-library and campus LMS to interact with the students. Results indicated that teachers can troubleshoot most of the technology-related issues. It was also found that integrating technology in learning enhanced the teachers' self-efficacy. Villeda (2019) found similar results and indicated that access to appropriate technology in the classroom is an excellent chance for teachers and students to enhance learning. It becomes easy for teachers to teach using different digital tools. Villeda found that effective use of technology can increase learning, creativity, communication, critical thinking and collaboration. Teachers need to foster a digital learning climate at every level. The study's findings were also consistent with the study conducted by Amick (2019) on six higher education teachers. The focus of the study was on changes in technology use and barriers to implementation. In this self-reported survey, Amick found that technology impacted how teachers plan and deliver lessons. Amick also found different barriers to planning lessons through technology, including lack of technical knowledge, time constraints and a crowded curriculum.

Survey results of the present study further indicated that teachers agreed that digital tools are valuable assets for teachers and that the use of technology provides various learning opportunities. Respondents were also found comfortable with integrating technology in foreign language classes. Teachers were found to prefer online learning material rather than printed media. Teachers were of the view that technology opens more ways in the teaching process and it also improves their teaching. Teachers can also produce their teaching material which ultimately gives them more control over their teaching. Perry (2018) studied teachers' attitudes and beliefs about technology integration. The data was gathered from 49 teachers. The results showed that teachers in the study had shown a reasonable level of comfort with the technology. The district has provided resources and time for the professional development of teachers. SAMR assessment indicated that teachers were indeed implementing technology in their classrooms.

The quantitative analysis further depicted that teachers found it easy to interact with foreign experts in the same field to discuss topics and educational matters. Digital tools also help teachers acquire the latest learning material which makes learning more enjoyable.

Teachers indicated that ICT helps improve the quality of teaching. Digital tools also enhance the creativity and problem-solving skills of the students. These results were consistent with the study conducted by Heberer (2021) based on the PICRAT matrix. Heberer examined the teachers' perceptions and technology integration. The study found an immediate shift in the teachers' perceptions after attending the training regarding technology integration. As a result of focused professional development teachers were able to integrate technology at higher levels of integration. Cotton (2021) used SAMR model and conducted a study to assess the in-service teachers' ability to integrate technology. Cotton used Technology Acceptance Model 2 and SAMR model to obtain the self-perceived ability of 131 teachers regarding technology integration. Cotton found that participants were confident in using technology in classroom. They perceived technology as an important tool for their job as a teachers. However, TAM2 scores of teachers significantly different from their self-reported SAMR scores in terms of integrating technology while planning lessons.

Results of the study indicated that teachers feel comfortable using digital tools in the learning process. The use of digital tools saves much time as well as makes the learning process smoother. Participants indicated that the use of technology is productive for the learning process. Teachers informed that they prefer searching the supporting material on the internet before delivering lectures. Self-perceived results indicated that students could search for information about the relevant topic. The use of technology in the classrooms enhances the interest of teachers and students and opens ways for students to understand a concept. According to participants, the use of technology enhances student learning. These results were consistent with the study by Bradley (2020) who conducted a study based on six-week training of teachers. Bradley found a positive correlation between professional development and thoughtful technology integration of teachers. Bradly suggested collaboration between participants when integrating technology. Bradly commented that professional development should focus on meeting the best practices and provide teachers an experience that enables them to develop strategies and tools necessary for technology integration. These results were in line with the study of Collins (2018) on differentiated instruction. Collins found that technology cannot be ignored in instruction as it is part of 21st-century skills. Collins also mentioned that various technologies could be used to differentiate instruction, technology can be helpful to assess student learning and specific technologies can be selected for group activities. Culver (2017) studied teachers' perceptions of their technology integration. The study aimed to assess the technology proficiency of 150 teachers. Culver found that teachers' experience with technology, training and proficiency in digital tools significantly impacts their competency in technology integration in the classroom.

Present research explored sector-wise differences in technology integration competencies and proficiency in using digital tools. The sector-wise comparison was conducted because it is the area of interest in Pakistan. There is evident competition between private and public sector institutions. The second objective was to determine the difference in faculty competence towards technology integration based on the sector at the university level. The objective dealt with four sub-variables of technology integration which were substitution, augmentation, modification and redefinition. The study found significant differences in technology integration of public and private sector university teachers. This finding was consistent with the study conducted by Suleman *et al.* (2012) in which they found that private sector teachers were more proficient in using the digital tool in their instruction.

The results of the study were contradictory to the study conducted by Afridi & Chaudhry (2019). They conducted a study to investigate technology adoption and integration in public and private sectors. They found no significant difference of opinion among teachers based on sectors. Most of the teachers were not aware of technology integration models. This is because the institutions have not provided any pre-service training skills and they tend to use traditional methods of teaching. The reason behind the findings of the current study may be that there is more competition in private sector universities and private sector institutions work more on the professional development of their teachers. While in public sector universities, the majority of the teachers are permanent faculty members and have job security which creates more room for collaboration among teachers. Another reason may be the cultural and environmental differences in both sectors. Private sector institutions provide more exposure and public sector universities have rules and regulations for their employees which ultimately decreases their exposure level.

The study also intended to assess the gender base differences in technology integration proficiency of teachers. Gender-wise comparison is also an area of interest for so many years. Men and women differ in many ways, including psychological characteristics and biological phenotypes. Feminine psychologists believe that women generally have more experience in thinking and interpreting the current scenario. Women actively seek self-analysis and self-understanding (Tunjera & Chigona, 2020). The third objective also dealt with four sub-variables of the study. A significant difference was found between technology integration scores of male and female teachers. This finding was in line with the study by Fallatah (2019) which found a significant difference between male and female respondents regarding technology integration. Further, it was found that male teachers were more proficient in technology integration than female teachers. These findings were contradictory to the findings of some studies in which female teachers outperform men in technology integration. Some studies found no significant difference based on gender regarding technology integration (Culver, 2017; Afridi & Chaudhry, 2019). The study's results were also in line with the study of Sharpton (2021) which found a significant difference between technology integration scores of male and female teachers. In the present study male respondents were more proficient in technology integration than female respondents. It may be because males are more concerned about their professional development and have more time to improve themselves in the profession. In South Asian culture working women have more responsibilities inside the home and in the profession. That is why they find less time to learn new digital tools.

A significant difference was found between the technology integration competencies of faculty members based on qualification at the higher education level. So the third hypothesis that there is no significant difference between mean technology integration scores of faculty members based on qualification at higher education level was rejected. It was found that more qualified teachers were better compared to less qualified teachers in their proficiency in integrating instructional activities at modification and redefinition levels, except for integrating the instruction at substitution and augmentation levels on which no difference between faculty members' opinions was observed. The results of the study were in line with the study conducted by Thomas (2018) on the utilization of technology in higher education. The study found a significant difference between teachers' utilization of technology based on their qualifications. A study conducted by Young (2012) divided teachers into groups to assess their technology integration competencies related to 21st-century learning skills; the results were contradictory to the results of the present study. Present study findings are in line with the findings of Beeson (2013) who conducted a qualitative study on teachers' knowledge of planning for technology integration and found that strong technological knowledge influences the teachers' ability to develop technological content. Dullien (2016) on the other hand, found a difference between the technology integration practices of newly appointed and senior teachers. It can be concluded that fresh teachers who join the teaching profession after post-graduation are found to be more proficient in integrating digital tools in their instructional process. The reason behind it could be that they recently have used the latest digital tools while completing their studies and applying the same in their teaching. As the new digital tools are emerging students are teachers try to perform tasks with the latest technology. Therefore it can be concluded that M.Phil. teachers are more proficient with technology and try to teach with new digital tools at a higher level of technology integration.

Results indicated a significant difference between technology integration competencies of faculty members based on their teaching experience at the higher education level. So the fourth hypothesis that there is no significant difference between mean technology integration scores of faculty members based on teaching experience at higher education level was rejected. Teachers having more than ten years' experience were found better as compared to respondents having teaching experience of fewer than three years, three to six years, or seven to ten years in their proficiency in integrating instructional activities at modification and redefinition levels except for integrating the instruction at substitution and augmentation levels on which no difference between faculty members' opinion was observed. These findings were consistent with the study conducted by Louis (2012) in which a significant difference was found in teachers' technology integration practices concerning 21st-century skills. Ritter (2016) observed that years of prior work experience have a lesser effect on teachers' technology integration. Ritter also found the experienced teachers more open to learning new technologies and skills that ultimately allow them to integrate technology-driven activities in the classroom.

Study found a significant difference between technology integration competencies of faculty members based on their designation at the higher education level. So the fifth hypothesis that there is no significant difference between mean technology integration scores of faculty members based on designation at the higher education level was rejected.

Teachers having the designation of associate professor were found better as compared to respondents having the designation of lecturer, assistant professor and professors about their proficiency in integrating instructional activities at modification and redefinition levels except for integrating the instruction at substitution and augmentation levels on which no difference between faculty members' competency was observed. A study by Savignano (2017) supports the findings of the present study by revealing that the designation plays an important role in the change in the pedagogy through technology and promotes positive student learning experiences. Duffy (2018) studied technology initiatives and career readiness and found similar results. Asad *et al.* (2020) conducted a study on the technology integration of higher education teachers and found significant differences within teachers' technology integration based on designation.

Findings of the study revealed a significant difference between technology integration competencies of faculty members based on their disciplines at higher education level. So the sixth hypothesis that there is no significant difference between mean technology integration scores of faculty members based on discipline at higher education level was rejected. Teachers of management sciences discipline were found to be better than respondents of social sciences regarding their proficiency in integrating instructional activities at every model level. Bajabaa (2017) found a different level of technology integration competency of teachers within different disciplines. Bajabaa mentioned that teachers have constructivist pedagogical beliefs and they use technology at a higher level to design effective learning content. Present study findings are consistent with the findings of Sawyer (2017) which explored teachers' level of technology integration in the classroom and found a difference among teachers' perceptions and level of technology integration on the basis of discipline. Hammett (2018) conducted a study on technology integration and found a significant role of disciplines in preparing the faculty to integrate technology into teaching and learning.

Inferential statistics on the data indicated a significant difference between technology integration competencies of faculty members based on their age groups at higher education levels. So the seventh hypothesis that there is no significant difference between mean technology integration scores of faculty members based on age at higher education level was rejected. Teachers from age 31-40 years were found better as compared to teachers of other age groups including 21-30 years, 41-50 years and more than 50 years in their proficiency in integrating instructional activities at modification and redefinition levels except integrating the instruction at substitution and augmentation levels on which no difference between faculty members' competency was observed. These results were in line with the study conducted by Patton (2015) which shows that there exists a positive relationship between teachers' age and technology integration. Patton further mentioned that relevant professional development could enhance technology integration in a meaningful way. A study by Bruton (2018) supports the findings of the present study by revealing that young teachers are more tech-savvy and possess self-paced experience with technology as compared to senior teachers. Bruton further indicated that teachers who are new to the profession are exposed to more specialized training and tend to be using digital tools. The present study results were also consistent with the study conducted by Wilson (2021) which shows that younger teachers tend to properly integrate technology in the classroom and move to higher level of SAMR model. Wilson further mentioned that younger teachers keep students engaged and motivated in the lesson.

Analysis of semi-structured interview results indicated various themes that emerged from the responses of heads of departments. First interview questions probed heads about teachers' technology integration in their classrooms. Through analysis and coding of responses different themes emerged, which included teachers' meaning of the SAMR levels, greater learning at the higher levels, increased student and teacher motivation, student and teachers engagement, student participation, relevance to students' career, ease and accessibility of technology, ease of finding appropriate resources, improved instruction, ability to monitor student progress, reaching more students, enhanced content presentation and increased access to curriculum. These themes were found consistent with various qualitative studies in which researchers found similar themes (Patton, 2015; Savignano, 2017; Duffy, 2018; Wilson, 2021)

Second interview question investigated heads about, how does technology integration transform teachers' instructional practices? Through analysis and coding of responses different themes emerged, which included concerns with the model, correct use of model, various uses of technology, ways of learning about technology, self-teaching, self-motivation, collaboration with colleagues, professional development, strategies of teaching, grouping of students, purpose of lesson with technology and teacher expertise with technology. These themes were found consistent with various qualitative studies in which researchers found similar themes (Donnelly, & Kyei-Blankson, 2015; Cox, 2019; James, 2020). Additionally, McKnight *et al*. (2016) informed that technology integration foster a student-centered classroom and improve student performance.

Third interview question explored heads' views on digital technology as an instructional tool. Through analysis and coding of responses different themes emerged, which included technology as an enhancement tool, technology as a transformative instructional tool, professional training, curriculum integration, curriculum mapping, technology coaches, resources and existing infrastructure, plan for technological professional training, technological changes, self-reflection of teachers and technology as a distraction. These themes were found consistent with various qualitative studies in which researchers found similar themes (Hamilton *et al*., 2016; Bicer, & Capraro, 2017; Green, 2019; Cotton, 2021).

Fourth interview question explored challenges can teachers encounter with the implementation of instructional activities based on technology. Through analysis and coding of responses different themes emerged, which included making it relevant, giving up control, moving to the next level, the complicated interface of software, starting from the basics, inappropriate use, rigidity, job-embedded training, technological resources, hierarchical approach of the model, time constraints, relevance, student negligence, personal discomfort with technology, lack of access to technology, lack of differentiation, learning curve and limited impact of professional development. These themes were found consistent with various qualitative studies in which researchers found similar themes (Warschauer, & Matuchiak, 2010; Williams, 2015; Sroka, 2020).

Fifth interview question explored, how technology integration can influence teachers' professional development needs? Through analysis and coding of responses different themes emerged, which included content area connections, online learning, instructional settings and digital content, pedagogical preferences, relevance of professional development, format of professional development, 21st-century trends in education, impact of the presenter, choice of learning opportunities, ongoing support in learning. These themes were found consistent with various qualitative studies in which researchers found similar themes (Jenkins, 2021; Romrell, Kidder, & Wood, 2014; Bataller, 2018; Rubalcaba, 2021).

Comparison of quantitative & qualitative analysis showed connections worthy of note. The qualitative data were analyzed within the context of quantitative data. The two data sets seemed aligned so that teachers' perceptions were paralleled with the heads' perceptions. Heads and faculty members agreed that technology integration at higher stages of any model needs more planning time. Both participants found that monitoring learners while working with digital technology was challenging. Teachers have to work more on reducing the off-task behavior of the learners. Teachers can actively check on students but there is no perfect solution to this problem. Participants further agreed that higher use of the technology integration model could increase the student outcome in a meaningful way. A theme in qualitative data pointed to the essence of focused integration rather than trying to integrate technology at higher level. This issue will further be addressed in the recommendation section. Maxey & Norman (2019) opined that parallel views of administrators and teachers are necessary for meaningful technology integration. These themes were consistent with various qualitative studies in which researchers found similar themes (Barnello, 2017; Bataller, 2018; Barnello, 2017; Savignano, 2017; Maxey & Norman, 2019; Jenkins, 2021).

5.4 Conclusions

Following conclusions were drawn from the findings of the study

Objective 1- To examine the faculty perceptions regarding their competence towards technology integration at higher education level with reference to SAMR model in the backdrop of Bloom's taxonomy.

Study concluded that teachers possess the technology integration competencies and often integrate technology in the teaching process. They can practice technology integration at the Substitution and Augmentation levels of the SAMR Model. The study indicated that most respondents were practicing ICT learning activities at the first two levels of the SAMR model. For instance, Note taking and the teachers performed content creation tasks through digital tools at the augmentation level. Results also indicate that Research activity was mainly performed at first two levels of the model. The study further concluded that most respondents were practicing ICT learning activities in Online Teaching. For instance, the Note-taking task was performed by the teachers through digital tools. Also for instance, the Content Creation activity was mainly dealt with online. Results also indicate that Research activity was also mainly performed online.

Participants mentioned that they must work with a laptop/ computer. Respondents were of the view that working with a computer is helpful and technology provides fast and efficient means to enhance student learning. Teachers think that ICT provides information quicker than the library. Teachers mentioned that they have considerable knowledge in integrating ICT in the learning process. Teachers often use ICT to acquire information and prepare learning material. Participants further indicated that if there is any difficulty while using technology, they can troubleshoot it.

Objective 2- To identify the differences in faculty competence towards technology integration at higher education level based on sector, gender, qualifications, experience, designations, disciplines and ages.

The results showed a significant difference in technology integration between public and private sector teachers. Private sector teachers possess significantly higher competency toward technology integration than public sector teachers.

The comparative analysis of technology integration scores of male and female teachers indicated that the results were found significant. While comparing the difference in scores based on teachers' qualifications. It was concluded that teachers having Ph.D. degrees were found to be more competent in technology integration as compared to M.Phil. and Post Doc. degree holders. The said difference can mainly be observed in the Transformation phase of the model i.e. modification and redefinition phase.

It was concluded that there was a significant effect of teachers' experience on their competency in technology integration. Teachers having more than 10 years of experience were found to be more competent in technology integration as compared to less than 3 years, three to six years and seven to ten years.

A major difference in technology integration was observed across faculty and disciplines. It was also concluded that teachers of management sciences were found more competent in technology integration than faculty of Social sciences. The study further concluded that there was a significant effect of teachers' age on their competency in technology integration. The teachers having age 31-40 were found to be more competent in technology integration as compared to teachers belonging to other age groups. The said differences can mainly be observed in the Transformation phase of the model i.e. modification and redefinition phase.

Objective 3- To explore the views of heads regarding faculty competence towards technology integration.

The quantitative data analysis was based on five semi-structured questions. Those questions were asked from the heads of the departments to strengthen the quantitative results. The responses indicated that teachers in social sciences were practicing the technology integration at the substitution level of the SAMR model but in a few cases, they used augmentation level. In management sciences, teachers were found practicing and utilizing the ICT tools at augmentation and modification levels. The major themes that emerged from the questions were teachers' understanding of SAMR model and more significant learning opportunities at higher levels of SAMR model. The model also increases the motivational level of students and teachers.

Comparison of Results

Technology integration is being practiced in higher education institutions in Pakistan. Education policies also indicated the importance of ICT in the instructional process. Information and communication technology provides various means to enhance learning skills and teaching abilities. The results indicated that teachers' technology integration could be placed at the first two levels of the SAMR model i.e. enhancement phase. Results further revealed that most respondents practiced ICT learning activities at the first two levels of the SAMR model. For instance, research activities were performed by the teachers through the integration of digital tools at augmentation level. Additionally results indicated that there existed significant differences among teachers' technology integration based on the sector, gender, qualification, experience, designation, disciplines and ages. The modification and redefinition levels have shown a more significant effect size. Modification and Redefinition levels revealed statistical differences among teachers' competency in technology integration based on each demographic variable. Several challenges are involved in this context especially the relevancy of the SAMR model with instructional activities, giving up control to the students, and moving to the next level of the model with suitable technology. Professional development may play an important role in enhancing the technology integration competency of the teachers.

5.5 Recommendations

Recommendations for enhancing teachers' technology integration are based on the research's most recent results.

1. Self-perception scores of faculty members indicated that majority of the faculty members are practicing technology integration at first two levels of the Model. It is recommended that digitalization in learning processes may be streamlined by devising course learning objectives with reference to Bloom's taxonomy keeping the SAMR level at parallel. Faculty must acquire and master the skills necessary to transition their conventional approaches and techniques to an online educational environment.

2. The study found significant differences in technology integration while assessing

teachers' technology integration. Management of HEIs may focus on building technology competence among faculty of the public sector. Furthermore, less qualified, less experienced and lower designations among faculty may be provided periodic training, monetary rewards (performance-based bonuses, merit-based raises, research stipends, grant funding, professional development funding, and retention bonuses) and non-monetary rewards (certificates, acknowledgements, appreciation letters, recognition and awards) and exposure to a more digitalized environment.

3. To deal with challenges faced by teachers during technology integration. University management may provide specific planning initiatives for professional development of faculty to overcome the challenges of technology integration. Professional development may ensure that teachers with limited competency can master accessible technology and that teachers with more excellent competency sets can interact with innovative and modern digital media.

4. It is recommended that universities may implement the proposed model to assist teachers in comprehending the many stages of successful technology integration. Additionally, administrators or program leaders will benefit from the proposed model while performing instructional observations to ascertain the extent and efficacy of technology integration.

5. Qualitative analysis depicted that technology adoption is challenging for some teachers. Institutions may provide opportunities for faculty to attend workshops and training sessions to enhance their skills and knowledge in this area. Collaboration can help faculty members learn from each other and share their expertise. Institutions can create a culture of collaboration and provide platforms for faculty members to

work together on projects.

6. This research established that teachers integrated technology mainly at substitution and augmentation levels. It is recommended that teachers may analyze their present level of comprehension and efficiency and adjust their blended learning to achieve the higher criteria of technology utilization, integration, and transformations. To achieve this teachers can use proposed model of technology integration.

7. The study found that appropriate professional development can allow teachers to go back and review the concept they are teaching and try to improve and implement those concepts through digital tools. Management may encourage the use of technology in the classroom by providing faculty members with the necessary tools and resources. This can help to create a more engaging and interactive learning environment for students.

8. The findings of the study revealed that teachers have time restrictions when it comes to professional development. Management may provide support to faculty members who are struggling with technology integration. This can include one-on-one coaching or mentoring, as well as technical support.

9. Management may evaluate the effectiveness of technology integration by gathering feedback from students and faculty members. This can help to identify areas for improvement and ensure that technology is being used in a way that enhances the learning experience for students.

10. Future professional development may foster a culture of innovation by encouraging faculty members to experiment with new technologies and teaching methods. This can help to keep teaching practices up-to-date and ensure that

students are receiving the best possible education.

5.5.1 Future Research

Future research opportunities are mentioned as under:

1. Additional studies are necessary to represent better online teaching techniques, resources, devices, and systems that may be required and how to evaluate learners' online technology-based practices.
2. Additional research based on the concept and methodologies utilized in this study will continue to assist teachers, whether beginners or masters, by inspiring additional investigation and evaluation into successful integration, best practices, and optimum technology blending.
3. Future studies in technology integration competencies may build on this mixed-method study by involving more teachers, each with their own particular situations, and expanding on the abundant data gathered via interviews, analysis of instructional plans, and class observations.
4. Future qualitative research might also examine how teachers perceive, establish, and implement technology integration in a higher education setting prior to and after technology integration training.
5. Longitudinal research is also necessary to examine faculty utilization of technology in higher education programs, examining how faculty utilize technology in their classes over particular time. A longitudinal study would provide other higher education institutions with guidance on how to structure their faculty development programs in light of the findings.
6. Similar research approach may be used to determine the efficacy of targeted training provided to teachers, as well as to request supplementary technological devices necessary to enhance technology integration practices.

Objective 4- To propose a model for technology integration based on research.

5.6 Proposed Model of Technology Integration in Pakistan

The researcher has reviewed various models for technology integration globally and analyzed the present scenario of technology integration in higher education in Pakistan. Keeping in view the global trends of technology integration and in the light of findings, conclusions and recommendations, the study proposed a model for improving technology integration in Pakistan.

The qualitative analysis provided in depth view of teachers' technology integration at higher education level, transformation of instructional practices using any model e.g. SAMR etc., instructional technology as educational tool, challenges of technology integration and effects of instructional technology on teachers' professional development needs. The themes obtained from the qualitative phase provided variety of input which formed the final design of the proposed model.

The model is flexible enough to cope with technological changes and reforms in HEIs. The phases of the model are interlinked and feedback from stakeholders directly goes back to the system in the form of opinions and suggestions to effectively incorporate technology. The perceptions of stakeholders can improve the internal efficiency of HEIs.

To verify the face and content validity of the proposed model, it was presented to three educationists, and improvements were made as suggested. The model was given a particular shape and was illustrated accordingly. The proposed model is open for future research, testing and improvement.

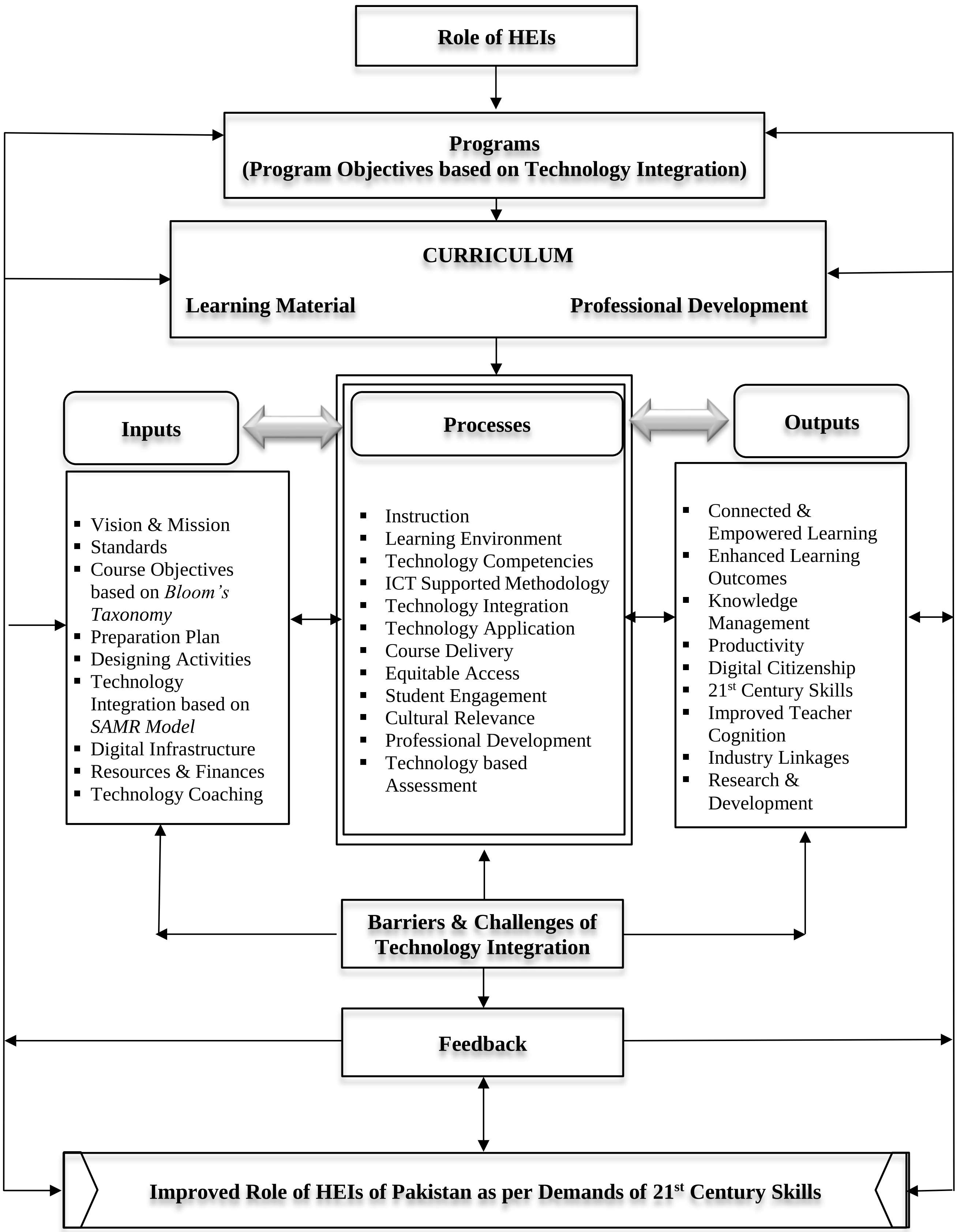

Figure 29: **Proposed Model for Technology Integration in Pakistan**

5.6.1 Development of Model

Technology integration model consists of the following components:

i. Title
ii. Rationale
iii. Objectives
iv. Inputs
v. Processes
vi. Outputs
vii. Barriers & Challenges
viii. Feedback

5.6.2 Description of Model

5.6.2.1 Title

Model for Technology Integration in Pakistan.

5.6.2.2 Rationale

Technology integration is a fundamental concept to attain the desired goals in face-to-face and online learning. After the COVID-19 pandemic institutions at every level has to prove their better instructional network according to the feasibility of the teachers, students and other stakeholders. Therefore, it is essential to how higher education institutions cater to the needs of ICT and how HEIs to help students cope with technology-related challenges.

In lieu of its importance, various strategies are adopted for coping with technology integration challenges in HEIs. Existing model of technology integration could accelerate the expected pace of learning in both face-to-face and online learning. A model of technology integration is a plan whom teachers can use to design face-to-face and online learning activities in HEIs.

5.6.2.3 *Objectives*

The objectives of the proposed model are as follows:

1. To provide various opportunities for faculty to select appropriate instructional methodologies.
2. To develop skills in using fundamental methods, techniques and procedures of teaching with ICT.
3. To develop desirable attitudes, professional interests, and ideas relative to technology integration.

5.6.2.4 *Inputs*

1. Vision & Mission
2. Standards
3. Course Objectives based on *Bloom's Taxonomy*
4. Preparation Plan
5. Designing Activities
6. Technology Integration based on *SAMR Model*
   - However educators may feel pressure to achieve the higher level on SAMR, believing the higher the better. Therefore, It is suggested to ignore the levels of the model, and consider integrating technology at any appropriate level. The levels will still retain their concept, and reducing the pressure for faculty to utilize technology at higher level.
7. Digital Infrastructure
8. Resources & Finances
9. Technology Coaching

5.6.2.5 *Processes*

1. Learning Environment
2. Instruction
3. Technology Competencies
4. ICT Supported Methodology
5. Technology Integration
6. Technology Application
7. Course Delivery

8. Equitable Access
9. Student Engagement
10. Cultural Relevance
11. Professional Development
12. Technology based Assessment

5.6.2.6 Outputs

1. Connected & Empowered Learning
2. Enhanced Learning Outcomes
3. Knowledge Management
4. Productivity
5. Digital Citizenship
6. 21st Century Skills
7. Improved Teacher Cognition
8. Industry Linkages
9. Research & Development

5.6.2.7 Feedback

Feedback loop is the highest priority in this model. The feedback plays a crucial role in bringing reforms to the higher education system. The process allows indicating students' needs and problems. The feedback loop indicates the dynamic nature of the model. Improvements and reforms whether they are in methodologies, content, support services and assessment processes greatly impact students. The model interrelates all components including stakeholders' feedback.

5.6.3 Future Research on Proposed Model

The proposed model is open for future research, testing and improvements. Proposed model of technology integration can be tested in both online, hybrid and face to face learning.

5.6.4 Preferences of Proposed Model

The faculty may prefer the proposed model under but not limited to the following educational settings:

1. The model can be used in any educational setting where technology is being utilized. It is a flexible framework that can be applied to a variety of educational contexts, such as higher education institutions and professional development programs.
2. The preference in using the model depends on the goals and objectives of the educational setting and the technology being used. For example, using the model to simply enhance traditional teaching methods with technology, or completely transform the learning experience.
3. Integrating technology into traditional lecture-based courses for increased student engagement and interaction.
4. Utilizing technology to facilitate project-based learning, allowing for increased collaboration and creativity.
5. Implementing technology-enhanced assessments to provide immediate feedback and improve assessment accuracy.
6. Using technology-based tools to facilitate online discussions and collaboration among students.
7. Implementing technology to support personalized learning and accommodate different learning styles.
8. Using technology to provide students with access to a wide range of multimedia resources and interactive activities.
9. Enhancing simulations and interactive experiences to improve student understanding of complex concepts.
10. Incorporating technology-based tools and resources to support the development of

critical thinking and problem-solving skills.

11. Using technology to facilitate and support student-led research projects and independent studies.

Ultimately, the preference in using the proposed model depends on the individual needs and goals of the educational setting and the teacher's comfort level with incorporating technology into their teaching practice.

5.7 Limitations of the Study

The first limitation is related to the type of data collection. Due to the government policies on COVID-19, the researcher collected self-reported data, without actually seeing the classroom instruction. Research is based on the instruments designed to collect data. The actual practice of technology integration cannot be verified. To overcome this challenge the researcher conducted semi-structured interview to support the findings of the quantitative aspects of the study as multiple sources of data strengthen the validity of study findings (Creswell, 2018). Secondly, the respondents were concerning about the confidentiality of the information they were providing. For this purpose the identities of the respondents were canceled.

After the COVID-19 pandemic, teachers were forced to virtual instruction overnight. This change was distressing for all academics and learners. This historic transformation in education, technology resources and how a particular institution responded to shift of virtual learning, this might have effect on teachers' beliefs, attitudes, perceptions and willingness to participate in the study about educational technology.

Creswell (2018) mentioned that the major limitation of the mixed method study is the possibility of discrepancies between the two data types (quantitative and qualitative). Second major limitation indicated by Creswell (2018) is that the mixed method study requires a particular transformation for integrating results in the analysis phase.

5.8 Concluding Remarks

The study ventured to find the perceptions of faculty and heads regarding technology integration at higher education level. Data obtained from heads and teachers showed that they had their own comforts and levels for integration, concerns and struggles regarding technology integration. In general, faculty is competent enough to integrate technology at appropriate level. Implementing above-mentioned recommendations, all of which are purely based on findings of research, would mark a determined effort towards improving instructional practices though digital technology.

Table 5.1a

Comprehensive review of the Study (n_1=552 & n_2=30)

Sr#	Objectives/Hypotheses	Findings	Conclusions	Recommendations
1	***Obj. 1:*** To examine the faculty perceptions regarding their competence towards technology integration at the higher education level with reference to SAMR model in the backdrop of Bloom's taxonomy.	Self-perception scores of faculty members regarding their competence in technology integration indicated that Substitution indicates high mean scores (Mean=4.51). The second dimension i.e. Augmentation indicated high mean scores (Mean=4.33). The third dimension i.e. Modification indicates medium mean scores (Mean=3.78). The fourth dimension i.e. Redefinition indicates low mean scores (Mean=3.45). Results obtain through mean scores indicate that majority of the faculty members are practicing technology integration at first two levels of the Model (Table, 4.9 to 4.10)	Teachers integrating technology integration at the Substitution and Augmentation level of the SAMR Model. The study concluded that most respondents practiced ICT learning activities at the first two levels of the SAMR model. For instance, Note-taking task was performed by the teachers through digital tools at Augmentation level. Also, for instance, the Content Creation activity was mainly dealt at Augmentation level. Results also indicate that Research activity was mainly performed at the first two levels of the model. The study further concluded that most respondents were practicing ICT learning activities in Online Teaching. For instance, Note-taking task was performed by the teachers through digital tools. Also for instance, the Content Creation activity was mainly dealt online. Results also indicate that Research activity was also mainly performed online.	University management may focus on the enhancement of ICT integration towards the transformation process by providing a digitalized environment by constituting proper ICT directorates. Digitalization in learning processes may be streamlined by devising course learning objectives with reference to Bloom's taxonomy.

Table 5.1b

Comprehensive review of the Study (n_1=552 & n_2=30)

Sr#	Objectives/Hypotheses	Findings	Conclusions	Recommendations
2	***Obj. 2:*** To identify the differences in faculty competence towards technology integration at higher education level based on sector, gender, qualifications, experience, designations, disciplines, and ages. **$H_{01\ to\ 07}$:** There are no statistical differences among teachers' technology integration while comparing sectors, gender, qualifications, experience, designations, disciplines and ages.	The results depicted significant differences in technology integration between teachers while comparing sectors, gender, qualifications, experience, designations, disciplines and ages. The hypotheses **$H_{01\ to\ 07}$** were rejected and further analyzed for supporting tests (Table 4.11 - 4.45).	The results depicted that there exists a significant difference in technology integration between teachers while comparing sector, gender, qualification, experience, designation, disciplines, and age. Private sector teachers possess significantly higher competency, male teachers have significantly higher competency, Teachers having Ph.D. degrees were found more competent, Teachers having more than 10 years of experience were found more competent in technology integration, The teachers of management sciences were found more competent in technology integration as compare to teachers belong to social sciences, The teachers having age 31-40 were found more competent in technology integration as compare to teachers belong to other age groups, towards their technology integration.	Administration of HEIs may focus on building technology competence among female faculty and faculty of the public sector. Furthermore, less qualified, less experienced and lower designations among faculty need more focus on digital literacy so that they are enabled to move towards modification and redefinition levels. This may be attained by providing periodic training, monetary and non-monetary rewards, and exposure to a more digitalized environment.

Table 5.1c

Comprehensive review of the Study (n_1=552 & n_2=30)

Sr#	Objectives/Hypotheses	Findings	Conclusions	Recommendations
3	***Obj. 3:*** To explore the views of heads regarding faculty competence towards technology integration.	The interview analysis further revealed that the use of SAMR model could transform the learning practices and technology integration competency of the teachers. The major themes that emerged from the thematic analysis were the greater concerns of the teachers with the SAMR model, and the correct use of the model. Furthermore, the model can open various ways of learning and using the technology. The model offers different opportunities related to self-teaching. In a student-centered environment, it increases the self-motivation of the students. The thematic analysis further revealed that teachers use digital technology as an instructional tool. The themes that emerged from the third question were technology as an enhancement tool, technology as a transformative tool. It further indicates the requirement of professional training to successful integration the technology into the curriculum. Technology coaches can guide teachers about the usage of digital tools. Curriculum mapping is felt necessary by the heads.	The quantitative data analysis was based on five semi-structured questions. Those questions were asked from the heads of the departments to strengthen the quantitative results. The responses indicated that teachers in social sciences were practicing the technology integration at substitution level of the SAMR model but in a few cases, they used augmentation level. In management sciences, teachers were found practicing and utilizing the ICT tools at augmentation and modification level. The significant themes that emerged from the questions were teachers' understanding of SAMR model and more significant learning opportunities at higher levels of SAMR model. The model also increases the motivational level of students and teachers.	University management may provide specific planning initiatives for PD of faculty to overcome the challenges of technology integration. PD may ensure that teachers with limited competency can master accessible technology and that teachers with more excellent competency sets can interact with innovative and modern digital media.

Table 5.1d

Comprehensive review of the Study (n_1=552 & n_2=30)

Sr#	Objectives/Hypotheses	Findings	Conclusions	Recommendations
4	***Obj. 4:*** To propose a model for technology integration based on gaps identified through research.	This research established that teachers integrated technology mainly at three levels, substitution, augmentation, and modification (to some extent). Without the appropriate tool, it would have been impossible to determine the effectiveness of technological integration.	While comparing the difference in results on the basis of disciplines. It can be concluded that there was a significant effect of teachers' discipline on their competency in technology integration. The teachers of management sciences were found more competent in technology integration as compared to teachers belonging to social sciences. The said difference can mainly be observed in Transformation phase of the model i.e. modification and redefinition phase.	It is recommended that universities may implement the proposed model to assist teachers in comprehending the many stages of successful technology integration. Additionally, administrators or program leaders will benefit from the proposed model while performing instructional observations to ascertain the extent and efficacy of technology integration. The proposed model is open for future research, testing, and improvement.

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APPENDICES

Appendix A

TOPIC APPROVAL LETTER

NATIONAL UNIVERSITY OF MODERN LANGUAGES
FACULTY OF SOCIAL SCIENCES
DEPARTMENT OF EDUCATION

ML.1-4/2017/Edu Dated: 09-02-2021

To: **Zia Ur Rehman,**
783-Ph.D/Edu/F18

Subject: **APPROVAL OF Ph.D THESIS TOPIC AND SUPERVISOR**

1. Reference to Letter No, ML.1/2/2020-Edu, dated 25-01-2020, the Higher Authority has approved the topic and supervisor on the recommendation of Faculty Board of Studies vide its meeting held on 16th Oct 2020.

a. **Supervisor's Name & Designation**
Dr. Wajeeha Shahid,
Assistant Professor,
Department of Education NUML, Islamabad.

b. **Topic of Thesis**

"An Investigation of Faculty Competence towards Technology Integration at Higher Education Level."

2. You may carry out research on the given topic under the guidance of your Supervisor and submit the thesis for further evaluation within the stipulated time. It is inform you that your thesis should be submit within described period by **31 July 2023** positively for further necessary action please.

3. As per policy of NUML, all MPhil/PhD thesis are to be run on turnitin by QEC of NUML before being sent for evaluation. The university shall not take any responsibility for high similarity resulting due to thesis run from own sources.

4. Thesis are to be prepared strictly on NUML's format that can be had from (Coordinator, Department of Education)

Telephone No: 051-9265100-110 Ext: 2094
E-mail: ftabassum@numl.edu.pk

Dr. Marium Din
A/Head,
Department of Education

Distribution: Mr. Zia Ur Rehman (Ph.D Scholar)

Dr. Wajeeha Shahid (Thesis Supervisor)

Appendix B

PERMISSION FOR DATA COLLECTION

DEPARTMENT OF EDUCATION
FACULTY OF SOCIAL SCIENCES
National University of Modern Languages
Sector H-9, Islamabad
Tel.No: 051-9265100 Ext: 2090

ML.1-3/2021-Edu

Dated: 23-02-2021

WHOM SO EVER IT MAY CONCERN

Mr. Zia Ur Rehman S/O Altaf Hussain, students of PhD (Edu) Department of Education of National University of Modern Languages is engaged in project of Research Work.

He may please be allowed to visit your Institution / Library to obtain the required information for his Research Work.

This information shall not be divulged to any unauthorized person or agency. It shall be kept confidential.

National University of Modern Languages
Education Deptt
Islamabad

Mariam Din
23/02/2021
Dr Marium Din
A/Head,
Department of Education.

Appendix C

PERMISSION TO USE FACULTY RESPONSE CHECKLIST

Gmail

Re: Permission to use the checklist
1 message

Linda Pfaffe <lpfaffe@hicksvillepublicschools.org>
To: Zia Ur Rehman <ziaurrehman@numl.edu.pk>

Hi Zia,
Yes, of course, you may use it. Best of luck with your research and I would love to see your results and review your research when complete!

Thank you,
Linda Pfaffe Ed.D.
Supervisor of Math, Business and Computer Education
Hicksville Public Schools
200 Division Avenue, Hicksville, NY 11801
516-733-2146

Zia Ur Rehman <ziaurrehman@numl.edu.pk> wrote:

Dear Linda Pfaffe

I hope this email finds you well.

I am a PhD scholar in the field of Education from NUML University Pakistan.

I would like your permission to use the Checklist (***Learning Activities and the SAMR Model***) in my research study which you have used in your article titled "Pfaffe, L. D. (2017). Using the SAMR model as a framework for evaluating mLearning activities and supporting a transformation of learning."

Your research instrument is the most appropriate tool for my research.

I would like to use and print your checklist under the following conditions:

- I will use the checklist only for my research study and will not sell or use it with any compensated or curriculum development activities.
- I will include the copyright statement on all copies of the instrument.

If these are acceptable terms and conditions, I humbly request you to permit me to use your checklist. Please indicate so by replying to me through this email.

Sincerely,
Zia Ur Rehman
PhD Scholar
National University of Modern Languages,
H-9 Islamabad, Pakistan.

Appendix D

PERMISSION TO USE SAMR EVALUATION MATRIX

Gmail

Re: Permission to use the SAMR Evaluation Matrix
1 message

Karen H Larwin <khlarwin@ysu.edu>
To: Zia Ur Rehman <ziaurrehman@numl.edu.pk>

Hi there.

If it's in the dissertation, you are welcome to use it.

Best.
Karen

Sent from XTra Special K's iPhone 13

Zia Ur Rehman <ziaurrehman@numl.edu.pk> wrote:

Dear Dr. Karen H. Larwin

I hope this email finds you well. I would like to appreciate your valuable contributions in the field of research. Your students must be lucky to receive your expert guidance and support.

I am a PhD scholar in the field of Education from NUML University Pakistan.

With the utmost respect, I would like your kind permission to use the Instrument (***SAMR Evaluation Matrix***) in my research study, the instrument was used in the study under your supervision titled " **Humes, V. (2017). The Impact of TPACK, SAMR, and Teacher Effectiveness on Student Academic Growth in Eighth Grade Language Art and Mathematics. Doctoral Dissertation. Youngstown State University. Ohio**". This research instrument is the most appropriate tool for my research.

I would like to use and print your "SAMR Evaluation Matrix" under the following conditions:

- I will use the instrument only for my research study.
- I will include the copyright statement on all copies of the instrument.

If these are acceptable terms and conditions, I humbly request you to permit me to use your instrument.

Please indicate so by replying to me through this email.

Sincerely,
Zia Ur Rehman
PhD Scholar
National University of Modern Languages,
H-9 Islamabad, Pakistan.

Appendix E

PANEL OF EXPERTS FOR TOOL VALIDATION

1. **Prof. Dr. Muhammad Imran Yousuf**
   Professor/Chairman, Education
   PMAS, Arid Agriculture University Rawalpindi

2. **Dr. Safia Saeed**
   Associate Professor/Principal
   Government Associate College for Women, Taxila

3. **Dr. Tehseen Tahir**
   Assistant Professor, Education
   The University of Haripur

4. **Dr. Wajiha Kanwal**
   Assistant Professor, Education
   University of Wah, Wah Cantt

5. **Dr. Saira Nudrat**
   Assistant Professor, Educational Sciences
   National University of Modern Languages, Islamabad

CERTIFICATE OF VALIDITY

AN INVESTIGATION OF FACULTY COMPETENCE TOWARDS TECHNOLOGY INTEGRATION AT HIGHER EDUCATION LEVEL

By: Mr. Zia Ur Rehman

Ph.D. Scholar, Department of Education, Faculty of Social Sciences
National University of Modern Languages, H-9, Islamabad, Pakistan.

It is certified that the research instruments developed by the aforementioned Ph.D. Scholar for his thesis has been assessed by me and I find it to have been designed adequately to analyze Faculty Competence towards Technology Integration at Higher Education Level.

The questionnaire has been developed to collect data related to faculty competence towards technology integration. The evaluation matrix, classroom observation sheet, and faculty response checklist have also been developed to gain more insight into the teaching practices of faculty members. The interview has been developed for Heads of Departments to collect data related to evaluating how teachers integrate technology into their lectures, and how they measure up against the research framework of the study.

It is considered that the research instruments developed for the aforementioned Ph.D. thesis title are according to the objectives and hypotheses of the research. It assures adequate construct and content validity according to the purpose of the research and can be used for data collection by the researcher with a fair amount of confidence.

Name: PROF. DR. MUHAMMAD IMRAN YOUSUF

Designation: CHAIRMAN

Institute: PMAS ARID AGRICULTURE, RWP

Signature: .... Dr. M. Imran Yousuf Associate Professor Education

Date: 09-03-2021 PIR MEHR ALI SHAH Arid Agriculture University RAWALPINDI

dr.imran@uaar.edu.pk

CERTIFICATE OF VALIDITY

AN INVESTIGATION OF FACULTY COMPETENCE TOWARDS TECHNOLOGY INTEGRATION AT HIGHER EDUCATION LEVEL

By: Mr. Zia Ur Rehman

Ph.D. Scholar, Department of Education, Faculty of Social Sciences
National University of Modern Languages, H-9, Islamabad, Pakistan.

It is certified that the research instruments developed by the aforementioned Ph.D. Scholar for his thesis has been assessed by me and I find it to have been designed adequately to analyze Faculty Competence towards Technology Integration at Higher Education Level.

The questionnaire has been developed to collect data related to faculty competence towards technology integration. The evaluation matrix, classroom observation sheet, and faculty response checklist have also been developed to gain more insight into the teaching practices of faculty members. The interview has been developed for Heads of Departments to collect data related to evaluating how teachers integrate technology into their lectures, and how they measure up against the research framework of the study.

It is considered that the research instruments developed for the aforementioned Ph.D. thesis title are according to the objectives and hypotheses of the research. It assures adequate construct and content validity according to the purpose of the research and can be used for data collection by the researcher with a fair amount of confidence.

Name: Dr. Safia Saeed
Designation: Associate Prof.
Institute: Govt Associate college for Women Taxila
Signature: Principal Govt. Associate College (W) Taxila
Date: 06-03-2021

CERTIFICATE OF VALIDITY

AN INVESTIGATION OF FACULTY COMPETENCE TOWARDS TECHNOLOGY INTEGRATION AT HIGHER EDUCATION LEVEL

By: Mr. Zia Ur Rehman

Ph.D. Scholar, Department of Education, Faculty of Social Sciences
National University of Modern Languages, H-9, Islamabad, Pakistan.

It is certified that the research instruments developed by the aforementioned Ph.D. Scholar for his thesis has been assessed by me and I find it to have been designed adequately to analyze Faculty Competence towards Technology Integration at Higher Education Level.

The questionnaire has been developed to collect data related to faculty competence towards technology integration. The evaluation matrix, classroom observation sheet, and faculty response checklist have also been developed to gain more insight into the teaching practices of faculty members. The interview has been developed for Heads of Departments to collect data related to evaluating how teachers integrate technology into their lectures, and how they measure up against the research framework of the study.

It is considered that the research instruments developed for the aforementioned Ph.D. thesis title are according to the objectives and hypotheses of the research. It assures adequate construct and content validity according to the purpose of the research and can be used for data collection by the researcher with a fair amount of confidence.

Name: Dr. TEHSEEN TAHIR.

Designation: ASSISTANT PROFESSOR

Institute: THE UNIVERSITY OF HARIPUR.

Signature:

Date: 05-03-2021

Assistant Professor
Department of Education
University of Haripur

CERTIFICATE OF VALIDITY

AN INVESTIGATION OF FACULTY COMPETENCE TOWARDS TECHNOLOGY INTEGRATION AT HIGHER EDUCATION LEVEL

By: Mr. Zia Ur Rehman

Ph.D. Scholar, Department of Education, Faculty of Social Sciences
National University of Modern Languages, H-9, Islamabad, Pakistan.

It is certified that the research instruments developed by the aforementioned Ph.D. Scholar for his thesis has been assessed by me and I find it to have been designed adequately to analyze Faculty Competence towards Technology Integration at Higher Education Level.

The questionnaire has been developed to collect data related to faculty competence towards technology integration. The evaluation matrix, classroom observation sheet, and faculty response checklist have also been developed to gain more insight into the teaching practices of faculty members. The interview has been developed for Heads of Departments to collect data related to evaluating how teachers integrate technology into their lectures, and how they measure up against the research framework of the study.

It is considered that the research instruments developed for the aforementioned Ph.D. thesis title are according to the objectives and hypotheses of the research. It assures adequate construct and content validity according to the purpose of the research and can be used for data collection by the researcher with a fair amount of confidence.

Name: Dr. Najiha Kanwal

Designation: Chairperson / HoD / Assistant professor

Institute: University of wah

Signature:

Date: 12-03-2021

CHAIRPERSON
Department of Education
University of Wah, Wah Cantt.

CERTIFICATE OF VALIDITY

AN INVESTIGATION OF FACULTY COMPETENCE TOWARDS TECHNOLOGY INTEGRATION AT HIGHER EDUCATION LEVEL

By: Mr. Zia Ur Rehman

Ph.D. Scholar, Department of Education, Faculty of Social Sciences
National University of Modern Languages, H-9, Islamabad, Pakistan.

It is certified that the research instruments developed by the aforementioned Ph.D. Scholar for his thesis has been assessed by me and I find it to have been designed adequately to analyze Faculty Competence towards Technology Integration at Higher Education Level.

The questionnaire has been developed to collect data related to faculty competence towards technology integration. The evaluation matrix, classroom observation sheet, and faculty response checklist have also been developed to gain more insight into the teaching practices of faculty members. The interview has been developed for Heads of Departments to collect data related to evaluating how teachers integrate technology into their lectures, and how they measure up against the research framework of the study.

It is considered that the research instruments developed for the aforementioned Ph.D. thesis title are according to the objectives and hypotheses of the research. It assures adequate construct and content validity according to the purpose of the research and can be used for data collection by the researcher with a fair amount of confidence.

Name: Dr. Saira Nudrat

Designation: Assistant Prof.

Institute: Deptt of Edu (NUML)

Signature: ....

Date: 12-03-2021

Appendix F

URL FOR HEC RECOGNIZED UNIVERSITIES

Higher Education Commission, Pakistan

HEC (/PAGES/VARIATIONROOT.ASPX) / UNIVERSITIES (/ENGLISH/UNIVERSITIES/PAGES/AJK/DEFAULT.ASPX) / RECOGNISED UNIVERSITIES

RECOGNISED UNIVERSITIES

HEC Recognised Universities and Degree Awarding Institutions

Filter View

Sector: Public | Chartered By: Select All
Discipline: Select All | Province: Punjab
City: Select All

49 results

Name	Sector	Chartered By	Discipline
Bahauddin Zakariya University (BZU), Multan (https://hec.gov.pk/english/universities/Pages/Punjab/Bahauddin-Zakariya-University.aspx)	Public	Government of Punjab	General
Cholistan University of Veterinary and Animal Sciences, Bahawalpur (https://hec.gov.pk/english/universities/Pages/Punjab/Cholistan-University-of-Veterinary-and-Animal-Sciences,-Bahawalpur.aspx)	Public	Government of Punjab	Agriculture & Veterinary
Faisalabad Medical University, Faisalabad (https://hec.gov.pk/english/universities/Pages/Punjab/Faisalabad-Medical-Unviersity,-Faisalabad.aspx)	Public	Government of Punjab	Medical
Fatima Jinnah Medical University, Lahore (https://hec.gov.pk/english/universities/Pages/Punjab/Fatima-Jinnah-medical-University,-Lahore.aspx)	Public	Government of Punjab	Medical

Appendix G

LIST OF UNIVERSITIES AND POPULATION DISTRIBUTION

S#	University Name	Sector	Year	Faculty of SS & MS	Heads of SS & MS
1	Bahauddin Zakariya University, Multan	Public	2021	204	22
2	Fatima Jinnah Women University, Rawalpindi	Public	2021	119	12
3	Ghazi University, Dera Ghazi Khan	Public	2021	28	6
4	GIFT University, Gujranwala	Private	2021	77	11
5	Government College University, Faisalabad	Public	2021	163	14
6	Government College University, Lahore	Public	2021	91	12
7	Hajvery University, Lahore	Private	2021	33	10
8	HITEC University, Taxila	Private	2021	112	6
9	Imperial College of Business Studies, Lahore	Private	2021	43	5
10	Institute of Southern Punjab, Multan	Private	2021	96	8
11	Islamia University, Bahawalpur	Public	2021	235	28
12	Khawaja Freed University of Engineering & Information Technology	Public	2021	139	9
13	Lahore College for Women University, Lahore	Public	2021	202	21
14	Lahore Leads University	Private	2021	105	13
15	Lahore University of Management Sciences	Private	2021	290	5
16	Minhaj University	Private	2021	108	4
17	Pir Mehr Ali Shah Arid Agriculture University, Rawalpindi	Public	2021	70	10
18	Superior University Lahore	Private	2021	46	15
19	The Green International University, Lahore	Private	2021	37	7
20	The University of Faisalabad	Private	2021	57	5
21	University of Agriculture, Faisalabad	Public	2021	134	12
22	University of Central Punjab	Private	2021	248	9
23	University of Chakwal, Chakwal	Public	2021	41	8
24	University of Engineering & Technology, Lahore	Public	2021	360	18
25	University of Engineering & Technology, Taxila	Public	2021	246	14

S#	University Name	Sector	Year	Faculty of SS & MS	Heads of SS & MS
26	University of Gujrat, Gujrat	Public	2021	117	12
27	University of Lahore	Private	2021	62	8
28	University of Management & Technology, Lahore	Private	2021	226	12
29	University of Sargodha, Sargodha	Public	2021	162	12
30	University of Sialkot	Private	2021	85	10
31	University of the Punjab, Lahore	Public	2021	243	35
32	University of Wah	Private	2021	54	7
Total				**4233**	**380**

Appendix H

SAMR EVALUATION MATRIX

©Humes, V. (2017). The Impact of TPACK, SAMR, and Teacher Effectiveness on Student Academic Growth in Eighth Grade Language Art and Mathematics. Doctoral Dissertation, Youngstown State University, Ohio

Please rate your technology integration skill at appropriate level (Degree of Occurrence).

Bloom's Revised Taxonomy Level	**SAMR Level**
Creating Compile information together in a different way by combining elements in a new pattern or proposing alternative solutions **Evaluating** Present and defend opinions by making judgments about information, validity of ideas, or quality of work based on a set of criteria.	**Redefinition** Technology allows for the creation of new tasks previously inconceivable ✓/✗ ☐
Analyzing Examine and break information into parts by identifying motives or causes. Make inferences and find evidence to support generalizations **Applying** Solve problems to new situations by applying acquired knowledge, facts, techniques and rules in a different way	**Modification** Technology allows for significant task redesign. ✓/✗ ☐
Understanding Demonstrate understanding of facts and ideas by organizing, comparing, translating, interpreting, giving descriptions, and stating main ideas	**Augmentation** Technology acts as a direct tool substitute with functional improvement. ✓/✗ ☐
Remembering Exhibit memory of previously learned material by recalling facts, terms, basic concepts, and answers.	**Substitution** Technology acts as a direct tool substitute with no functional change. ✓/✗ ☐

Appendix I

FACULTY RESPONSE CHECKLIST

©Pfaffe, L. D. (2017). Using the SAMR Model as a Framework for Evaluating M-Learning Activities and Supporting a Transformation of Learning. Doctoral Dissertation. The School of Education. St. John's University, New York

For following questions: Please refer to the above Model to identify ICT activities in learning perspective that you have used (in or out of the classroom) at each level of SAMR Model

1. **Identify all ICT Learning Activities you have used at SUBSTITUTION level** (the new technology is used as a direct substitute for an older tool, with no change in the tasks undertaken by students or how these tasks are accomplished using the new toolset.)

At this level, no noticeable improvements in student outcome are recorded

Please, check all that apply

- ☐ Note Taking (e.g. taking pictures, videos, or recordings)
- ☐ Research
- ☐ Communication (e.g. audio/video conferencing, homework reminders, etc.)
- ☐ Individual/Group Collaboration
- ☐ Content Creation
- ☐ Learning Organizers
- ☐ Presentation Apps (e.g. photo, video, music)
- ☐ Data Collection Software Interfacing with Built-in sensors or external probes
- ☐ Formative Feedback
- ☐ Texting (SMS)/Twitter/ Social Networking
- ☐ Webquests
- ☐ Augmented Reality (e.g. Google Earth, Google Goggles, Google Map)
- ☐ Simulations
- ☐ Guided Reading
- ☐ Other ____

2. **Identify all ICT Learning Activities you have used at AUGMENTATION level** (the new technology substitutes for an older tool, with no change in the tasks undertaken by students, however, features of the new technology are used to improve how these tasks are carried out by students, such as by making the tasks easier or faster to accomplish or by providing additional features not previously available.)

   At this level, small improvements in student outcomes are recorded

   Please, check all that apply

- ☐ Note Taking (e.g. taking pictures, videos, or recordings)
- ☐ Research
- ☐ Communication (e.g. audio/video conferencing, homework reminders, etc.)
- ☐ Individual/Group Collaboration
- ☐ Content Creation
- ☐ Learning Organizers
- ☐ Presentation Apps (e.g. photo, video, music)
- ☐ Data Collection Software Interfacing with Built-in sensors or external probes
- ☐ Formative Feedback
- ☐ Texting (SMS)/Twitter/ Social Networking
- ☐ Webquests
- ☐ Augmented Reality (e.g. Google Earth, Google Goggles, Google Map)
- ☐ Simulations
- ☐ Guided Reading
- ☐ Other ____

3. Identify all ICT Learning Activities you have used at MODIFICATION level (the tasks to be undertaken by students are significantly redesigned in order to achieve new educational goals, the redesign is made possible by features of the new technology, not available before.)

At this level, noticeable improvements in student outcome are recorded.

Please, check all that apply

- ☐ Note Taking (e.g. taking pictures, videos, or recordings)
- ☐ Research
- ☐ Communication (e.g. audio/video conferencing, homework reminders, etc.)
- ☐ Individual/Group Collaboration
- ☐ Content Creation
- ☐ Learning Organizers
- ☐ Presentation Apps (e.g. photo, video, music)
- ☐ Data Collection Software Interfacing with Built-in sensors or external probes
- ☐ Formative Feedback
- ☐ Texting (SMS)/Twitter/ Social Networking
- ☐ Webquests
- ☐ Augmented Reality (e.g. Google Earth, Google Goggles, Google Map)
- ☐ Simulations
- ☐ Guide Reading
- ☐ Other ____

4. **Identify all ICT Learning Activities you have used at REDEFINITION level** (older tasks are replaced in part or in whole by newer tasks in order to achieve previously unattainable educational goals, the new tasks are made possible by features of the new technology, not available before.)

At this level, strong improvements in student outcomes are recorded.

Please, check all that apply

- ☐ Note Taking (e.g. taking pictures, videos, or recordings)
- ☐ Research
- ☐ Communication (e.g. audio/video conferencing, homework reminders, etc.)
- ☐ Individual/Group Collaboration
- ☐ Content Creation
- ☐ Learning Organizers
- ☐ Presentation Apps (e.g. photo, video, music)
- ☐ Data Collection Software Interfacing with Built-in sensors or external probes
- ☐ Formative Feedback
- ☐ Texting (SMS)/Twitter/ Social Networking
- ☐ Webquests
- ☐ Augmented Reality (e.g. Google Earth, Google Goggles, Google Map)
- ☐ Simulations
- ☐ Guide Reading
- ☐ Other ____

5. For each of the following ICT Learning Activities you have used in your lessons, please indicate where primarily used:

Mark only one oval per row

	In Class	Out of Class	Both
Note Taking (e.g. taking pictures, videos, or recordings)	▢	▢	▢
Research	▢	▢	▢
Communication (e.g. audio/video conferencing, homework reminders, etc.)	▢	▢	▢
Individual/Group Collaboration	▢	▢	▢
Content Creation	▢	▢	▢
Learning Organizers	▢	▢	▢
Presentation Apps (e.g. photo, video, music)	▢	▢	▢
Data Collection Software Interfacing with Built-in sensors or external probes	▢	▢	▢
Formative Feedback	▢	▢	▢
Texting (SMS)/Twitter/ Social Networking	▢	▢	▢
Webquests	▢	▢	▢
Augmented Reality (e.g. Google Earth, Google Goggles, Google Map)	▢	▢	▢
Simulations	▢	▢	▢
Guide Reading	▢	▢	▢

Appendix J

TECHNOLOGY INTEGRATION SCALE FOR FACULTY

Section A (Demographics)

1: Name (Optional) _______________

2: Gender:
- a) Male ☐
- b) Female ☐

3: Sector:
- a) Public ☐
- b) Private ☐

4: Qualification:
- a) M.Phil. / MS ☐
- b) Ph.D. ☐
- c) Post Doc. ☐

4: Discipline:
- a) Social Sciences ☐
- b) Management Sciences ☐

5: Designation:
- a) Lecturer ☐
- b) Assistant Professor ☐
- c) Associate Professor ☐
- d) Professor ☐

6: Experience:
- a) Less than 3 years ☐
- b) 3-6 years ☐
- c) 7-10 years ☐
- d) More than 10 years ☐

6: Age:
- a) Less than 30 years ☐
- b) 31-40 years ☐
- c) 41-50 years ☐
- d) More than 50 years ☐

Section B

Technology Integration Scale for Faculty

Given below are the statements, please ✓ to the appropriate level of your agreement.
(**5**=Strongly Agree, **4**=Agree, **3**=Neutral, **2**=Disagree and **1**=Strongly Disagree)

S#	SAMR's Substitution & Bloom's Remembering	SA(5)	A(4)	N(3)	D(2)	SD(1)
1	It is necessary for me to work with a laptop/ computer.	☐	☐	☐	☐	☐
2	I think working with a laptop/computer is helpful in teaching and learning.	☐	☐	☐	☐	☐
3	Technology provides fast and efficient means to enhance student learning.	☐	☐	☐	☐	☐
4	ICT helps provide information quicker than the library.	☐	☐	☐	☐	☐
5	I have considerable knowledge in integrating ICT into the learning process.	☐	☐	☐	☐	☐
6	I am well aware of operating digital tools and resources.	☐	☐	☐	☐	☐

S#	SAMR's Augmentation & Bloom's Understanding	SA(5)	A(4)	N(3)	D(2)	SD(1)
7	If there is any difficulty while using technology, I can troubleshoot it.	▢	▢	▢	▢	▢
8	The ICT provides effective ways which enable learner to understand concepts.	▢	▢	▢	▢	▢
9	The use of technology in my class helps students to work on shared documents (G Docs. etc.).	▢	▢	▢	▢	▢
10	The online learning databases and resources can transform student learning.	▢	▢	▢	▢	▢
11	The digital tools are meant for student learning because it is easy to use and handle digital devices.	▢	▢	▢	▢	▢
12	My students are aware of browsing e-journals and online databases (ProQuest etc.).	▢	▢	▢	▢	▢

S#	SAMR's Augmentation & Bloom's Applying	SA(5)	A(4)	N(3)	D(2)	SD(1)
13	I frequently use ICT to acquire and prepare learning material.	▢	▢	▢	▢	▢
14	Acquiring information from digital tools is easier than using printed material.	▢	▢	▢	▢	▢
15	The use of technology in my class helps students to browse subject material on the internet.	▢	▢	▢	▢	▢
16	Using suitable tasks, I encourage students to browse the internet to acquire information.	▢	▢	▢	▢	▢
17	My students have information retrieval skills while searching for relevant information.	▢	▢	▢	▢	▢
18	I often use technology to make instructional material (PowerPoint, hand-outs etc.).	▢	▢	▢	▢	▢

S#	SAMR's Modification & Bloom's Applying	SA(5)	A(4)	N(3)	D(2)	SD(1)
19	I utilize technology to collaborate with international faculty members on research topics.	☐	☐	☐	☐	☐
20	I utilize technology to publish my research work.	☐	☐	☐	☐	☐
21	Technology permits access to current learning materials.	☐	☐	☐	☐	☐
22	It is easy for me to organize electronic material than printed material.	☐	☐	☐	☐	☐
23	My students can perform their homework using ICT.	☐	☐	☐	☐	☐
24	The syllabus provide enough room to integrate technology into the learning.	☐	☐	☐	☐	☐

S#	SAMR's Modification & Bloom's Analyzing	SA(5)	A(4)	N(3)	D(2)	SD(1)
25	I prefer consulting and organizing from internet before delivering lecture.	☐	☐	☐	☐	☐
26	The use of technology in my class helps students to find online information on a particular topic.	☐	☐	☐	☐	☐
27	The use of technology tools in my class has improved students' ability to analyze and organize information.	☐	☐	☐	☐	☐
28	I design lessons that allow students to use technology tools to relate and compare relevant information.	☐	☐	☐	☐	☐
29	The use of technology tools in my class has increased students' engagement in the data analysis tasks.	☐	☐	☐	☐	☐
30	The use of technology tools in my class has improved students' ability to validate the acquired information.	☐	☐	☐	☐	☐

S#	SAMR's Modification & Bloom's Evaluating	SA(5)	A(4)	N(3)	D(2)	SD(1)
31	I use digital tools to evaluate the learning outcomes.	☐	☐	☐	☐	☐
32	The use of technology in my class improves the way I provide feedback on student learning.	☐	☐	☐	☐	☐
33	The use of digital tools help students to evaluate the effectiveness of their work (learning activities).	☐	☐	☐	☐	☐
34	The use of technology in my class help students make informed decisions based on their learning progress.	☐	☐	☐	☐	☐
35	The use of technology in my class allows students to collaborate with peers to accomplish assigned tasks.	☐	☐	☐	☐	☐
36	The use of technology in my class helps students make changes to their assignments based on feedback.	☐	☐	☐	☐	☐

S#	SAMR's Redefinition & Bloom's Evaluating	SA(5)	A(4)	N(3)	D(2)	SD(1)
37	I use technology to support students' decision-making in the learning process.	☐	☐	☐	☐	☐
38	The use of technology enables students to monitor their progress through real-time feedback.	☐	☐	☐	☐	☐
39	I often ask students to use technology to critically synthesize information from multiple sources.	☐	☐	☐	☐	☐
40	I use technology in a way that allows students to evaluate the accuracy and reliability of digital information.	☐	☐	☐	☐	☐
41	The use of technology in my class helps students make informed decisions based on the information they have gathered.	☐	☐	☐	☐	☐
42	I design lessons that allow students to use technology to make informed decisions based on data analysis.	☐	☐	☐	☐	☐

S#	SAMR's Redefinition & Bloom's Creating	SA(5)	A(4)	N(3)	D(2)	SD(1)
43	The technology I use in my class helps students engage in unique forms of problem-solving.	☐	☐	☐	☐	☐
44	The technology I use in my class helps redefining traditional teaching and learning methods.	☐	☐	☐	☐	☐
45	The use of technology in my class has improved the assessment or evaluation of student learning.	☐	☐	☐	☐	☐
46	I use technology in a way that allows students to create and manipulate digital media (Publishing, Podcasting, broadcasting)	☐	☐	☐	☐	☐
47	I design lessons that allow students to engage in new forms of communication or collaboration using technology.	☐	☐	☐	☐	☐
48	I use technology to support student innovation in the learning process.	☐	☐	☐	☐	☐

Appendix K

SEMI-STRUCTURED INTERVIEW FOR HEADS

The purpose of this interview is to evaluate how teachers integrate technology into their instructional practices.

1. How do you describe your teachers' technology integration in their classrooms? Considering the SAMR Model as a guide.
2. How does technology integration transform teachers' instructional practices?
3. What are your views on technology as an educational tool?
4. What challenges can teachers encounter with the implementation of instructional activities based on the SAMR model?
5. How technology integration can influence teachers' professional development needs?

Appendix L

RESULTS OF CONSTRUCT VALIDITY OF THE QUESTIONNAIRE

KMO and Barlett's Test[a]

Kaiser-Meyer-Olkin Measure of Sampling Adequacy		.754
Barlett's Test of Sphericity	Approx. Chi-Square	461.52
	df	59
	Sig.	.000

Rotated Component Matrix[b]

	Component							
	1	2	3	4	5	6	7	8
SR4	.780							
SR6	.765							
SR1	.751							
SR3	.744							
SR5	.681							
SR2	.675							
AU4		.765						
AU5		.758						
AU2		.733						
AU1		.721						
AU6		.691						
AU3		.684						
AA4			.761					
AA5			.754					
AA1			.750					
AA2			.699					
AA3			.695					
AA6			.685					
MoAp3				.780				
MoAp1				.775				
MoAp6				.771				
MoAp5				.692				
MoAp4				.681				
MoAp2				.675				
MoAn2					.787			
MoAn3					.771			
MoAn5					.765			
MoAn4					.741			
MoAn6					.666			
MoAn1					.654			
ME4						.791		
ME1						.774		
ME3						.764		
ME6						.689		

ME2						.684		
ME5						.671		
RE5							.764	
RE2							.756	
RE1							.744	
RE6							.731	
RE4							.677	
RE3							.651	
RC2								.794
RC4								.771
RC1								.757
RC5								.722
RC3								.684
RC6								.658

Appendix M

TABLE FOR DETERMINING THE SAMPLE SIZE

Sample size, confidence levels and confidence intervals for random samples

Population	Confidence level 90 per cent			Confidence level 95 per cent			Confidence level 99 per cent		
	5% CI	4% CI	3% CI	5% CI	4% CI	3% CI	5% CI	4% CI	3% CI
30	27	28	29	28	29	29	29	29	30
50	42	45	47	44	46	48	46	48	49
75	59	64	68	63	67	70	67	70	72
100	73	81	88	79	86	91	87	91	95
120	83	94	104	91	100	108	102	108	113
150	97	111	125	108	120	132	122	131	139
200	115	136	158	132	150	168	154	168	180
250	130	157	188	151	176	203	182	201	220
300	143	176	215	168	200	234	207	233	258
350	153	192	239	183	221	264	229	262	294
400	162	206	262	196	240	291	250	289	329
450	170	219	282	207	257	317	268	314	362
500	176	230	301	217	273	340	285	337	393
600	187	249	335	234	300	384	315	380	453
650	192	257	350	241	312	404	328	400	481
700	196	265	364	248	323	423	341	418	507
800	203	278	389	260	343	457	363	452	558
900	209	289	411	269	360	468	382	482	605
1,000	214	298	431	278	375	516	399	509	648
1,100	218	307	448	285	388	542	414	534	689
1,200	222	314	464	291	400	565	427	556	727
1,300	225	321	478	297	411	586	439	577	762
1,400	228	326	491	301	420	606	450	596	796
1,500	230	331	503	306	429	624	460	613	827
2,000	240	351	549	322	462	696	498	683	959
2,500	246	364	581	333	484	749	524	733	1,061
5,000	258	392	657	357	536	879	586	859	1,347
7,500	263	403	687	365	556	934	610	911	1,480
10,000	265	408	703	370	566	964	622	939	1,556
20,000	269	417	729	377	583	1,013	642	986	1,688
30,000	270	419	738	379	588	1,030	649	1,002	1,737
40,000	270	421	742	381	591	1,039	653	1,011	1,762
50,000	271	422	745	381	593	1,045	655	1,016	1,778
100,000	272	424	751	383	597	1,056	659	1,026	1,810
150,000	272	424	752	383	598	1,060	661	1,030	1,821
200,000	272	424	753	383	598	1,061	661	1,031	1,826
250,000	272	425	754	384	599	1,063	662	1,033	1,830
500,000	272	425	755	384	600	1,065	663	1,035	1,837
1,000,000	272	425	756	384	600	1,066	663	1,036	1,840

N=Population Size
n=Sample Size
(Cohen, L., Manion, L., & Morrison, K. (2013). Research methods in education. Routledge, p.104)

Appendix N

ITEM-WISE MEAN RESPONSE OF FACULTY MEMBERS

'Substitution and Remembering' at University Level (n_1=552)

S#	'Substitution and Remembering' *(M=4.51, SD=0.75)*	n_1	Mean	S.D
1	It is necessary for me to work with a laptop/ computer.	552	4.11	0.43
2	I think working with a laptop/computer is helpful in teaching and learning.	552	4.46	0.30
3	Technology provides fast and efficient means to enhance student learning.	552	4.17	0.75
4	ICT helps provide information quicker than the library.	552	4.61	0.49
5	I have considerable knowledge in integrating ICT into the learning process.	552	4.26	0.28
6	I am well aware of operating digital tools and resources.	552	4.10	0.61

'Augmentation and Understanding' at University Level (n_1=552)

S#	'Augmentation and Understanding' *(M=4.54, SD=0.38)*	n_1	Mean	S.D
1	If there is any difficulty while using technology, I can troubleshoot it.	552	4.40	0.48
2	The ICT provides effective ways which enable learner to understand concepts.	552	4.32	0.53
3	The use of technology in my class helps students to work on shared documents (G Docs. etc.).	552	4.33	0.29
4	The online learning databases and resources can transform student learning.	552	4.64	0.42
5	The digital tools are meant for student learning because it is easy to use and handle digital devices.	552	4.46	0.55
6	My students are aware of browsing e-journals and online databases (Proquest etc.).	552	4.33	0.62

'Augmentation and Applying' at University Level (n_1=552)

S#	'Augmentation and Applying' *(M=4.11, SD=0.52)*	n_1	Mean	S.D
1	I frequently use ICT to acquire and prepare learning material.	552	3.80	0.25
2	Acquiring information from digital tools is easier than using printed material.	552	4.41	0.53
3	The use of technology in my class helps students to browse subject material on the internet.	552	3.75	0.37
4	Using suitable tasks, I encourage students to browse the internet to acquire information.	552	3.55	0.44
5	My students have information retrieval skills while searching for relevant information.	552	4.53	0.41
6	I often use technology to make instructional material (PowerPoint, hand-outs etc.).	552	3.98	0.39

'Modification and Applying' at University Level (n_1=552)

S#	'Modification and Applying' *(M=4.13, SD=0.61)*	n_1	Mean	S.D
1	I utilize technology to collaborate with international faculty members on research topics.	552	3.83	0.33
2	I utilize technology to publish my research work.	552	4.15	0.14
3	Technology permits access to current learning materials.	552	4.27	0.41
4	It is easy for me to organize electronic material than printed material.	552	4.08	0.53
5	My students can perform their homework using ICT.	552	4.28	0.26
6	The syllabus provide enough room to integrate technology into the learning.	552	4.20	0.38

'Modification and Analyzing' at University Level (n_1=552)

S#	'Modification and Analyzing' *(M=3.99, SD=0.77)*	n_1	Mean	S.D
1	I prefer consulting and organizing from internet before delivering lecture.	552	4.20	0.20
2	The use of technology in my class helps students to find online information on a particular topic.	552	3.46	0.43
3	The use of technology tools in my class has improved students' ability to analyze and organize information.	552	3.68	0.35
4	I design lessons that allow students to use technology tools to relate and compare relevant information.	552	4.23	0.33
5	The use of technology tools in my class has increased students' engagement in the data analysis tasks.	552	4.12	0.47
6	The use of technology tools in my class has improved students' ability to validate the acquired information.	552	4.21	0.39

'Modification and Evaluating' at University Level (n_1=552)

S#	'Modification and Evaluating' *(M=3.66, SD=0.72)*	n_1	Mean	S.D
1	I use digital tools to evaluate the learning outcomes.	552	3.53	0.23
2	The use of technology in my class improves the way I provide feedback on student learning.	552	3.01	0.56
3	The use of digital tools help students to evaluate the effectiveness of their work (learning activities).	552	3.34	0.35
4	The use of technology in my class help students make informed decisions based on their learning progress.	552	3.48	0.42
5	The use of technology in my class allows students to collaborate with peers to accomplish assigned tasks.	552	3.26	0.27
6	The use of technology in my class helps students make changes to their assignments based on feedback.	552	3.77	0.45

‘Redefinition and Evaluating’ at University Level (n_1=552)

S#	‘Redefinition and Evaluating’ *(M=3.53, SD=0.78)*	n_1	Mean	S.D
1	I use technology to support students’ decision-making in the learning process.	552	3.59	0.61
2	The use of technology enables students to monitor their progress through real-time feedback.	552	3.20	0.44
3	I often ask students to use technology to critically synthesize information from multiple sources.	552	3.41	0.28
4	I use technology in a way that allows students to evaluate the accuracy and reliability of digital information.	552	3.34	0.55
5	The use of technology in my class helps students make informed decisions based on the information they have gathered.	552	3.24	0.31
6	I design lessons that allow students to use technology to make informed decisions based on data analysis.	552	3.20	0.34

‘Redefinition and Creating’ at University Level (n_1=552)

S#	‘Redefinition and Creating’ *(M=3.20, SD=1.01)*	n_1	Mean	S.D
1	The technology I use in my class helps students engage in unique forms of problem-solving.	552	3.14	0.19
2	The technology I use in my class helps redefining traditional teaching and learning methods.	552	3.46	0.64
3	The use of technology in my class has improved the assessment or evaluation of student learning.	552	3.16	0.43
4	I use technology in a way that allows students to create and manipulate digital media (Publishing, Podcasting, broadcasting)	552	3.05	0.31
5	I design lessons that allow students to engage in new forms of communication or collaboration using technology.	552	3.13	0.82
6	I use technology to support student innovation in the learning process.	552	3.00	0.53

Appendix O

THEMES & SUB-THEMES
OF SEMI-STRUCTURED INTERVIEW

Themes	Sub-Themes
Teachers' Technology Integration	Teachers' Meaning of the SAMR Levels Greater Learning at the higher Levels Increased Student and Teacher Motivation Student and Teachers Engagement Student Participation Relevance to students' Career Ease and Accessibility of technology Ease of finding appropriate resources Improved Instruction Ability to monitor student progress Reaching more students Enhanced Content Presentation Increased access to curriculum
Technology and Transformation of Teachers' Practices	Concerns with the SAMR model Correct Use of SAMR Various Uses of Technology Ways of Learning about technology Self-Teaching Self-Motivation Collaboration with Colleagues Professional Development Strategies of Teaching Grouping of Learners Purpose of Lesson with Technology Teacher Expertise with technology
Technology as an Instructional Tool	Technology as an enhancement tool Technology as a transformative instructional tool Professional training Curriculum integration Curriculum mapping Technology coaches Resources and Existing Infrastructure Plan for technological professional training Technological changes Self-reflection of teachers Technology as a distraction
Technology Integration Challenges	Making it relevant Giving up control Moving to the next level Complicated interface of software Starting from the basics Inappropriate use Rigidity Job-Embedded training Technological resources Hierarchical approach of the Model Time constraints Relevance Student negligence Personal discomfort with technology

Themes	Sub-Themes
Technology Integration & Professional Development	Lack of Access to technology Lack of differentiation Learning curve Limited impact of PD Content Area connections Online Learning Instructional settings and digital content Pedagogical preferences Relevance of PD Format of PD 21^{st} century Trends in Education Impact of the Presenter Choice of learning opportunities Ongoing support in learning