AN INVESTIGATION INTO THE TEACHER EDUCATORS' PEDAGOGICAL KNOWLEDGE OF TECHNOLOGY INTEGRATION

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Abstract

The major purpose of this research is to investigate teacher educators' pedagogical knowledge of technology integration. The specific purposes of this research are to compare teacher educators' pedagogical knowledge of technology integration with four dimensions, to investigate teacher educators' pedagogical knowledge of technology integration by total teaching experiences, and to investigate teacher educators' pedagogical knowledge of technology integration by educational experiences. Total of (127) teacher educators were selected from three Education Degree Colleges in Yangon Region. A descriptive (survey) research design was used. As an instrument, questionnaire was comprised of (40) items; (10) items in each dimension. A descriptive statistics and independent samples *t* test were applied to analyze quantitative data. According to research findings, technological pedagogical content knowledge of teacher educators is the highest and technological knowledge is the lowest among the four dimensions of pedagogical knowledge of technology integration. There were no significant differences in pedagogical knowledge of technology integration between the two groups by the total teaching experiences and by the educational experiences. Thus, it is hoped that this study will partially support the improvement of teacher educators' pedagogical knowledge of technology integration. It was suggested that the teacher education program should provide enough technological training and facilities and opportunities for teacher educators.

Keywords: Technological Knowledge, Pedagogical Knowledge, Technological Pedagogical Knowledge, Technological Pedagogical Content Knowledge, Technology Integration

Introduction

Education is the process of facilitating learning, or the acquisition of knowledge, skills, values, morals, beliefs and habits. It helps people become better citizens, gets a better-paid job, and shows the difference between good and bad. It polishes a person's mind, human personality, reinforces thoughts and strengthens character and behaviors toward others. Education will implement both teacher and learner in the teaching and learning process of education.

Teacher should adopt a fun method and technology-based learning method to teach students instead of a lecture method. Teacher can combine appropriate methods, techniques and technologies based on student needs to enrich the teaching and learning process. The use of technology as an instructional tool is strongly recommended by many professional organizations. Organizers should educate teachers the technological activities via educational programs (Brush, Glazewski, Rutowski, Berg, Stromfors, Hernandez Van-Nest & Sutton, 2003).

Purposes of the Study

The main purpose of this study is to investigate teacher educators' pedagogical knowledge of technology integration.

The specific objectives of this study are as follows.

1. To compare teacher educators' pedagogical knowledge of technology integration with four dimensions

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2. To explore the significant differences in teacher educators' technological knowledge, pedagogical knowledge, technological pedagogical knowledge and technological pedagogical content knowledge by total teaching experiences and educational experiences
3. To make suggestions and recommendations based on research findings

Research Questions

The research questions of this study are as follows.

1. To what extent do the teacher educators possess technological knowledge, pedagogical knowledge, technological pedagogical knowledge, and technological pedagogical content knowledge?
2. Which one is the highest and which one is the lowest among the four dimensions of teacher educators' pedagogical knowledge of technology integration?
3. Are there any significant differences in teacher educators' pedagogical knowledge of technology integration by total teaching experiences?
4. Are there any significant differences in teacher educators' pedagogical knowledge of technology integration by educational experiences?

Scope

Three Education Degree Colleges were selected from Yangon Region. It involved (127) teacher educators of Education Degree Colleges in the 2021-2022 Academic Year. A questionnaire for investigating the teacher educators' pedagogical knowledge of technology integration was used as the instrument. This questionnaire was based on four dimensions among seven dimensions of the studies conducted by Mishra and Koehler (2008) conceptualized the TPACK framework. Four major dimensions are (a) technological knowledge, (b) pedagogical knowledge, (c) technological pedagogical knowledge, and (d) technological pedagogical content knowledge.

Definition of Key Terms

Technological Knowledge: Technological knowledge refers to the knowledge about various technologies, ranging from low-tech technologies such as pencil and paper to digital technologies such as the Internet, digital video, interactive whiteboards, and software programs (Mishra & Koehler, 2008).

Pedagogical Knowledge: Pedagogical knowledge refers to the methods and processes of teaching and includes knowledge in classroom management, assessment, lesson plan development, and student learning (Mishra & Koehler, 2008).

Technological Pedagogical Knowledge: Technological pedagogical knowledge refers to the knowledge of how various technologies can be used in teaching, and to understanding that using technology may change the way teachers teach (Mishra & Koehler, 2008).

Technological Pedagogical Content Knowledge: Technological pedagogical content knowledge refers to the knowledge required by teachers for integrating technology into their teaching in any content area. Teachers have an intuitive understanding of the complex interplay between the three basic components (technological knowledge, pedagogical knowledge, and content knowledge) of knowledge by teaching content using appropriate pedagogical methods and technologies (Mishra & Koehler, 2008).

Technology Integration: Technology integration is the use of technology tools in general content areas in education to allow students to apply computer and technology skills to learning and problem-solving (Christensen, 2019).

Significance of the Study

Some researchers have emphasized on the difference between knowing technologies and knowing how to effectively technologies for teaching. The Technological Pedagogical and Content Knowledge (TPACK) framework is a promising way forward for successfully integrating technology throughout curriculum planning while finding a model for incorporating technology into the curriculum. According to TPACK, technology is not merely a new item added into the curriculum. It provides the special kind of teacher knowledge which is required for effectively using technology for teaching.

In this study, the TPACK framework is used to develop a survey for measuring teachers' knowledge of technology integration. This study will observe the area of integrating technology into the implementation of a curriculum and expand the discussion of TPACK as a framework and as an instrument for measuring technology integration. The TPACK framework has proven beneficial in the areas of elementary, secondary, and undergraduate in-service education. This study will also provide teacher educators with possible educational technology and content-based uses of those tools and resources. Regarding this research, teacher educators may be provided with the proper use of educational technologies, tools and resources at schools. Consequently, it may also support assessing teacher educators' knowledge in the area of technology integration.

Review of Related Literature

Technology Integration from Behaviorist Perspective

Behaviorism is a theory of animal and human learning that only focus on observable behaviors and discounts mental activities. Behavior theorists define learning as nothing more than the acquisition of new behavior (Mills, 2006).

An integrated learning system, computer-based tutoring system, drill-practice program and assessment software are some of the technologies designed based on behaviorist learning theory. Integrated learning system and computer assisted instruction have been readily adopted in many schools as they closely match the traditional routine of classroom life (Onyegegbu, 2007).

Integration technology from behaviorist perspective allows computers to:

1. incorporate different kinds of materials,
2. incorporate different kinds of exercises,
3. monitor each student's progress,
4. provide feedback that is immediate and geared to the student's response, and
5. set up the instruction so that the student can start and stop whenever they like.

Technology integration from this perspective is commonly used to increase student motivation. Such integration of technology was mainly related to its usage to employ computers as presentation tools providing additional resources and engaging visuals to enhance lessons, motivate students and promote belief.

Educational Technology

Educational technology helps in providing efficiency to the task of teaching and learning. To make teaching-learning more effective and efficient, teachers need to understand the role of

educational technology. Educational technology has two main areas. The first area refers to the use of audio-visual aids. The second area is concerned with educational psychology, philosophies, learning theories, etc.

Teachers need to have sufficient knowledge of educational technology to be able to take advantages of modern technology. Educational technology is a systematic approach to designing and evaluating learning and teaching methods and methodologies and to the application and exploitation of media and the current knowledge of communication techniques in education, both formal and informal (Okojie, Olinzock, & Okojie-Boulder, 2005).

Relationship between Technology in Education and Pedagogy

The process of exploring the relationship between technology in education and pedagogy will encourage critical thinking on the part of teachers as they practice technology integration. The role of technology in education can only be determined if teachers who implement technology at the classroom level are involved in technology decision-making because teachers have the responsibility of a facilitating instruction. It is important for teachers to recognize that a relationship exists between technology in education and pedagogical decision-making. Therefore, effort should be made to link technology for instruction to all levels of pedagogical processes and activities.

Constructs of TPACK Framework

Technological Pedagogical and Content Knowledge (TPACK) was introduced to the educational research field as a conceptual framework for understanding teacher knowledge that is required for technology integration (Mishra & Koehler, 2008).

TPACK framework provides a critical perspective with which to view technology integration in classroom settings. Mishra and Koehler (2008) conceptualized the TPACK framework consists of seven components. Definitions for each component are as follows.

1. Technological Knowledge (TK) means knowledge about different technologies, including both low-tech and high-tech technologies.
2. Pedagogical Knowledge (PK) means knowledge of teaching methods.
3. Content Knowledge (CK) means knowledge about the actual subject matter to be taught.
4. Technological Content Knowledge (TCK) means knowledge of how technology can create new representations for subject content.
5. Technological Pedagogical Knowledge (TPK) means knowledge of using technology to implement different teaching methods.
6. Pedagogical Content Knowledge (PCK) means knowledge of teaching methods with respect to subject matter content.
7. Technological Pedagogical Content Knowledge (TPCK) means knowledge of using technology to implement teaching methods for different types of subject matter content.

These seven components characterize the different types of knowledge teachers need for technology integration (See Figure 1).

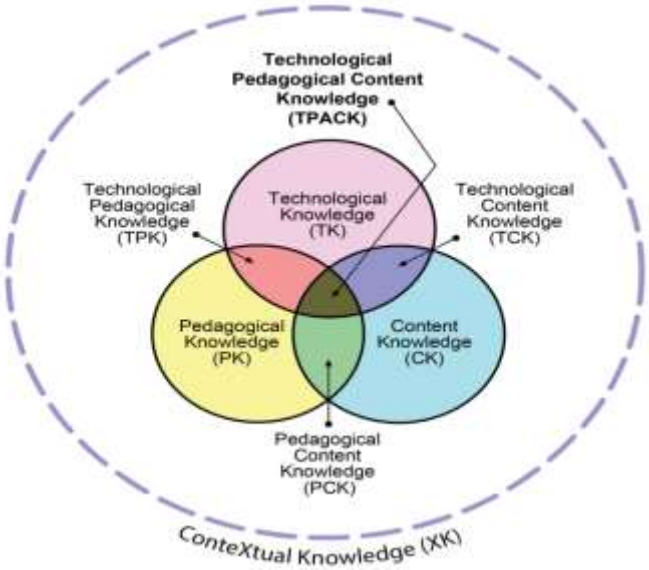

Figure 1. Technological Pedagogical and Content Knowledge Framework

Source: From Schmidt, Baran, Thompson, Mishra, Koehler, & Shin (2009), p. 125.

Among these seven constructions, four components were used in this study. These four components are _

1. Technological Knowledge
2. Pedagogical Knowledge
3. Technological Pedagogical Knowledge
4. Technological Pedagogical Content Knowledge

TPACK framework focuses on designing and evaluating teacher knowledge. TPACK is a useful frame for thinking about what knowledge teachers must have to integrate technology into teaching and how they might develop this knowledge.

Technological Knowledge (TK)

The technological knowledge strand guides teachers to develop learning activities that support students to develop specialist knowledge of what they will need to design and develop outcomes. Technological knowledge involves a working understanding of technical and operational language, an understanding of common technological equipment and related software, a grasp of basic scientific and mathematical principles on which technology rests, and an understanding of the history of technology and its impacts on society. It also includes the use of technology to learn, discover, analyze, test, and comprehend ideas.

Pedagogical Knowledge (PK)

The pedagogical knowledge base of teachers includes all the required cognitive knowledge for creating effective teaching and learning environments.

The main components of the various models of general pedagogical knowledge are as follows.

Knowledge of classroom management. It means knowledge of maximizing the quantity of instructional time, handling classroom events, teaching at a steady pace, and maintaining clear direction in lessons.

Knowledge of teaching methods. It means knowledge of having a command of various teaching methods, knowing when and how to apply each method.

Knowledge of classroom assessment. It means knowledge of different forms and purposes of formative and summative assessments, knowledge of how different frames of reference (e.g., social, individual, criterion-based) impact students' motivation.

Structure. It means knowledge of structuring of learning objectives and the lesson process, lesson planning and evaluation.

Adaptively. It means knowledge of dealing with heterogeneous learning groups in the classroom (Shulman, 1987).

Technological Pedagogical Knowledge (TPK)

Technological pedagogical knowledge is an understanding of how teaching and learning can change when particular technologies are used in particular ways. This includes knowing the pedagogical affordances and constraints of a range of technological tools as they relate to disciplinarily and developmentally appropriate pedagogical designs and strategies. To build technological pedagogical knowledge, a deeper understanding of the constraints and affordances of technologies and the disciplinary contexts within which the function is needed.

Technological Pedagogical Content Knowledge (TPCK)

Technological pedagogical content knowledge is an understanding that emerges from interactions among content, pedagogy, and technology knowledge. TPCK is the basis of effective teaching with technology, requiring an understanding of the representation of concepts using technologies; pedagogical techniques. By simultaneously integrating knowledge of technology, pedagogy and content, expert teachers bring TPCK into play any time they teach. Each situation presented to teachers is a unique combination of these three factors. This is the kind of deep, flexible, pragmatic, and nuanced understanding of teaching with technology in considering TPCK as a professional knowledge construct.

Levels of Teachers' Technological Pedagogical and Content Knowledge

Niess, Sadri, and Lee (2007) proposed a development model for TPACK. In this model, there are five steps, namely: (a) recognizing, (b) accepting, (c) adapting, (d) exploring, and (e) advancing.

Recognizing (knowledge). At this level, teachers are able to use the technology and recognize the alignment of the technology with particular content. Teachers rarely think about incorporating the technology, and only consider the technology as a low level for learning the content.

Accepting (persuasion). Teachers form a favourable or unfavourable attitude towards teaching and learning subject matter with technology. Teachers at this level practice with the technology but do not consistently think about how the technology might support teaching.

Adapting (decision). Teachers engage in activities that lead to a choice to adopt or reject teaching and learning the content with technology. Teachers manage the activities through the use of prepared worksheets that guide learners toward the intended ideas.

Exploring (implementation). Teachers actively integrate teaching and learning of subject matter with technology. Teachers investigate different ways of teaching the content and are willing to demonstrate new ways of thinking about concepts with technology. They are more apt to allow learners to explore with technology.

Advancing (confirmation). Teachers evaluate the results of the decision to integrate teaching and learning topics with spreadsheets. Teachers willingly consider using the technology in a variety of ways in building content concepts and ideas. They incorporate technology in learner assessment of the content.

Previous Related Research

Hosseini and Kamal (2012) conducted a study that aims to develop an instrument to aid investigators and educators in measuring and researching the knowledge of teachers for the integration of technology in teaching. Based on a review of the literature, the technological pedagogical and content knowledge (TPACK) framework was selected as the lens for examining technology integration and a new questionnaire was built upon the work of Schmidt and colleagues. This study was carried out through descriptive survey. The participants of this survey contained (275) in-service teachers in Islamic Azad University, South Tehran Branch enrolled in five different fields in the academic year of 2010-2011.

The sample of the study was selected using a stratified sampling method. Fifty five participants were randomly selected from each group to form the sample of (275) participants. The TPACK instrument contained (53) close-ended Likert-scale questions, for indicating TPACK knowledge and its components. These (53) items were allocated to seven categories corresponding to the components of TPACK. TPACK questionnaire provided strong support for measuring teachers' pedagogical knowledge of integration of technology in teaching. The findings expressed no significant difference of the TPACK questionnaire service teachers' pedagogical knowledge of integration of technology in teaching.

Research Method

The quantitative research method was used in this study.

Research Design

The research design for this study is a descriptive (survey) research design.

Subjects

The participants were selected from three Education Degree Colleges in Yangon Region. Since the population was less than (1000), the whole population was selected for this study. There were (127) teacher educators in this study.

Instrument

As the instrument, the questionnaire for an investigation into the teacher educators' pedagogical knowledge of technology integration was based on the studies constructed by Mishra and Kohler (2008). This research questionnaire was modified to suit the purposes of the study. It includes (40) items, (10) items in each dimension. Each item in the questionnaire was measured with True or False statement.

Procedure

First of all, the relevant literature concerning the research was explored. Secondly, in order to get the required data, an instrument was constructed. The pilot study was held at the Yangon University of Education. For the internal consistency reliability, Cronbach's alpha coefficient was used. The reliability coefficient of the questionnaire was (0.724). And then, the main study was conducted at Hlegu Education Degree College, Thingangyun Education Degree College, and Yankin Education Degree College.

Analysis of Data

In order to know the mean and standard deviation for the teacher educators' pedagogical knowledge of technology integration, descriptive statistics were used. Independent samples *t* test was used to explore the significant difference between two groups of teacher educators by experience.

Research Findings

The collected data were analyzed in order to get accurate results and make appropriate interpretations. The findings and interpretations of the results are presented.

Findings of Teacher Educators' Pedagogical Knowledge of Technology Integration

According to the teacher educators' responses, the mean score of teacher educators' pedagogical knowledge of technology integration is presented in Table 1.

Table 1 Mean Score of Teacher Educators' Pedagogical Knowledge of Technology Integration

Overall Dimension	*N*	Mean	Standard Deviation	Minimum	Maximum
Pedagogical Knowledge of Technology Integration	127	35.03	5.31	13	40

For the overall dimension, the mean value of pedagogical knowledge of technology integration was (35.03) and the standard deviation was (5.31). Teacher educators with scores less than (29.72) were identified as a low-level group. And teacher educators with scores between (29.72) and (40.34) without exception were identified as a moderate-level group. Teacher educators with score greater than (40.34) were identified as a high-level group. The three groups of teacher educators are presented in Table 2.

Table 2 Levels of Teacher Educators' Pedagogical Knowledge of Technology Integration

Level	Score	Number of Teacher	Percentage (%)
Low	$x < 29.72$	16	13%
Moderate	$29.72 \leq x \leq 40.34$	96	75%
High	$x > 40.34$	15	12%
TOTAL		**127**	**100%**

According to the data presented in Table 2, (12%) of teacher educators were at a high level of pedagogical knowledge of technology integration and (75%) of teacher educators were at

a moderate level of pedagogical knowledge of technology integration. But (13%) of teacher educators were at a low level of pedagogical knowledge of technology integration.

Findings of Descriptive Statistics of Teacher Educators' Pedagogical Knowledge of Technology Integration in Each Dimension

In order to determine the mean scores and standard deviations of teacher educators' pedagogical knowledge of technology integration in each dimension, descriptive statistics were used. The results are described in Table 3.

Table 3 Comparison of Mean Scores of Teacher Educators' Pedagogical Knowledge of Technology Integration in each Dimension

Dimension	*N*	Mean	Standard Deviation	Minimum	Maximum
TK	127	8.55	1.33	3	10
PK	127	8.82	1.00	6	10
TPK	127	8.80	1.30	4	10
TPCK	127	8.86	1.68	0	10

Note. TK = Technological Knowledge; PK = Pedagogical Knowledge; TPK = Technological Pedagogical Knowledge; TPCK = Technological Pedagogical Content Knowledge.

Table 3 shows that the comparison of mean scores of teacher educators' pedagogical knowledge of technology integration in each dimension. The mean score of technological knowledge was the lowest. And that of technological pedagogical content knowledge was the highest among the four dimensions.

Findings of Teacher Educators' Pedagogical Knowledge of Technology Integration by Total Teaching Experiences

The independent samples *t* test was used to find whether teacher educators' pedagogical knowledge of technology integration differs between two groups by total teaching experiences: under (18) years and (18) years and over.

Table 4 *t* Values for Teacher Educators' Pedagogical Knowledge of Technology Integration by Total Teaching Experiences

Knowledge	Group	*N*	*M*	*SD*	*MD*	*t*	*df*	Sig.
TK	(18) years and over	59	8.64	1.26	0.17	0.73	125	0.46 (ns)
	Under (18) years	68	8.47	1.39				
PK	(18) years and over	59	8.86	1.07	0.08	0.48	125	0.64 (ns)
	Under (18) years	68	8.78	0.94				
TPK	(18) years and over	59	8.75	1.43	-0.10	-4.55	125	0.65 (ns)
	Under (18) years	68	8.85	1.19				
TPCK	(18) years and over	59	9.07	1.19	0.39	1.32	125	0.19 (ns)
	Under (18) years	68	8.68	1.99				
TOTAL	(18) years and over	59	35.32	3.63	0.54	0.86	125	0.39 (ns)
	Under (18) years	68	34.78	3.50				

Note. TK = Technological Knowledge; PK = Pedagogical Knowledge; TPK = Technological Pedagogical Knowledge; TPCK = Technological Pedagogical Content Knowledge; ns = not significant.

According to Table 4, it was found that there were no significant differences between the two groups in terms of total teaching experiences: one group with under (18) years and the other group with (18) years and over. All teacher educators either with lower teaching experiences or higher teaching experiences had nearly the same pedagogical knowledge of technology integration.

Findings of Teacher Educators' Pedagogical Knowledge of Technology Integration by Educational Experiences

The independent samples *t* test was used to find whether teacher educators' pedagogical knowledge of technology integration differs between two groups by educational experiences: under (11) years and (11) years and over.

Table 5 *t* Values for Teacher Educators' Pedagogical Knowledge of Technology Integration by Educational Experiences

Knowledge	Group	*N*	*M*	*SD*	*MD*	*t*	*df*	Sig.
TK	(11) years and over	60	8.63	1.26	0.15	0.66	125	0.5 (ns)
	Under (11) years	67	8.48	1.39				
PK	(11) years and over	60	8.73	1.06	-0.17	-0.91	125	0.37 (ns)
	Under (11) years	67	8.90	0.96				
TPK	(11) years and over	60	8.68	1.32	-0.23	-0.98	125	0.33 (ns)
	Under (11) years	67	8.91	1.29				
TPCK	(11) years and over	60	9.15	1.10	0.55	1.93	125	0.06 (ns)
	Under (11) years	67	8.60	2.03				
TOTAL	(11) years and over	60	35.20	3.65	0.32	0.50	125	0.62 (ns)
	Under (11) years	67	34.88	3.48				

Note. TK = Technological Knowledge; PK = Pedagogical Knowledge; TPK = Technological Pedagogical Knowledge; TPCK = Technological Pedagogical Content Knowledge; ns = not significant.

According to Table 5, it was found that there were no significant differences between the two groups in terms of educational experiences: one group with under (11) years and the other group with (11) years and over. Teacher educators who had (11) years and over (11) years of educational experience had approximately the same pedagogical knowledge of technology integration as that of teacher educators who had under (11) years of educational experience. There were no significant differences in technological knowledge, pedagogical knowledge, technological pedagogical knowledge, technological pedagogical content knowledge and overall pedagogical knowledge of technology integration between the two groups.

Discussion

According to research findings, most of the teacher educators from three selected education degree colleges were at a moderate level of pedagogical knowledge of technology integration. By comparing the mean scores of teacher educators' pedagogical knowledge of technology integration by four dimensions, it was found that the mean score of technological knowledge was the lowest level and that of technological pedagogical content knowledge was the highest among the four dimensions. There were no significant differences between the mean scores of the two groups in terms of total teaching experiences: one group with under (18) years and the other group with (18) years and over. There were no significant differences between the

mean scores of the two groups in terms of educational experiences: one group with under (11) years and the other group with (11) years and over.

This study revealed that teacher educators from three education degree colleges in Yangon Region possessed technological knowledge, pedagogical knowledge, technological pedagogical knowledge, and technological pedagogical content knowledge focusing on technological resources to teach effectively in the teaching-learning process. The research findings were also consistent with the findings of the related research by Hosseini and Kamal (2012). It can be expressed from these findings that teacher educators possessed the required knowledge of technology integration in teaching.

Suggestions

Based on research findings, five suggestions were made for teacher educators. First of all, teacher educators should be encouraged to view technology integration from a wider perspective and be reflective in their teaching when they use technology to facilitate instruction. Another one, technology integration should be considered as part of the process of instructional preparation. Next, instructional technology should be identified at the planning stage just as the learners' readiness is accessed, lesson objectives are identified, methods of presenting are established, and evaluation strategies are determined.

Next, every teacher needs to enhance the implementation of technology integration on going desired outcomes. Finally, a strong focus should be placed on instructional planning and implementation strategies as a way to provide key assistance for teacher educators.

Recommendations

The essence of this research is to provide insight into how teachers can improve their use of technology to support instruction. This study supports ideas with the fact that must the use of technology enhance the student learning experience. The implementation of combination technology and contents area also creates pathways for differentiated instruction to meet the unique needs of students as individual learners within a broader classroom climate.

This study only investigated pedagogical knowledge for technology integration of teacher educators from three education degree colleges in the Yangon Region. Therefore, teacher educators from other Education Degree Colleges are recommended to study. Further research should include teacher educators in other regions and states, high school teachers, middle school teachers and primary school teachers.

Conclusion

The rapid growth in information and communication technologies has brought amazing changes in the 21st century, as well as affected the demands of modern societies. Quality of education directly depends upon the quality of teachers. By knowing technological integration in teaching, the teachers can support not only to improve the achievement of the learners but also to know the learners' innate ability and creativity. Through technology-based teaching, teachers can enhance learners' thinking skills about the problem, search the ways to solve the problems, and solve the problems in the most effective ways in collaboration.

This study supported teachers to know the vital role of technological pedagogical knowledge (TPK) to integrate technology successfully into instruction. And then, it is highlighted that TPK characteristics played the most significant role in successful planning and implementation. If the teacher lacks these foundational understandings, they will have a negative

impact on lesson implementation in practice. The technological pedagogical and content knowledge (TPACK) framework offered educators and researchers a way to evaluate and present practical suggestions to develop the teachers' knowledge and skills which are needed for integrating technology into teaching.

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