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Exploring the impact of technological pedagogical content knowledge framework on higher education: Faculty practices in emergency learning

Abdelrahim Fathy Ismail[1+]
Ohaud Al-Muoaeweed[2]
Samia Mokhtar Shahpo[3]
Amro Hassan Ahmed Badran[4]
Ghada Nasr Elmorsy[5]

[1]*Curriculum and Instruction Department, Faculty of Education, King Faisal University, Al Ahsa, Saudi Arabia.*
Email: afismail@kfu.edu.sa
[2]*Department of Humanities and Social Sciences, Prince Mohammad Bin Fahd University, Dhahran, Saudi Arabia.*
Email: oalmuoaeweed@pmu.edu.sa
[3]*Department of Early Childhood, College of Sciences and Humanities Studies, Imam Abdulrahman Bin Faisal University, Dammam, Saudi Arabia.*
Email: smmali@iau.edu.sa
[4]*Education and Psychology Department, College of Education, King Faisal University, Al-Ahsa, Saudi Arabia.*
Email: abadran@kfu.edu.sa
[5]*Department of Kindergarten, College of Education, King Faisal University, Al Ahsa, Saudi Arabia.*
Email: gelmorsy@Kfu.edu.sa

(+ Corresponding author)

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ABSTRACT

This study aims to develop a training program based on the Technological Pedagogical and Content Knowledge (TPACK) framework and to examine its impact on improving emergency distance teaching practices among university faculty members. The study used the experimental approach through a quasi-experimental design with one-group pre- and post-tests. The study sample consisted of 30 faculty members from the Colleges of Education, Arts, and Community at King Faisal University in the Kingdom of Saudi Arabia. A test was conducted to assess the cognitive dimension of TPACK knowledge with a performance observation checklist to evaluate TPACK practices. The research group participated in the distance training program through Microsoft Teams over 12 sessions. Measurement tools were applied before and after the program to identify differences between the pre- and post-tests and to calculate the effect size of the program. The results of the t-test for differences between the means were statistically significant in favor of the post-test in both the cognitive knowledge test and the performance observation checklist for distance teaching practices in light of the TPACK framework across all subdomains and overall scores. This study confirms that the TPACK-based training program significantly enhanced the knowledge and practical teaching skills of faculty in an emergency.

Contribution/Originality: This study uniquely addresses university faculty's emergency teaching practices, focusing on the abrupt shift from face-to-face teaching to emergency distance education. Unlike previous research, it highlights the essential knowledge and skills faculty need in such crises, offering important contributions to the practical application of the TPACK framework.

1. INTRODUCTION

Various educational perspectives ranging from supporting to oppositional have evolved in response to the current increase in interest in distance learning whether at the level of international institutions, educational stages or families. These perspectives focus on the effectiveness and institutional capability that the outcomes of this mode of education will yield, especially in the long term (Nelson, 2020). Several studies have also emerged, analyzing the viability of replacing traditional face-to-face education with distance learning. These studies explored the extent to which the implementation of distance education was influenced by the elements of "surprise and disruption" brought about by the COVID-19 pandemic within the global educational sector and how this mode of education became an unavoidable alternative (Kłosowski, 2020).

In practice, within Arab universities, there may be insufficient capabilities to design or modify curricula and educational programs to align with the emergency nature of distance education. The sudden shift to emergency remote learning during crises reveals many training needs for human resources in educational institutions, particularly at the university level (Al Lily, Ismail, Abunasser, & Alqahtani, 2020). It appears that the implementation of emergency remote learning has exposed certain deficiencies in the professional development of university faculty members contrary to expectations given the extensive experience and logistics of universities. The professional stagnation under the stability of traditional face-to-face education has led faculty to overlook many skills that have become evident as critically needed (Bataineh, Atoum, Alsmadi, & Shikhali, 2021).

Emergency distance education has posed a significant challenge and concern for faculty members at Arab universities particularly for those accustomed to delivering lectures in a traditional manner especially in the humanities disciplines. This mode of education has presented them with unforeseen challenges that necessitate moving beyond mere knowledge of the educational content to effectively employ technology and teaching skills to deliver this content (Ibrahim & Abu Rawi, 2020).

It may be crucial to highlight the integration of content knowledge, technology, and pedagogical skills among university faculty members. This aligns with 21st-century skills on the one hand and the nature of emergency distance education on the other hand. This integrative approach can be reflected through the TPACK framework which is based on the comprehensive understanding and integration of its three components: technology, content, and pedagogy as well as the intersecting knowledge and practices that emerge from their interaction. According to TPACK developers (Koehler & Mishra, 2009) the framework encompasses the types of knowledge and practices required by teachers, including Technological Content Knowledge (TCK), Technological Pedagogical Knowledge (TPK), Pedagogical Content Knowledge (PCK) and Technological Pedagogical Content Knowledge (TPCK).

Previous studies have indicated the effectiveness of training programs based on the TPACK framework in fostering professional growth among school teachers and pre-service teachers. For instance, Kirikçilar and Yildiz (2018) highlighted the positive impact of training some middle school math teachers on TPACK competencies for designing classroom activities using GeoGebra. Nazari, Nafissi, Estaji, and Marandi (2019) confirmed the improvement in teaching skills among beginner and experienced English as a Foreign Language teachers through TPACK training. Kul, Aksu, and Birisci (2019) found a relationship between TPACK training and pre-service math teachers' self-efficacy in using web tools. Shafie, Majid, and Ismail (2019) demonstrated a significant relationship between teachers' knowledge of TPACK and the application of 21st-century skills in classroom settings. Abdul Raouf (2020) reported the impact of a TPACK-based training program on design thinking and technological acceptance of the Internet of Things among pre-service chemistry teachers, enhancing their teaching practices through virtual labs. Abd al-Hamid (2020) confirmed the effectiveness of a proposed TPACK-based program using Google Classroom in developing TPACK competencies and integrating technology into teaching among pre-service female teachers.

Field observations indicate that knowledge of pure academic content, even when supported by university teaching skills is insufficient for achieving effective learning (Ammade, Mahmud, Jabu, & Tahmir, 2020) particularly

in emergencies and crisis education. From time to time, critical challenges imposed by emergencies arise for educational systems. It is essential to address these challenges by seeking frameworks and methodologies to bridge these gaps. The Technological Pedagogical and Content Knowledge (TPACK) framework emphasizes the integration of technology, pedagogy, and content knowledge which is crucial for enhancing the effectiveness of education during crises. The TPACK framework offers a comprehensive approach to developing the skills and knowledge necessary for teachers to adapt in emergency teaching contexts. This raises the question of exploring the impact of the Technological Pedagogical Content Knowledge (TPACK) framework on higher education, particularly in light of faculty practices during emergency teaching situations. The significance of this study may stem from its timing, as it focuses on the development of professional skills during emergencies using the important educational framework, TPACK. Additionally, the subject of the research-teaching practices during emergencies and pandemics adds to its relevance.

1.1. Study Questions

1. To what extent does a training program based on the Technological Pedagogical and Content Knowledge (TPACK) framework enhance the cognitive dimension of teaching in emergencies among faculty members?
2. How effective is a training program based on the Technological Pedagogical and Content Knowledge (TPACK) framework in improving the practices aspect of teaching in emergencies among faculty members?

2. LITERATURE REVIEW

2.1. Technological Pedagogical and Content Knowledge Framework TPACK

TPACK is a practical framework that describes and identifies the types of knowledge and competencies necessary for teachers enabling them to integrate content knowledge, pedagogical knowledge, and technological knowledge in an interactive context to achieve effective teaching (Kabakci Yurdakul, 2018). The TPACK framework is defined by researchers as the training domain that serves as the foundation for the present study. It includes the knowledge and practices that university faculty members need to implement distance education during emergencies by integrating seven types of knowledge: Content Knowledge (CK), Pedagogical Knowledge (PK), Technological Knowledge (TK), Technological Content Knowledge (TCK), Technological Pedagogical Knowledge (TPK), Pedagogical Content Knowledge (PCK), and Technological Pedagogical Content Knowledge (TPCK).

The TPACK framework is built upon the Pedagogical Content Knowledge (PCK). Shulman (1986) emphasized that successful teaching requires teachers to understand the pedagogical methods and strategies appropriate to their field of specialization (the content delivered to students). Shulman's framework viewed educational technology merely as tools that facilitate teaching. This perspective is evident in the Pedagogical Content Knowledge (PCK) framework. Building on Shulman's framework which focuses on content knowledge and pedagogical knowledge, Mishra and Koehler (2006) created a framework that combines three crucial categories of knowledge needed by teachers by adding the dimension of technology knowledge to Shulman's framework, which focuses on content knowledge and pedagogical knowledge: Technological Knowledge (TK), Pedagogical Knowledge (PK), and Content Knowledge (CK). The TPACK framework is recognized globally for its focus on training teachers by integrating technology within an educational context that is grounded in a deep understanding of these three areas: technology, content, and pedagogy (Valtonen et al., 2019).

2.2. Dimensions of the TPACK Framework

2.2.1. Technological Knowledge (TK)

This dimension refers to the knowledge of technology applications in teaching and addresses the question: "What" sources, applications, and digital media contribute to effectively delivering content to learners? It

encompasses the necessary knowledge and familiarity with technologies that assist teachers in presenting subject matter (content) in an engaging, attention-grabbing, and comprehensible manner. Acquiring technological knowledge (TK) helps teachers perform various tasks and skills using information technologies (IT) as well as develop multiple methods for teaching efficiently through engagement with new technological advancements in general and educational technology in particular (Al-Shwaiar, 2020).

2.3. Pedagogical Knowledge (PK)

This dimension answers the question: "How" do we teach, including planning, execution, and assessment. It requires teachers to understand educational objectives, teaching methods, and evaluation processes. Pedagogical knowledge involves familiarity with instructional methods and strategies as well as understanding students' backgrounds and prior knowledge. It enables learners to connect new information with existing knowledge to build a coherent cognitive structure. Pedagogical knowledge is deep and encompasses understanding how students learn, general classroom management skills, lesson planning, and student assessment. It includes knowledge about classroom methods and strategies, requiring an understanding of cognitive, social, and developmental learning theories and their application to students in classroom settings (Baturay, GOkcearslan, & Sahin, 2017).

2.4. Content Knowledge (CK)

This dimension addresses "what" we teach reflecting familiarity with the scientific content of the subject matter. Content Knowledge (CK) refers to teachers' expertise in their subject area, including staying updated with the latest developments in the field. It involves understanding the components of the content, such as concepts, facts, laws, relationships, and theories as well as its connections with other subjects (Bas & Senturk, 2018).

2.5. Interactions Resulting from the TPACK Framework

The TPACK framework does not focus on the three components independently but also emphasizes the complex interactions among content, pedagogical methods, and technological knowledge and how these are applied in unique classroom and out-of-class contexts (Willermark, 2018). The interactions between these domains give rise to additional components:

Technological Content Knowledge (TCK)

Technological Pedagogical Knowledge (TPK)

Pedagogical Content Knowledge (PCK)

Technological Pedagogical Content Knowledge (TPCK)

This knowledge represents an understanding of the interconnections between content, pedagogy, and technological knowledge in a relational and integrated manner. This integrative knowledge is fundamental to effective teaching as it requires the application of technology and pedagogical methods within content to achieve effective education. Teachers are expected to link content components such as concepts, facts, generalizations, principles, and theories with teaching and learning methods supported by modern technology. This knowledge necessitates that teachers possess a complex understanding to succeed in their teaching specifically related to the technical knowledge of teaching content (Koehler, Mishra, Akcaoglu, & Rosenberg, 2013).

Examples of TPCK include:

Using technology to deliver content.

Using technology in teaching methods for content.

Employing pedagogy to organize or present content.

In this context, Saldana (2015) provides an example of TPCK as follows: Among examples of pedagogical knowledge are strategies like reciprocal teaching. Examples of content knowledge include understanding the subject matter taught by the teacher such as knowledge of chemical reactions in a science class. Examples of

technological knowledge include knowing how to upload and download videos from YouTube and examples of technological knowledge related to the subject include using YouTube videos to show cell structure in a science class.

In a nutshell, the core principles of the TPACK framework can be articulated as follows: mastery of content knowledge alone is insufficient for effective teaching. Knowledge of content, pedagogy, and technology individually without their integration and blending according to the educational context may not achieve the desired educational outcomes. The TPACK framework is both a theoretical and practical model that connects theoretical knowledge requirements for teaching with practical performance that reflects this knowledge. Teacher preparation should not be viewed solely from the perspective of content mastery while neglecting aspects of how to convey this content to learners. The framework emphasizes the interactions among curriculum components (content, teaching methods, goals and assessment) and the teacher and technology. Under the TPACK framework, the focus of teacher preparation shifts from what teachers should learn about technology to how technology interacts with content and teaching methods. Every subject teacher should be sufficiently knowledgeable about the technology used to convey that content to students within an appropriate pedagogical framework.

2.6. Learning in Emergencies

Education in emergencies is defined as alternative education provided during sudden changes in normal life conditions whether caused by human actions, natural disasters, or epidemics ensuring that all learners have the right to continue their education in safe and effective ways. It guarantees the continuity of education during emergencies, conflicts, and epidemics and in the aftermath of such events.

In the current study, this concept refers to the mode of higher education provided by university faculty to students during crises and emergencies that impede face-to-face education.

The shift to remote education in emergencies has revealed the urgent need for university faculty to receive training that integrates technology with academic content teaching skills despite the robustness of the higher education system (Kłosowski, 2020). These training needs are not only associated with remote education practices during crises but are essential for any emergency educational mode. Furthermore, they are critically needed in traditional face-to-face education which itself has necessitated professional requirements due to the quantitative expansion of higher education institutions and the diverse roles of universities (Fernando, 2020).

In the context of the challenges posed by emergency remote education at the university level, studies such as Umenne and Hlalele (2020) and Fernando (2020) have recommended the development of professional growth among faculty members in accordance with the training needs associated with delivering remote education to learners. The current situation of applying emergency remote education has highlighted that university faculty still require comprehensive training programs tailored to this mode of education, addressing technical, pedagogical, and academic aspects.

Al Lily et al. (2020) pointed to the need for professional intervention to assist faculty members in Arab universities in developing their skills for emergency remote education given the confusion and disruption they experienced during the abrupt transition to this mode. Similarly, Al-Rashidi (2020) emphasized the necessity of enhancing faculty competencies through training programs aimed at improving skills required in the era of digital transformation.

The critical importance of emergency remote education has been highlighted and explored in various studies. Fernando (2020) aimed to identify the success factors of e-learning systems in the context of remote learning at universities. The study's findings indicated that the factors considered in the development of e-learning systems for higher education include: system quality significantly impacts user satisfaction, service quality affects system quality, system usage, and user satisfaction; information quality affects system usage; the instructor influences system use and user characteristics affect motivation.

Kłosowski (2020) discussed that most universities have implemented remote learning solutions. Organizing remote education still requires adequate technological infrastructure. Providing suitable IT infrastructure is not an easy challenge as network devices and servers face record peak loads during this period.

Da Costa, De Souza, De Castro, De Medeiros Valentim, and De Pinho Dias (2020) aimed to identify learning styles and methods in remote education through student interaction with the Learning Management System (LMS). The study hypothesized a relationship between artificial intelligence techniques and learning style concepts in remote education which determines each student's learning preferences. Results revealed a low correlation between students' learning styles and their behaviors within the LMS. However, the study identified a new category of learning styles during remote education termed as 'undefined'.

The current study responds to the recommendations of these studies by adopting an experimental approach, differing in its methodology, materials, and research tools. It aims to design a training program based on the Technological Pedagogical Content Knowledge (TPACK) framework to enhance remote teaching practices among university faculty, complementing previous research and addressing its recommendations.

3. METHODOLOGY

3.1. Research Design

This study was conducted as a quantitative study using a quasi-experimental approach to implement a faculty training program and evaluate its effectiveness in enhancing remote teaching practices during emergencies. The experimental design followed a single-group pre- and post-tests where the independent variable was the TPACK-based training program and the dependent variable was faculty remote teaching practices in emergency contexts. Over a defined period, participants completed 12 training sessions. Quantitative tools were used both before and after the intervention to measure differences and assess the TPACK framework's impact on participants' teaching practices in a higher education setting.

3.2. Research Participants

The research sample consisted of an experimental group of 30 faculty members from the Colleges of Humanities, Arts, Education, and Community upon which the training program was applied. This number is deemed appropriate for conducting experimental studies and implementing training programs as it allows for suitable participation opportunities for trainees (Jaber & Kazem, 2011). Participants were selected using simple random sampling with 40% from the College of Arts, 40% from the College of Education and 20% from the College of Community. The sample was chosen through random representation where a number was assigned to each faculty member within each participating college. The papers corresponding to participants from each college were folded separately and placed in a single box. Then, papers were drawn randomly one by one until the required percentage from each college was achieved.

3.3. Ethical Considerations

Ethical considerations were given the highest priority for all participants to conduct this study. Approval was obtained from the Research Ethics Committee at King Faisal University as detailed below: Institutional Review Board Statement: The Ethical Committee of the [Deanship of Scientific Research/King Faisal University], Saudi Arabia approved this study on 31/12/2023 (Ref. No. KFU-REC-2023-ETHICS1892).

Informed consent was secured from all participants, ensuring their full understanding of the study's objectives, procedures, and their right to withdraw at any time without penalty. Confidentiality was strictly maintained throughout the research program implementation. Training sessions were not recorded on Microsoft Teams based on the preference of 67% of the study participants. The research team was committed to upholding the highest standards of ethical practice during the implementation of the study program.

3.4. Study Tools

3.4.1. A Test to Measure the Cognitive Aspect of Emergency Distance Teaching Practices

This test aimed to measure the cognitive aspect of distance teaching practices during emergencies among university faculty members in the areas of content, pedagogy and technology based on the TPACK framework. The test was administered before and after the implementation of the training program developed in the current study.

The test was constructed based on the academic content of the study program aligned with the three main components of TPACK knowledge (pedagogy, content, and technology). The test questions were in the format of multiple-choice (with four response options). The initial version of the test included the following breakdown:

Domain 1: Content Knowledge Practices: The initial version included 12 questions representing 31% of the total number of test questions.

Domain 2: Pedagogical Knowledge Practices: The initial version included 13 questions representing 33% of the total number of test questions.

Domain 3: Technological Knowledge Practices: The initial version included 14 questions representing 36% of the total number of test questions.

The initial version was reviewed by seven experts in curricula, teaching methods, and educational technology to verify the validity of the test. They assessed the appropriateness of the content about what it was intended to measure and evaluated the test's comprehensiveness in covering the relevant knowledge domains as well as the accuracy of its wording both scientifically and linguistically. Two questions from the first domain and one question from the second domain were recommended for deletion and some questions were linguistically revised based on their feedback.

The test was then administered to a pilot sample consisting of 13 faculty members from the Colleges of Education and Arts who were not included in the main study sample. This pilot testing was conducted to ensure the reliability of the test and to calculate the internal consistency of its items. It is worth noting that the pilot test was conducted remotely using Google Forms which was deemed suitable for designing multiple-choice tests.

The reliability of the test was calculated using Cronbach's alpha coefficient based on the pilot test results. This method relies on administering the test once and the reliability coefficient was found to be 0.79 which is an educationally acceptable level of reliability. No questions were removed based on the reliability calculations as all test items showed statistically significant contributions.

The internal consistency of the test items was further verified by calculating the correlation coefficient between the results of each domain (content, pedagogy and technology) and the total test score. The correlation results for the domains content, pedagogy, and technology were 0.91, 0.84, and 0.83, respectively. All of these correlations were statistically significant indicating a high level of internal consistency for the test items and also reflecting a high validity indicator for the test.

3.4.2. Observation Checklist for Distance Teaching Performance Practices of University Faculty Members in Light of the TPACK Framework

The observation checklist was designed to assess the performance aspect of distance teaching practices necessary for university faculty members in the domains of content knowledge, pedagogy, technology and their interactions as guided by the TPACK framework. The checklist comprised seven domains, each containing a set of performance practices detailed as follows:

Content Knowledge (CK) included 5 performance practices.

Pedagogical Knowledge (PK) included 6 performance practices.

Technological Knowledge (TK) included 6 performance practices.

Technological Content Knowledge (TCK) included 3 performance practices.

Technological Pedagogical Knowledge (TPK) included 4 performance practices.

Pedagogical Content Knowledge (PCK) included 3 performance practices.

Technological Pedagogical Content Knowledge (TPCK) included 3 performance practices.

The method for recording the observation checklist (quantitative assessment of practices) was determined according to the levels of a three-point Likert scale as follows:

High degree of practice achievement by the faculty member scored 3 points.

Moderate degree of practice achievement by the faculty member scored 2 points.

Low degree of practice achievement by the faculty member scored 1 point.

It was reviewed by the same group of experts in curriculum and instructional technology who previously assessed the test to ensure the content validity of the observation checklist. The experts made minor adjustments to the content of the checklist.

3.5. Training Program Based on the Technological Pedagogical Content Knowledge (TPACK) Framework

The primary objective of developing the training program was to enhance remote teaching practices in emergencies among university faculty members in line with the integration of content, pedagogy, and technology knowledge. The specific procedural goals of the program were derived from this overall aim and were outlined at the beginning of each training session.

3.6. Program Description

3.6.1. Content and Organization of Training Sessions

The training program was scheduled over six days comprising a total of 12 sessions. Each day included two training sessions with each session lasting three hours and a break in between. The program sessions were designed to provide the necessary knowledge, activities, and applications to improve remote teaching practices based on TPACK knowledge. The sessions included micro-teaching activities and practical examples related to TPACK.

3.7. Program Structure

The program began with a theoretical introduction covering the following: the title of the training program, its objectives, and key concepts related to TPACK and remote teaching in emergencies, training methods, rules of engagement, evaluation mechanisms, and the schedule for the training sessions.

3.8. Session Components

Each training session included several key elements: the session topic, procedural objectives, time allocated, theoretical and practical remote training methods, scientific content, activities, self-assigned tasks, applications, micro-teaching, and evaluation.

3.9. Initial Focus

The first training day focused on establishing the concepts of the TPACK framework and its significance for remote teaching in emergencies.

3.10. Training Needs

The program was designed to address the actual (realistic) training needs of the faculty members.

3.11. Measurement Tools

Separate days were allocated for applying measurement tools before and after the program to avoid affecting the designated training time.

The training program was based on TPACK knowledge, involving content, pedagogy, and technology and their interactions. Consequently, appropriate methods employed included guided self-learning, online brainstorming, electronic worksheets, practical demonstrations, remote workgroups and online collaborative learning.

The program was reviewed by five experts in curriculum, instructional methods, and educational technology. They provided feedback on the program's objectives, session content and implementation timeline. The experts suggested revisions to some procedural objectives and adjustments to the timing and placement of certain activities and applications within the session content.

3.12. Data Collection and Analysis

For data collection, the study sample was selected as previously described. A WhatsApp group was created for the study participants to facilitate continuous communication regarding instructions, schedules, events, and the exchange of academic materials related to the program. The researchers held an introductory online meeting for an hour and a half with the research group through Microsoft Teams to clarify the requirements for implementing the program and to present its basic details. All trainees were provided with a copy of the program. The training program was conducted for the participating faculty members throughout 12 sessions using Microsoft Teams. The program was implemented over 6 training days comprising 12 sessions (two sessions per day with a break in between, each lasting 3 hours). The training days were spread across three weeks with two training days conducted each week. Pre- and post-tests of the measurement tools (the test and the observation checklist) were administered and the scores were recorded and entered into an Excel file in preparation for statistical analysis. A paired-samples t-test was used to determine the significance of the differences between the mean scores of the research sample in the pre- and post-tests and the observation checklist. The eta-squared value (η^2) was used to calculate the effect size of the training program in enhancing the cognitive and practices aspects of TPACK.

Table 1. Results of the paired samples t-test for the pre- and post-test of the cognitive aspect of teaching among faculty members in light of the TPACK framework (N = 30)

TPACK knowledge domains	Pre-test mean	Pre-test SD	Post-test mean	Post-test SD	T-value	Significance level	Direction of differences	Effect size (η^2)	Effect size level
Content knowledge (CK)	3.4	1.20	8.47	0.76	19.5	0.001	Post-test	0.92	Large
Pedagogical knowledge (PK)	3.8	1.43	11.13	0.73	24.6	0.001	Post-test	0.91	Large
Technological knowledge (TK)	4.1	1.65	12.52	1.01	28.4	0.001	Post-test	0.96	Large
Overall test score	11.3	2.81	32.12	1.6	45.3	0.001	Post-test	0.98	Large

4. RESULTS AND DISCUSSIONS

4.1. Results of Measuring the Cognitive Aspect of Teaching in Emergency Situations in Light of the TPACK Framework

Quantitative results in Table 1 indicate that the differences between the pre- and post-tests means for the cognitive aspect of TPACK knowledge practices in emergencies were statistically significant in favor of the post-test at a level of (0.001). The overall t-value was 45.3. Additionally, the effect size was greater than 0.8 indicating a large effect size of the training program in improving the cognitive aspect of TPACK Knowledge among university faculty members. The researchers attribute this result to the significant impact of the training program based on the TPACK framework in enhancing the cognitive aspects related to knowledge of content, pedagogy, and technology among the faculty members participating in the study.

This finding aligns with the studies of Kirikçilar and Yildiz (2018); Kul et al. (2019); Hassan and Radhi (2019) and Abd al-Hamid (2020) which highlighted the positive impact of training programs on improving TPACK knowledge among both pre-service and in-service teachers. The emphasis on TPACK knowledge in the program content played a crucial role in fostering participants' engagement with training and research on integrating content, pedagogy and technology. This integration has become essential for delivering distance education, especially in the current context. The research group emphasized the relevance of the TPACK-based knowledge provided in the training program considering it particularly vital at this time.

The program specifically focused on enhancing the cognitive dimension related to delivering emergency distance education which deepened the faculty members' engagement with the content. The training program provided an opportunity to develop the trainees' knowledge regarding the fundamentals of teaching, its skills, and basic strategies such as formulating learning objectives, identifying the most suitable teaching methods, selecting appropriate learning activities, understanding effective classroom interaction techniques during distance education, and general teaching skills. This program contributed to answering the question: How do we teach? This had a positive impact on the post-training application for the research group in the field of pedagogical knowledge.

In the area of technology knowledge, the program provided knowledge about familiarizing with modern digital resources, applications, and media and integrating them into distance teaching. This included understanding how to use computer applications, the internet, materials, tools and modern technological media in delivering scientific content. The training participants emphasized the importance of this area and their clear need for it in the pattern of distance education in emergencies.

The training methods used in the program encouraged faculty members to share and enrich knowledge on the program topics. Methods such as electronic brainstorming, electronic worksheets, remote micro-teaching applications, flipped classrooms, and scientific discussions on the participants' WhatsApp group allowed for open discussions about the program's knowledge and content as well as answering questions related to its applications. According to the TPACK framework, this directly contributed to achieve a positive impact of the program on the cognitive aspect of remote education practices in emergencies among faculty members.

Additionally, the self-directed training applications integrated into the program's activities and events kept participants continuously searching and discovering new knowledge related to their training tasks. These practices led them to read and explore the cognitive aspects underpinning the training, enriching their knowledge of the TPACK framework and its relation to emergency remote education. Consequently, this improved their cognitive understanding. The program also kept pace with the technological advancements necessary for remote education applications in emergencies besides focusing on providing contemporary and practical knowledge, including TPACK knowledge. It aligned with 21st-century teaching skills which necessitate the integration and alignment of technology with scientific content and teaching fundamentals. This is precisely what the training program aimed to address with the trainees resulting in a significant impact on the post-training application among the research group of university faculty members.

Table 2. Results of the paired samples t-test for pre- and post-assessment of teaching practices among faculty members based on the TPACK framework (N = 30).

TPACK practices domains	Pre-observation mean	Pre-observation SD	Post-observation mean	Post-observation SD	T-value	Significance level	Direction of differences	Effect size (η^2)	Effect size level
Content knowledge practices	7.9	1.6	13.3	1.6	28.8	0.001	Post observation	0.96	Large
Pedagogical knowledge practices	8.1	1.3	16.4	1.4	42.5	0.001	Post observation	0.99	
Technological knowledge practices	9.8	1.8	15.6	1.8	36.6	0.001	Post observation	0.94	
Technological content knowledge practices	4.2	2.4	8.2	1.2	22.4	0.001	Post observation	0.93	
Technological pedagogical knowledge practices	5.7	1.6	10.4	1.6	37.1	0.001	Post observation	0.92	
Pedagogical content knowledge practices	3.4	1.3	7.5	1.4	46.2	0.001	Post observation	0.96	
Technological and pedagogical content knowledge practices	4.3	7	8.53	1.8	36.3	0.001	Post observation	0.94	
Total score of the observation card	43.4	2.8	79.9	3.6	54.3	0.001	Post observation	0.97	

4.2. Results of Measuring the Practices Aspect of Teaching Practices in Emergency Situations in Light of the TPACK Framework

Table 2 shows the results of the observation card for the performance aspect of the participants' practices in the study. The differences between the pre- and post-test means for the observation card were statistically significant in favor of the post-test at a level of 0.001 with an overall t-value of 54.3. The effect size was greater than 0.8 in both the subdomains and the equal pedagogical knowledge practices, pedagogical content knowledge practices and technological and pedagogical content knowledge practices. These practical practices contributed to developing the trainees' performance in incorporating electronic media, interactive presentations, using networks in training, implementing distance teaching through flipped classrooms, employing educational videos, and other applications that contributed to achieving a significant impact of the program on distance education practices. The use of modern training methods that integrate technology and its applications into content and teaching methods made the trainees more adept at distance education applications and their implementation. These training activities provided numerous opportunities for trainees to realistically integrate TPACK practices into distance education.

Researchers observed that participants in the training program were eager to demonstrate their desire for professional growth and self-development and to keep up with the contemporary requirements for implementing distance education. This enriched the program by providing practical and modern requirements for the professional development of faculty members. In this regard, some sample members expressed a desire to move beyond traditional methods of distance teaching which the current training program addressed by refining their skills in integrating technology with content and teaching methods. Practical opportunities were provided for participants to practice distance education by integrating technology with content and teaching methods as the training sessions included numerous applications and activities based on practice rather than theoretical learning.

Several participants noted that they had previously overlooked many practices when delivering distance education to their students before the training, and that the training exercises during the program enhanced their practices based on sound scientific principles. The program sessions employed a variety of training methods that played a clear role in enriching and achieving a significant impact on distance education practices within the TPACK framework. Participants used flipped classroom applications, practical demonstrations through micro-teaching, electronic collaborative learning, and electronic projects and activities which contributed to the realistic implementation of distance education practices during the training.

5. CONCLUSION

The results of the current study indicated an improvement in both the performance and cognitive aspects of emergency teaching practices through a training program based on the Technological Pedagogical Content Knowledge (TPACK) framework in higher education. The current study confirms the significant impact of the training program used on enhancing both the cognitive and performance aspects of emergency teaching practices within the TPACK framework. The results reveal improvements in cognitive aspects. The training program demonstrated a substantial effect on enhancing faculty members' cognitive understanding of TPACK practices. Statistical analysis indicated significant differences between pre- and post-test scores in the cognitive aspects of the TPACK framework with a clear effect size highlighting the program's effectiveness in advancing knowledge in content, pedagogy and technology.

Regarding practical practices, the training program led to notable improvements in performance practices among participants. The statistical significance of the observed differences in the performance aspect, combined with the large effect size suggests that the program effectively contributed to enhancing the practical application of emergency teaching practices. The methods used in the training program fostered a deeper engagement with contemporary technological tools and pedagogical strategies, resulting in improved performance in teaching scenarios.

The program effectively addressed participants' needs to move beyond traditional methods in handling emergency teaching practices. The results align with previous research supporting the effectiveness of TPACK-based training programs in enhancing teaching practices overall. The study underscores the value of integrating TPACK principles in training programs to improve both theoretical understanding and practical application in emergency teaching contexts.

6. POLICY SUGGESTION

There is a pressing need for training on emerging media and technologies in educational technology, especially with the increasing prevalence of online learning platforms and programs based on the study's results and participants' feedback. Training workshops can be organized for university faculty members to enhance their skills in using e-learning platforms, distance education, and digital educational applications and tools. Furthermore, it is essential to diversify the areas of distance training offered to university faculty ensuring they encompass the knowledge and practices related to TPACK and its interactions.

7. LIMITATIONS

Given that the current study is quasi-experimental, it includes several limitations that should be considered. First, the research was conducted with a relatively small sample size (N = 30) which may limit the generalizability of the findings to a larger population of university faculty members. The study focused on a specific training program within the context of emergency distance education and within a specific TPACK framework, which may not fully capture the effectiveness of other training programs or models in different educational settings. Additionally, the research design relied on data collection tools specifically developed for this study, namely the test and observation card which may be subject to biases. Future research could benefit from using larger and more diverse samples, exploring additional evaluation methods and providing a more comprehensive understanding of training effectiveness for enhancing emergency teaching practices.

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