Level of Tpack of the Btled and Btvted Pre-Service Teachers: Input for Teaching Methodology Program

***Fedrick Herrera., Justine Karl Adriano., Juliet Salao., Allysa Aira Guanzon., Joseline Santos, PhD., Aileen Abelgos MITM, LPT**

Bulacan State University, College of Education, Malolos City, Bulacan 3000

DOI: https://dx.doi.org/10.47772/IJRISS.2025.90300089

Received: 18 February 2025; Accepted: 28 February 2025; Published: 01 April 2025

ABSTRACT

TPACK plays a significant role in today's education setup. Every pre-service teacher needs to possess the knowledge and skills necessary for integrating technology into their teaching methodology. However, this teaching technique isn't compatible with everyone. Therefore, each pre-service teacher should aim to acquire this necessary skill to cope with today's learning setup. This study focuses on the level of TPACK of BTLED and BTVTED pre-service teachers, particularly on how they developed their TPACK during their practice teaching experiences. The study sample comprised 97 pre-service teachers from the BTLED and BTVTED programs. This study utilized a convergent parallel design, subdivided into a survey and interview format. The survey questionnaire was based on a four-point Likert scale and investigated the level of understanding of the respondents regarding the component of TPACK. Moreover, the interview sought how the respondents devised their TPACK based on their experience in the actual school set-up. The data collected was analyzed and served as the basis for the proposed program to address this gap in educational setup.

Keywords: TPACK, Practice teaching experience, Technology integration, Teaching methodology

INTRODUCTION

Today's era is solely driven by different technological advancements and innovative approaches of advanced methodology, the integration of technology into the educational system has become imperative. Educational technology is at the heart of good teaching, resulting in an effective teaching approach wherein it scaffolds independent and collaborative learning (Zhang et al., 2021). The integration of technology inside a classroom is not just introducing the latest gadgets or software; it requires a deep understanding of the relationship between technology to content and pedagogy. The Technological, Pedagogical, and Content Knowledge (TPACK) framework is a means of integrating technology into teaching (Moreno et al., 2019). It has emerged as a guiding principle for educators seeking to harness the potential of technology for effective teaching and learning. The definition of TPACK and its components is given below:

Content Knowledge (CK). It refers to the mastery of skills and understanding the knowledge of specific areas of learning that the teachers possessed before teaching it to their students.

Pedagogical Knowledge (PK). It refers to the art of teaching in which the methodology and approach the teachers use are crucial in knowledge retention and understanding.

Technological Knowledge (TK). It refers to the teacher's knowledge and understanding of maximizing and utilizing technology. It involves a wide range of approaches that utilize different technological advancements to improve the quality of the learning process.

Pedagogical Content Knowledge (PCK). It refers to the different teaching methods and approaches that correspond to the specific area of knowledge teachers are intended to apply. It is the relationship between the knowledge itself and how it is delivered to the students.

Technological Content Knowledge (TCK). It refers to the integration of technology to improve the content knowledge of teachers to enhance their material to heighten the learning process of their students.

Technological Pedagogical Knowledge (TPK). It refers to the methods and approaches teachers use while incorporating technology as its medium. It surfaces a wide range of tools that may enhance teaching and learning processes.

Technological, Pedagogical, and Content Knowledge (TPACK). It refers to the knowledge and understanding of the teachers in utilizing technology in their teaching content and pedagogy. It is incorporated by different sets of tools and equipment to improve traditional teaching and learning into a 21st-century student-centered learning approach.

TPACK is rooted in the idea that successful teaching involves a harmonious fusion of technological knowledge, pedagogical knowledge, and content knowledge. These three domains do not exist in isolation but are intimately intertwined; they can significantly contribute to a teacher's training to further enhance their educational work, alongside the training context of technological implementation in the classroom (Colon et al., 2023). Educators must not only be proficient in their subject matter (content knowledge) but also possess the pedagogical skills (pedagogical knowledge) to convey information effectively to their students. Furthermore, they must be adept at leveraging technology to enhance the teaching and learning process.

Nowadays, technology has become an integral part of the modern classroom. The typical visual aids have turned into different online media resources such as images, videos, and online presentations. Moreover, today's educators escalate the use of different e-learning platforms to help them teach amidst different circumstances. These e-learning platforms are considered an effective tool for transferring knowledge and it has the potential to overtake the conventional teaching method (Rawashdeh et. al, 2021). It makes learning very exciting because of the abundant resources available plus the concept of collaboration and student-centeredness. Learners value the integration of technology inside the classroom, this is supported by the study conducted by Rawashdeh et. al (2021), who found that technology integration specifically e-learning enables educators and learners to communicate easily. It contributes mainly to interestingly developing student's skills. Additionally, they can access it anytime through the use of different devices such as mobile phones and personal computers (Alghizzawi et. al, 2019). These advantages give ease and a lot of opportunity to everyone in the academe, the only problem is that when the teacher isn't familiar with using and maximizing it.

Teachers who aren't equipped with vast knowledge and experience in technology integration are a huge gap to consider in today's educational system. The researchers wanted to address it by helping aspiring teachers maximize TPACK in their teaching methodology and pedagogy. These hindrances require an immediate solution (Adesope & Rud, 2019), with a systematic program that addresses this identified gap, anyone can enjoy the advantages of educational technology if and only if it is faced with constant developments and affordances.

To give emphasis, the primary objective of this study is to assess and understand the current level of TPACK of the BTLED and BTVTED pre-service teachers in Bulacan State University – College of Education; and how it affects their teaching performance with the fact that they are currently in their practice teaching experience. Hence, this research will manage to understand how these things correlate with each other and whether they can formulate a framework to be integrated into today's set-up of education.

Statement of the Problem

The general problem of the study is to determine the level of TPACK of the pre-service teachers in the College of Education specifically the fourth-year BTLED and BTVTED students and to understand how they integrate technology in their practice teaching.

Specifically, this study will find answers to the following questions:

1. What is the level of TPACK of the pre-service teachers in terms of:

    1.1 Content Knowledge (CK);

1.2 Pedagogical Knowledge (PK);

1.3 Technological Knowledge (TK);

1.4 Pedagogical Content Knowledge (PCK);

1.5 Technological Content Knowledge (TCK);

1.6 Technological Pedagogical Knowledge (TPK);

1.7 Technological, Pedagogical, and Content Knowledge (TPACK)?

2. Is there a significant relationship between CK, PK, TK, PCK, TCK, and TPK to the TPACK of the pre-service teachers?

3. How does the pre-service teachers develop their TPACK during their practice teaching?

4. What program maybe proposed to integrate TPACK to the teaching methodology of the BTLED and BTVTED program?

Scope and Delimitations of the Study

This study aimed to determine the level of TPACK of the pre-service teachers, to understand the correlation between its components to apprehend how it interrelated with each other. Also, the researcher tried to commiserate how the pre-service teachers developed their TPACK knowledge and how it can be improved. Moreover, the data was gathered through interviews and survey questionnaires.

The study focused on the pre-service teachers of the BTLED and BTVTED programs of the Bulacan State University – College of Education academic year 2023 – 2024. They served as the respondents of the study. They were asked a series of questions to perceive their current knowledge regarding TPACK concerning how they integrate it into their practice teaching. Furthermore, they were questioned about their experiences with technology integration and how they applied it during their practice teaching.

On the other hand, the study is confined to three parts; first, the assessment of the level of TPACK of the pre-service teachers; second, a set of questions on how they applied their TPACK during their practice teaching; and third, an analysis to further understand how the variables are related to each other and how the pre-service teachers manage to use TPACK efficiently and effectively in their respective school/classes.

METHODOLOGY

The study utilized a convergent parallel approach of mixed-method design. It is a simultaneous collection of qualitative and quantitative data, followed by the combination and comparison of these multiple data sources (Edmonds & Kennedy, 2017). This process involves the collection of different data that support and/or are interrelated with each other.

Population and Sample

This study used a purposive sampling technique to select the participants and respondents to avoid biases. The BTLED and BTVTED programs were chosen because they are the ones that can give in-depth and detailed information about the aim and goal of this study. Additionally, they are more capable in technology integration, hence they can fully maximize the benefits and advantages of technology in their pedagogy and methodology.

Table 1. Population and Sample of the Study

ISSN No. 2454-6186 | DOI: 10.47772/IJRISS | Volume IX Issue III March 2025

BTLED AND BTVTED	Population	Sample	Answered Questionnaires
BTLED 4B – ICT	22	19	18
BTVTED 4A – FSM	39	36	36
BTVTED 4B – FSM	40	36	27
BTVTED 4C - GFD	18	14	16
Total	119	105	97

Among the 119 target populations of this study, only 97 of them participated in the data-gathering procedure. Personal preferences are one of the prior reasons why some of the target respondents declined to participate, despite this, their personal choice was respected by the researchers. The available collected data are still manageable and reliable enough to proceed with the data tabulation and analysis for this study.

Respondents According to Age

Table 2. Distribution of the respondents according to Age

Age	Frequency	Percentage
19-20	0	0.0
21-22	77	79.38
24-24	18	18.56
25 & above	2	2.06
Total	97	100

Table 2 presents the frequency and percentage distribution of the respondents according to their age. Based on the data presented, ages 21-22 years old reveal a dominant presence by having 79.38% or 77 individuals among the total respondents. This observation suggests a notable concentration of younger participants within this age bracket, indicating their active involvement in the subject matter of the study. According to Parsons et. al. (2024), younger age groups often exhibit higher levels of engagement and participation in research studies, attributed to factors such as accessibility to educational institutions and familiarity with modern research methodologies.

Moreover, the age groups 23-24 years old and 25 years old & above having a percentage of 18.56% and 2.06% respectively, though comparatively smaller in proportion, still contribute valuable insights to the overall dataset. The presence of respondents in these categories underscores the importance of incorporating diverse age ranges to capture a comprehensive understanding of the research phenomenon. By acknowledging and contextualizing these demographic nuances, researchers can enhance the validity and generalizability of this study, thus contributing to the advancement of knowledge within this field.

Respondents According to Gender

Table 3. Distribution of the respondents according to Gender

Gender	Frequency	Percentage
Male	18	18.56
Female	50	51.54
Prefer not to say	29	29.9

Total	97	100

Table 3 presents the frequency and percentage distribution of the respondents according to their gender. Based on the results, most of the BTLED and BTVTED pre-service teachers identified as female having a total of 51.54% or 50 individuals compared to the total number of the population. This comparison of data is very much observed in the field of education where women outnumbered men in the teacher training programs.

Conversely, the male representation is considered lower, having a percentage of 18.56% or 18 individuals of the total sample. This disparity may reflect societal norms and perceptions regarding gender roles in education, as well as potential barriers that discourage men from pursuing careers in teaching. This emphasizes the importance of considering gender in educational settings, despite having typical gender stereotypes, both male and female teachers should negate external pressures and focus on making a positive influence on the teaching and learning experiences (Preece & Bullingham, 2022). On the other hand, nearly a third of the respondents (29.9%) chose not to disclose their identity. This highlights the importance of creating an inclusive research environment that respects an individual's autonomy in disclosing personal information. It concluded with the promotion of gender equity and diversity within the teaching profession, contributing to more inclusive and effective educational practices.

Research Instrument

Survey Questionnaire

The survey questionnaire is subdivided into two parts, the demographic profile of the respondents and the TPACK questionnaire. The demographic profile of the respondents will provide the necessary information about their background, they will be asked for details of their name (optional), age, gender, and program/course. The second part is the TPACK questionnaire which will measure the pre-service teachers' methodology as well as their capability to integrate technology inside the classroom. The survey questionnaire adopted from Schmid et. al. (2020) will cover the following: Pedagogical Knowledge (PK), Content Knowledge (CK), Technological Knowledge (TK), Pedagogical Content Knowledge (PCK), Technological Pedagogical Knowledge (TPK), Technological Content Knowledge (TCK), and Technology Pedagogy and Content Knowledge (TPACK). The questionnaire has reliability scores of 0.86, 0.76, 0.92, 0.83, 0.78, 0.92, and 0.84 respectively which implies that is valid and reliable.

Interview Questions

The researchers utilized a self-made questionnaire that sought to find how the pre-service teachers devised their TPACK on the course of their practice teaching experience. They were asked a series of interview questions to determine their teaching performance while utilizing and integrating technology in their teaching practices.

Data Processing, Statistical Treatment, and Coding Process

The data collected from the survey questionnaire underwent a statistical treatment. The gathered data were classified and tabulated to get its weighted mean in order to interpret the level of TPACK of the pre-service teachers. The respondents answered the survey questionnaire in a Likert-scale format with the following interpretation:

Table 4. TPACK Questionnaire Likert-scale

Scale	Verbal Interpretation
3.50 – 4.00	Strongly Agree / Has Strong Knowledge
2.50 – 3.49	Agree / Has Knowledge
1.50 – 2.49	Disagree / Has Fairly Knowledge

1.00 – 1.49	Strongly Disagree / Has Poor Knowledge

After the data processing, the quantified mean will undergo a profound computation of its r-value as well as its p-value to determine whether the hypothesis and assumption of the study are significantly true. On the other hand, the information collected from the interview undergoes a coding process. The researchers utilized the Descriptive Coding Approach which determines the qualitative nature of the information from the respondents. After collecting the data about how they devised and implemented technology in their practice teaching, the information they provided was encoded to itemize their response to formulate sub-codes and to have a unified theme. Moreover, the qualitative information will then be evaluated to correlate its significance with the different components of TPACK that subsequently motivate the pre-service teachers to develop their very own TPACK to help them excel in their practice teaching experience.

RESULTS AND DISCUSSION

Level of TPACK of the BTLED and BTVTED Pre-service

The Technological, Pedagogical, and Content Knowledge (TPACK) model has been determined to be one of the most important elements in today's teaching practices (Castera et. al., 2020). Table 5 shows the level of TPACK of the BTLED and BTVTED pre-service teachers to understand their current knowledge in terms of integrating technology into their teaching pedagogy.

Table 5. Level of TPACK of the BTLED and BTVTED Pre-service Teachers

Components	Mean	SD	Verbal Interpretation
CK	3.54	0.54	Has Strong Knowledge
PK	3.63	0.53	Has Strong Knowledge
TK	3.54	0.54	Has Strong Knowledge
PCK	3.55	0.53	Has Strong Knowledge
TCK	3.65	0.52	Has Strong Knowledge
TPK	3.67	0.49	Has Strong Knowledge
TPACK	3.65	0.51	Has Strong Knowledge

- The Content Knowledge (CK) among the pre-service teachers have an overall mean score of 3.65 and a 0.54 standard deviation, indicating that the BTLED and BTVTED pre-service teachers have strong knowledge in different areas and concepts that must be taught to the students.

- The Pedagogical Knowledge (PK) among the pre-service teachers have an overall mean score of 3.65 and a 0.53 standard deviation, indicating that the BTLED and BTVTED pre-service teachers have strong knowledge in possessing and implementing different pedagogical activities, practices, and techniques to heighten the learning process of the students.

- The Technological Knowledge (TK) among the pre-service teachers have an overall mean score of 3.54 and a 0.54 standard deviation, indicating that the BTLED and BTVTED pre-service teachers have strong knowledge in knowing different technologies, the only concern is that proper training should impose to acquire and maximize the skills of using technological tools in classroom because it is necessity in 21st century learning environment.

- The Pedagogical Content Knowledge (PCK) among the pre-service teachers have an overall mean score of 3.54 and a 0.53 standard deviation, indicating that the BTLED and BTVTED pre-service teachers have strong knowledge in choosing the best suited methodology in a particular area or field of learning competency.

- The Technological Content Knowledge (TCK) among the pre-service teachers have an overall mean score of 3.65 and a 0.52 standard deviation, indicating that the BTLED and BTVTED pre-service teachers have strong knowledge in integrating technology to expound learning content to deliver an effective and efficient learning discussion.

- The Technological Pedagogical Knowledge (TPK) among the pre-service teachers have an overall mean of 3.67 and a 0.49 standard deviation, indicating that the BTLED and BTVTED pre-service teachers have strong knowledge in maximizing technology available to improve learning process. Furthermore, they can clearly adapt to these changes ensuring that despite of what process they implement, technology can boost its potential to achieve learning goals and objectives.

- The TPACK among the pre-service teachers have an overall mean score of 3.65 and a 0.51 standard deviation, indicating that BTLED and BTVTED pre-service teachers have strong knowledge in integrating technology, pedagogy, and understanding the content and application of TPACK principles in their teaching practices as evidenced through their responses.

Correlation Matrix

This part discusses the relationship between CK, PK, TK, PCK, TCK, and TPK to the TPACK of the pre-service teachers. These components of TPACK are commonly misunderstood for having identical purposes, but if we look closer, we can see their differences and distinctions from each other. TPACK components play an important role in enhancing the overall performance of a certain pedagogy, but for the context, it unifies and covers almost entire teaching techniques to come up with an enhanced teaching approach for the betterment of learning.

Table 6. Correlation Matrix CK, PK, TK, PCK, TCK, TPK, and TPACK

Variables	Pearson-r	Description	P-value	Decision	Interpretation
CK & TPACK	0.3843	Positive Correlation	0.000102	Reject H0	There is a significant relationship between CK, PK, TK, PCK, TCK, and TPK to the TPACK of the pre-service teachers.
PK & TPACK	0.413	Positive Correlation	0.000026	Reject H0	There is a significant relationship between CK, PK, TK, PCK, TCK, and TPK to the TPACK of the pre-service teachers.
TK & TPACK	0.468	Positive Correlation	0.00001	Reject H0	There is a significant relationship between CK, PK, TK, PCK, TCK, and TPK to the TPACK of the pre-service teachers.
PCK & TPACK	0.5001	Positive Correlation	0.00001	Reject H0	There is a significant relationship between CK, PK, TK, PCK, TCK, and TPK to the TPACK of the pre-service teachers.

TPK & TPACK	0.621	Positive Correlation	0.00001	Reject H0	There is a significant relationship between CK, PK, TK, PCK, TCK, and TPK to the TPACK of the pre-service teachers.
TCK & TPACK	0.6611	Positive Correlation	0.00001	Reject H0	There is a significant relationship between CK, PK, TK, PCK, TCK, and TPK to the TPACK of the pre-service teachers.

Table 6 shows the correlation matrix between CK, PK, TK, PCK, TCK, and TPK to the TPACK of the pre-service teachers. The data reveals that the Technological and Content Knowledge got the highest Pearson-r value of 0.6611 indicating a positive correlation. This means that technological implications truly help the knowledge retention of the content knowledge provided by the pre-service teachers. On the other hand, Content Knowledge got the lowest Pearson-r value of 0.3843 but still connotates a positive correlation among the TPACK components meaning that there should be a continuous improvement to the teaching content of the pre-service teachers. Overall, the components imply a positive correlation to the overall TPACK of the respondents, this signifies that despite their specific focus area, still they work together for the betterment of the teaching approach used by the pre-service teachers.

Moreover, the CK, PK, TK, PCK, TPK, and TCK got the p-values of 0.000102, 0.000026, 0.00001, 0.00001, 0.00001, and 0.00001 respectively. This results in a uniform decision of rejecting the null hypothesis, meaning there is a significant relationship between the variables. Among the components, TPK and TCK were statistically powerful, this result is in line with the study conducted by Santos and Castro (2021), they've found that among the second-level knowledge basis (PCK, TCK, and TPK) TCK had the most impact and influence to the overall TPACK of the pre-service teachers. In conclusion, the correlation matrix proves the relationship between the components of TPACK as they work in unison to enhance the teaching and learning experience of the students and teachers.

Developed TPACK of the Pre-service Teachers

This part emphasizes how the BTLED and BTVTED pre-service teachers devised their TPACK during their practice teaching. It gives a subjective explanation of how they manage to integrate technology into their teaching practices. Moreover, it presents data about their practice teaching experiences, familiarity, and comfort when using technology, opportunities perceived in using technology, and different technological tools and applications they use that enhance students' learning process.

Practice Teaching Experiences

Table 7. Summary of Codes and Themes in terms of Practice Teaching Experiences

Respondent Number	Response Code	Sub-code	Theme
1	Pressured	pressured	pressured but challenging
7	It was like a roller coaster, there were ups and downs.	ups and downs	
8	Challenging	challenging	
14	Challenging	challenging	
2	Good, the students are very cooperative and attentive. The environment is very accommodating and the teachers are approachable.	positive teaching and learning environment	positive experience

ISSN No. 2454-6186 | DOI: 10.47772/IJRISS | Volume IX Issue III March 2025

3	It's all good	good experience	
9	Grateful	grateful	
10	Happy	happy	
11	Fine and fun	fun and challenging	
12	My experience in practice teaching was a good one.	good experience	
13	It was a nice experience	good experience	
16	My experience during the practice teaching was enjoyable.	enjoyable	
20	Very exciting all day	exciting	
23	Happy and fulfillment	happy and fulfillment	
4	I learned a lot during my teaching experience such as teaching techniques.	learned teaching techniques	learned teaching techniques
6	I enjoy my teaching experience because I gain a lot of knowledge.	gain a lot of knowledge	
18	My critic teacher is always supported from the first day until the last, he gave me different strategies to use or implement in my demo teaching.	learned different strategies	
22	It was challenging but I learned a lot during that time.	learned a lot	
5	My teaching experience was mixed feelings, there are times that I enjoyed teaching to the students but the preparation was so tiring.	enjoy but tiring	mixed emotions
15	Challenging an enjoyable	challenging and enjoyable	
17	It takes a lot of me and it is really tiring but teaching student is fun.	tiring but fun	
19	It was fun but I'm a bit nervous, I am happy because I met a lot of people.	fun and challenging	
21	It was hard, but still I did my best because I need to achieve my dream.	hard and fulfillment	

Theme 1: Pressured but Challenging: Respondents no. 1, 7, 8, and 14 share the same idea that practice teaching may sound tiring but challenging. Their feedback highlighted feelings of pressure alongside the challenging nature of being a teacher. This theme emphasizes the existing literature on psychological stressors and cognitive demands associated with teaching and its processes (Tatli et. al., 2019). Educators are encouraged to address these challenges by providing support resources to foster a growth mindset. Understanding and addressing pressures and challenges are essential for creating a supportive learning environment conducive to long-term success in the academic field.

Theme 2: Positive Experience: The experiences shared by respondent no. 2,3,9,10,11,12,13,16,20 and 23 highlighted satisfaction, gratitude, and enjoyment in their corresponding learning environment. Having a positive learning environment encourages educators to prioritize inclusivity and collaboration to create the best possible

teaching approach they can use for their students. Moreover, learners can benefit so much from it that they can create a healthy atmosphere that can encourage motivation and resilience (Asuo-Baffour et. al., 2019).

Theme 3: Learning Teaching Techniques: Learning teaching techniques is one of the experiences that pre-service teachers absorb during their practice teaching. Respondents 4, 6, and 18 share valuable knowledge they gained during their practice teaching experiences, particularly acquiring new pedagogical strategies. According to Resch (2023), it is important to experience practical teaching, aside from having abundant knowledge, it provides opportunities for novice teachers to apply theoretical knowledge and receive mentorship from their respective schools. This can lead to a transformative and impactful practical teaching experience that can foster the development of effective teaching techniques.

Theme 4: Mixed Emotions: Different emotions are expressed by the respondents 5, 15, 17, 19, 21, and 22. This feedback reflects a blend of positive feelings alongside negative emotions that are truly memorable, especially for pre-service teachers. Recognizing and managing emotions effectively can help every teacher in the making to achieve professionalism in their field. According to Zaretsky et. al. (2019), understanding mixed emotions has implications for teacher support and professional development. It led to different strategies and approaches to promote educator well-being and foster a positive school culture.

Familiarity and Comfort when Using Technology

Table 8. Summary of Codes and Themes in terms of Familiarity and Comfort when Using Technology

Respondent Number	Response Code	Sub-code	Theme
1	I find it fascinating, because from the three years of studying ICT, I can actually use technology properly.	use technology properly	*maximizing / utilizing the use of technology*
2	It makes the teaching process easier.	makes teaching easier	
4	Since I am an ICT Major, I utilize the technology well to my class	utilized technology well in class	
5	I can utilize the technology in teaching easily.	utilized technology easily	
10	I feel comfortable using technology because it is easy to make ppt.	helping in making presentations	
12	Using technology was a big help for me.	technology was a big help	
17	I find it quite helpful and miraculous to have the assistance of technology.	assistance of technology	
20	It is easy to discuss or give an activity when using technology.	assistance of technology	
21	I was super familiar with it to the point that I can easily manipulate the things I need.	easily manipulate - organization	
22	It easier for me to teach because I didn't have to make a paper visual aid.	easier to teach - visual aids	
3	I'm very much familiar	familiar	*familiar and comfortable*
6	Since we are an ICT major, we are familiar in technology, so it makes teaching intern easier.	familiar and makes teaching easier	

7	Using technology while teaching is not new to me so I felt confident and more excited to teach.	confident to teach	*in using technology*
8	It's very comfortable	comfortable	
9	It meets my standard because it is easy to use.	easy to use	
11	Super familiar and comfortable	familiar and comfortable	
13	Out of 10, I would rather say I'm in 8	familiar	
14	Confident	confident	
15	It was easy for me to use technology while teaching because we always use it when we are reporting.	easy to use technology	
16	I am very much familiar when using technology.	familiar in using technology	
18	I am very familiar and comfortable with the use of technology since I am an ICT student.	familiar and comfortable	
19	Since we have computer shop, I am very familiar with technology.	familiar with technology	
23	I am very comfortable when using technology.	comfortable in using technology	

Theme 5: Maximizing/Utilizing the Use of Technology: Utilizing technology in teaching offers valuable insight into its impact on student learning outcomes. The responses gathered are diverse but unified by how technology helps them during their practice teaching. When we talk about familiarity, respondents 1,2,4,5,10,12,17,20,21, and 22 say that they were confident in using and maximizing technology. Pre-service teachers who are knowledgeable in maximizing technology can utilize computers and their advancements efficiently (Schmid et.al., 2001). It helps them to improve student engagement and motivation as well as promotes access to diverse learning resources such as using different applications to facilitate personalized learning.

Theme 6: Familiar and Comfortable in Using Technology: Pre-service teachers nowadays are now prone to different technological advancements that can change the traditional learning process. Being knowledgeable on how technology works in this field, can alter the expected outcome of teachers when teaching. Familiarity and comfort are achievable if and only if technology is used continuously and appropriately. Teachers must not only utilize technology but also be comfortable in using it; by having familiarity, they can create significant effects in such time (Humaera et.al., 2023). Nevertheless, this advancement might be put to waste if it is not handled legibly and purposively.

Technological Tools and Applications Used in Practice Teaching

Table 9. Summary of Codes and Themes in terms of Technological Tools and Applications Used in Practice Teaching

Respondent Number	Response Code	Sub-code	Theme
1	Desktop, Smart TV, and a Projector	Desktop, Smart TV, and a Projector	*computer devices and software applications*
2	Laptop and Cellphone	Laptop and Cellphone	
3	Laptop, Cellphone, and Projector	Laptop, Cellphone, and Projector	

4	Laptop	Laptop	
5	Laptop, Projector, and TV	Laptop, Projector, and TV	
6	Powerpooint, Quizziz, and Photoshop	Powerpooint, Quizziz, and Photoshop	
7	Powerpoint and Kahoot	Powerpoint and Kahoot	
8	Canva, Slidesgo, and Powerpoint	Canva, Slidesgo, and Powerpoint	
9	Canva, Prezi, and Powerpoint	Canva, Prezi, and Powerpoint	
10	Powerpoint, Canva, and Prezi	Powerpoint, Canva, and Prezi	
11	Canva and Powerpoint	Canva and Powerpoint	
12	Canva and Google Slides	Canva and Google Slides	
13	Prezi and Canva	Prezi and Canva	
14	Canva, Powerpoint, and Prezi	Canva, Powerpoint, and Prezi	
15	Canva, Poweproint, and Prezi	Canva, Poweproint, and Prezi	
16	Canva, Powerpoint, Illustrator	Canva, Powerpoint, Illustrator	
17	Adobe Illustrator	Adobe Illustrator	
18	Photoshop	Photoshop	
19	Smart TV, Laptop, Canva, Powerpoint, Wordwall	Smart TV, Laptop, Canva, Powerpoint, Wordwall	
20	Laptop, Canva, Powerpoint	Laptop, Canva, Powerpoint	
21	Canva, Powerpoint Computer Desktop	Canva, Powerpoint Computer Desktop	
22	Laptop, Softwares to use in my practice teaching	Laptop, Softwares to use in my practice teaching	
23	Canva, Powerpoint, Projector, Youtube	Canva, Powerpoint, Projector, Youtube	

Theme 7: Computer Devices and Software Applications: Computer devices and software applications are a great help especially to pre-service teachers. Being exposed to the actual learning environment helps the practice teachers to clearly see the reality in the academe. Different technological tools and devices are utilized by different educational institutions to enhance the learning process and prolong knowledge retention. According to Shahid et. al. (2019), learning how to use technological tools is an edge compared to conventional teaching techniques in the 21st century. The primary purpose of integrating technology in teaching is to improve productivity, the effectiveness of current pedagogical practices can be improved and be beneficial if technology is widely used. Educators are highly encouraged to integrate technological advancement to increase the standards of the academe in terms of the learning process and knowledge retention. Furthermore, technology can change the usual strategy and techniques that we have and make it into a more inclusive and productive teaching and learning environment.

How Technology Enhances Learning Process

ISSN No. 2454-6186 | DOI: 10.47772/IJRISS | Volume IX Issue III March 2025

Table 10. Summary of Codes and Themes in terms of How Technology Enhances Learning Process

Respondent Number	Response Code	Sub-code	Theme
1	Its quiet engaging for us teachers and students, especially when I incorporate games from my presentations, that really captivates the attention of my students and keep them focus on the lesson.	incorporate games in teaching	incorporate games in teaching
2	They are engaging in the learning process because they use it to try the functions of the application and learning at the same time.	trying on using application	maximizing computer applications
6	Because it catches the attention of the students and have a lot of interacting app.	interacting app	
22	Because my students are very engaging on my presentation because of some animation.	animation in presentation	
3	Using technology enhances students' engagement.	enhances student engagement	enhances student engagement
9	It engages the students	engage students	
10	The students follow my instructions.	follow instructions	
11	It makes them super attracted to the discussion	attracted to the discussion	
13	Technology can get the attention of the students and it enhances their collaboration.	enhances student collaboration	
15	It catches the attention of the students.	catches student attention	
16	It catches the attention of the students.	catches student attention	
19	It is engaging	engaging	
20	I use technology in the way that my students are motivated and active in my class.	motivate students	
4	Using technology enhances learning process because it let the students see and visualize the lesson.	visualize the lesson	computer application as visual aids
7	I make sure to not put too much words on the ppt so that they will listen to me.	ppt format	
17	They pay attention when they taught with visuals.	visual aid	
23	Lessen the animation, color usage, fonts in the ppt and canva, the video must be animate to keep retention.	presentation format	

ISSN No. 2454-6186 | DOI: 10.47772/IJRISS | Volume IX Issue III March 2025

5	Very convenient	supports learning	teaching aid
12	I use technology more to enhance learning.	enhances learning	
14	Use technology as a support only.	supports leaning	
18	My teaching lesson is always related when using the technology.	relevant in teaching	
21	Because my students are able to comprehend what I am teaching.	supports learning	
8	I always make sure that my technology achieved and it has correlated to my objectives.	aligned with objectives	aligned with objectives

Theme 8: Incorporate Games in Teaching: In the realm of education, the integration of technology has become a pivotal tool in enhancing the learning process. One prominent avenue through which technology augments learning is the incorporation of educational games into teaching methodologies. This theme emerges from the voices of educators, like Respondent Number 1, who recognize the profound impact of gamification on student engagement and comprehension. Respondent Number 1's assertion regarding the integration of games into teaching underscores the transformative potential of technology in education. Drawing upon existing literature, various studies have elucidated the efficacy of gamified learning environments in fostering active participation and sustained focus among students. For instance, according to Mohanty et.al. (2021), the utilization of games in education creates an enjoyment that enables students to focus more on the discussion while insightfully. By harnessing the interactive engagement of games, educators can create dynamic learning environments that facilitate active participation, promote knowledge acquisition, and cultivate essential 21st-century skills among students. As technology continues to evolve, leveraging gamification strategies offers immense potential in redefining traditional teaching paradigms and fostering a generation of lifelong learners.

Theme 9: Maximizing Computer Applications: Respondents 2 and 6 articulate a shared sentiment regarding the pivotal role of technology in augmenting the learning process. They emphasize the significance of harnessing computer applications to their fullest potential. These applications serve as dynamic tools that not only facilitate learning but also engage students in a meaningful way. The sentiments expressed by respondents 2 and 6 align closely with findings from contemporary research. According to Smith and Pedersen (2019), integrating technology into education can enhance student engagement and learning outcomes. Computer applications offer diverse functionality, ranging from interactive simulations to collaborative platforms that cater to varied learning styles. In relation, Al-Abdullatif et al. (2021) stated that this diversity promotes active participation and fosters a deeper understanding of the subject matter. Moreover, the interactive nature of technology aligns with the principles of constructivist learning theory, computer simulations for example are an effective approach to teaching operative skills (Nassar & Tekian, 2020). This highlights the importance of leveraging technology in education but also provides valuable insights for educators seeking to harness the power of technology to enrich their pedagogical practices.

Theme 10: Enhances Student Engagement: The respondents (3, 9, 10, 11, 13, 15, 16, 19, & 20) collectively assert that technology plays a pivotal role in enhancing student engagement within the learning environment. Their responses illuminate the multifaceted ways in which technology captivates students, ignites their interest, and encourages active participation. The consensus among the respondents underscores the significant role of technology in enhancing student engagement within the educational landscape. This is supported by Moubayed et.al., (2020), whose study proves that e-learning platforms help personalized learning experiences to catch students' attention to engage them more interestingly. By leveraging technological tools and platforms, educators can create interactive learning experiences that are student-centered, fostering a deeper sense of engagement and investment in their academic pursuits.

Theme 11: Computer Application as Visual Aids: Among the myriad ways technology enriches learning, the utilization of computer applications as visual aids emerges as a cornerstone. Respondent 4 highlights this,

emphasizing how technology allows students to visually comprehend complex concepts, thereby enhancing their understanding. This sentiment is echoed by Respondent 17, who observes heightened student engagement when lessons are supplemented with visuals. The significance of visual stimuli in learning is corroborated by scholarly research. According to Hrabovskyi et. al. (2020), visual information using multimedia applications helps the learner to focus more deeply on their learning. It ensures that information will enter the interests of the students knowing that their acquisition of knowledge is supported by visualization to aid them in knowledge retention. By adhering to multimedia design principles and leveraging dynamic visual content, educators can harness the power and potential of technology to create positive learning environments that cater to diverse learning styles and foster meaningful educational experiences.

Theme 12: Teaching-aid: One prominent theme that emerges is the role of technology as a teaching aid. Respondents 12, 14, 18, and 21 provide insights into various aspects of this theme. Respondent 12 expresses a proactive approach, stating, "I use technology more to enhance learning." This suggests a conscious effort to integrate technology into teaching practices to improve learning outcomes. This sentiment is supported by the research conducted by Chou and Feng (2019), wherein they stated that innovative instructional strategy and computer-aided learning improve the performance of the students making them actively engage in laboratory settings. On the other hand, Respondent 14 views technology as a supportive tool, indicating, "Use technology as support only." While this approach acknowledges the value of technology, it may not fully exploit its potential to transform the learning experience. Research by Francom (2020) highlights the need for educators to adopt a transformative mindset when integrating technology, moving beyond mere supplementation towards redefining instructional practices. Respondent 18 emphasizes the alignment between technology use and teaching content, stating, "My teaching lesson is always related when using technology." This demonstrates a deliberate effort to integrate technology seamlessly into the curriculum, ensuring that it enhances rather than distracts from the learning objectives. Such integration aligns with the TPACK framework proposed by Paskins (2023), which emphasizes the interrelation between technology, pedagogy, and content for an effective teaching approach. The narrative discussion highlights the multifaceted role of technology as a teaching aid in enhancing the learning process. From proactive integration to alignment with teaching content and facilitating comprehension, technology offers educators a myriad of opportunities to enrich their pedagogical practices. By understanding these concepts, educators can fully maximize technology to have an engaging and impactful learning experience for their students.

Theme 13: Aligned with Objectives: The statement provided by Respondent 8 underscores the significance of ensuring that technology aligns with educational objectives. This theme highlights the importance of coherence between the use of technology and the overarching goals of teaching. By incorporating technology that directly supports the intended learning outcomes, educators can maximize its potential to facilitate student engagement, comprehension, and retention. Research in the field of educational technology emphasizes the importance of aligning technological interventions with instructional objectives. According to Tuma (2021), students are now overwhelmed by the complexity of learning, thus educational technology has been gradually introduced to support learning. Aligning the choice of technology applications promotes interactive learning. In conclusion, the integration of technology in education holds immense potential for enhancing the learning process. However, this can be fully utilized if the technology used is aligned with educational objectives. Respondent 8 emphasis on this alignment serves as a reminder of the essential role that instructional coherence plays in leveraging technology effectively. By embracing this principle, educators can harness the power of technology to cultivate meaningful learning experiences that empower students to thrive in the digital age.

Opportunities Perceived in Using Technology while Teaching

Table 11. Summary of Codes and Themes in terms of Opportunities Perceived in Using Technology while Teaching

Respondent Number	Response Code	Sub-code	Theme
1	It is very convenient	convenient	

ISSN No. 2454-6186 | DOI: 10.47772/IJRISS | Volume IX Issue III March 2025

3	It made my discussion easier	made discussion easier	*convenient / saves time*
4	Makes the discussion easier and time is well consumed	made discussion easier	
5	Makes the teaching easier	made teaching easier	
9	It is very convenient	convenient	
11	It is very convenient	convenient	
12	All things are easier to do with the use of technology.	easier	
15	Very convenient	convenient	
16	It is very convenient	convenient	
17	Can collab and save time	saves time	
21	Easy to use as well as there are a lot of learning to get.	easy to use	
22	It is very convenient to use	convenient	
23	It makes some difficult topic easier to explain.	easier to explain	
2	Engage the students	engage students	*engage students*
6	More engagements and learning	more engagements	
7	Achieved and it will help my students to be more active in school.	help students to be more active	
14	More engagements	more engagements	
18	With the use of technology, we can sure that the student has collaboration and the lesson system is interactive.	student collaboration	
8	Easy to make presentations	easy to make presentation	*helps in making teaching materials*
10	Easy to make ppt	easy to make presentation	
19	It becomes easy for us to teach students using technology/applications.	easy to teach students	
20	It is easy to teach and discuss because I have technology tools and application.	easy to teach students	
13	It enhances the digital literacy of the teachers and also it can help them to achieved their objectives	enhances digital literacy	*enhances digital literacy*

Theme 14: Convenient / Saves Time: In exploring the impact of technology on the learning process, one recurring theme is its role in enhancing convenience and saving time for both educators and learners. The respondents,

numbering 1, 3, 4, 5, 9, 11, 12, 15, 16, 17, 21, 22, and 23, unanimously express how technology has made various aspects of teaching and learning more convenient and efficient. These responses collectively highlight the transformative impact of technology on the learning process. By streamlining tasks, facilitating collaboration, and providing access to vast learning resources, technology has significantly enhanced both the teaching and learning process. The convenience factor is particularly crucial in today's fast-paced educational landscape, where time is of the essence, and educators are tasked with covering extensive curricula within limited timeframes. The findings align with the study of Alenezi (2020), which emphasizes that students who are exposed to different web and online resources can learn at their own pace and work efficiently at a specific time of day. Similarly, the study by Yeung et. al. (2021) emphasizes the importance of technology in improving learning outcomes and increasing efficiency in educational settings. These references provide empirical support for the assertions made by the respondents regarding the convenience and time-saving benefits of technology in education.

Theme 15: Engage Students: In the digital age, technology has become an indispensable tool in education. The codes and themes derived from the respondent's feedback, explain how technology enhances the learning process, focusing particularly on Theme 15: Engage students. By examining respondents' perspectives and aligning them with relevant literature, we aim to elucidate the multifaceted role of technology in fostering student engagement and active participation in the educational journey. Technology advancement serves as a tool for student engagement, offering myriad opportunities for interactive learning experiences. This fosters collaborative learning environments where students actively participate in knowledge co-construction. The significance of technology-mediated engagement in the learning process is corroborated by empirical research. According to Hodges et al. (2020), technology-enhanced pedagogies promote active learning by facilitating student-centered approaches and fostering collaboration among peers. Moreover, these electronic learning resources are now being utilized to enhance the learning process and increase students' engagement (Bringman-Rodenbarger & Hortsch, 2020). The amalgamation of respondent insights and empirical evidence underscores the pivotal role of technology in fostering a student-centered learning process.

Theme 16: Making Teaching Materials: In education, the integration of technology has become an indispensable tool, revolutionizing traditional teaching methods and enhancing the learning process. Through the lens of theme 3 - "helps in making teaching materials," we delve into how technology facilitates educators in crafting dynamic and engaging instructional content. These responses align with the findings of researchers like Kopcha (2020), who explored how technology integration enhances instructional practices, enabling educators to create interactive and multimedia-rich teaching materials. Furthermore, Moreno (2019) advocates for the Technological Pedagogical Content Knowledge (TPACK) framework, which emphasizes the seamless integration of technology, pedagogy, and content knowledge, thus empowering educators to design innovative teaching materials tailored to their students' needs. By embracing technology, educators can transcend the constraints of traditional teaching materials, fostering creativity, interactivity, and adaptability in the learning environment. Through platforms like Google Slides, Prezi, or interactive whiteboards, educators can incorporate multimedia elements such as videos, animations, and simulations, catering to diverse learning styles and promoting active engagement.

Theme 17: Enhances Digital Literacy: Enhances digital literacy underscores how technology empowers teachers by enriching their digital literacy skills. Their response succinctly captures the essence of how technology serves as a catalyst in advancing teachers' proficiency in navigating digital realms to achieve pedagogical objectives. By embracing technology, educators embark on a journey of continuous learning and adaptation, honing their digital competencies to effectively engage with modern educational practices. The respondent's acknowledgment of technology's role in enhancing digital literacy among teachers resonates with existing literature. Research conducted by Clipa et. al. (2023) emphasizes the importance of integrating technology into teacher education programs to foster digital competence. Through hands-on experience and training, educators develop the skills necessary to leverage digital tools and resources in their instructional practices. Furthermore, as noted by Bice and Tang (2022), technology integration workshops and professional development initiatives empower teachers to explore innovative teaching methodologies grounded in digital literacy. By providing educators with opportunities for collaborative learning and skill development, institutions foster a culture of digital fluency essential for navigating the complexities of the digital age.

Proposed Program

This part presents the proposed program formulated by the researchers to address the gaps faced by pre-service teachers in utilizing technology in their teaching methodology. This provides a detailed intervention program to aid the pre-service teachers in harnessing the potential of technology that can benefit them to have an engaging and student-centered learning approach.

Figure 1. Proposed Program

Rationale	Objectives	Time Frame Activities/Strategies	Time Frame/Budget Allotment/ Target Venue	Resource Speakers	Outcome
Integrate TPACK to the teaching methodology of the BTLED and BTVTED Pre-service Teachers	a. To improve the Content Knowledge of the pre-service teachers focusing on their area and field of expertise.	• Seminars & Lectures	1 Day/ The cost of a professional speaker is determined by the resource speaker/ Valencia Hall	• TLE Teacher • Experts in the different field of TLE	The pre-service teachers are expected to be knowledgeable in their field of expertise to improve the content of their discussion.
	b. To give an overview on how to utilize TPACK effectively with its application to improve learning process.	• TPACK Assessment • Discussion/Lecture Proper • Presentation about the different technological tools and applications available for use.	3 Days/ The cost of a professional speaker is determined by the resource speaker/ Valencia Hall	• Computer Technology Teacher • Expert/s in the Field of ICT	The pre-service teachers are expected to learn formulated teaching methodology incorporated by technological tools and applications that can help them enhance their teaching processes.
	c. To discuss how to improve student learning process by incorporating technology to the different teaching approach and methodologies used by the pre-service teachers (TPK)	• Discussion/Lecture Proper • Application of Learned TPACK	3 Days/ The cost of a professional speaker is determined by the resource speaker/ Valencia Hall	• Computer Technology Teacher • Expert/s in the Field of ICT • Experts Teacher Education Trainers	

Figure 1 gives a detailed outline of the proposed program. It begins with its rationale that amplifies the integration of TPACK and how it can benefit the BTLED and BTVTED pre-service teachers. Personalized learning systems are now recommended to improve the quality of professional teachers in the academe (Chaipidech et. al., 2021). Utilizing this kind of intervention can greatly influence today's educational setup that fully maximizes the advantages of these technologies. The proposed program also indicates its primary objective in helping pre-service teachers employ TPACK in their teaching system.

To continue with, the proposed program lists its target activities/strategies – for the partakers to be fully aware and to prepare themselves for this mindful discussion. The TPACK Assessment will serve as the basis to identify what area of TPACK the pre-service teacher is least aware of, hence this program will provide in-depth support on that particular field to help them grow and acquire techniques to further enhance their pedagogy The second part of it is the discussion/lecture proper, since the gaps are already identified, the program can now be systematized. The program will be implemented by the form of seminars or workshops to discuss interventions that might help pre-service teachers incorporate TPACK in their teaching practices. Moreover, it encourages a learner-centered approach that reaches deeply to the needs of the pre-service teachers and to cater to their questions to fully understand TPACK and its implementation. Lastly, the application of TPACK to the actual practice teaching will later be evaluated to determine the effectiveness of the enhanced teaching techniques to identify whether there is an improvement before and after the integration of technology.

The proposed program also stated its time frame/budget allocated/target venue to envision the flow of the program and its required resources. It will be embodied by professionals and teachers who specialize in the field of computer technology and ICT. They are knowledgeable in this field therefore they can give a lot of insights on how to effectively integrate technology in teaching. The primary beneficiaries of this program are the BTLED and BTVTED pre-service teachers since they are in line in this field and are often utilizing technology. The proposed program highlights its output of having formulated a teaching methodology relevant to the competencies of today's teaching and learning approach – the maximization and utilization of technology that supports and enhances teaching in the 21st century.

CONCLUSION

The BTLED and BTVTED pre-service teachers manifest a strong knowledge of maximizing and utilizing the different partitions of TPACK in their teaching practices. This implies that they are capable of promoting a student-centered learning approach through utilizing technology to support independent learning. To conclude with the results gathered, the study proves that the components of TPACK have a significant relationship with each other. It supports the assumption of the study that the BTLED and BTVTED pre-service teachers have prior knowledge and need to enhance it to effectively utilize it in their teaching practices. Moreover, pre-service teachers should not be satisfied and contented with their current knowledge, they should be eager to learn more to continuously improve their teaching approach to keep up with the fast-changing and technological developments in the academe.

In terms of the proceeds of this study, future researchers should focus on analyzing whether the current implemented TPACK is still appropriate, or whether there's a need for further development to enhance teaching processes among pre-service teachers. Nonetheless, the existing technological tools and applications are still of great help in ensuring a progressive and effective learning experience for students and improving teaching techniques for teachers in the academe.

RECOMMENDATIONS

Considering the findings presented, the following recommendations were made: academe.

1. The BTLED and BTVTED pre-service teachers have already knowledge about TPACK, therefore improving and enhancing it can open up a lot of opportunities that are significant for the betterment of the students at Bulacan State University – College of Education.

2. The study had proved the relationship between the components of TPACK, therefore it is highly recommended to utilize TPACK in the different areas and fields of teaching focusing on how it can further improve its content and pedagogy. More importantly, TPACK can assure positive changes that can establish its foundation in enhancing teaching methodology

3. It is true that the experiences and learning teaching techniques of the pre-service teachers helped them to devise their own TPACK from their cooperating teachers, therefore it is highly suggested that the learning must not stop there, pre-service teachers are encouraged to further explore the art of teaching knowing that every teacher has their unique proposition in delivering the lesson.

4. In maximizing technology to the teaching practices of the pre-service teachers, the proposed program can be a great help to start a revolutionized way of teaching. By having an intervention, professionals can be of help to pre-service teachers to guide them in enhancing their TPACK in line with their unique teaching approach.

5. Future researchers are encouraged to focus on the implementation of TPACK and its relation to the teaching performance of pre-service teachers. We live in a timeline where technology plays a vital role in everyone's life, therefore, utilizing technology in education can heighten the teaching performance of pre-service teachers and can guarantee an effective and efficient learning process.

REFERENCES

1. Adesope, O. O., & Rud, A. G. (2019). Maximizing the affordances of contemporary technologies in education: Promises and possibilities. Contemporary technologies in education: Maximizing student engagement, motivation, and learning, 1-15.
2. Al Rawashdeh, A. Z., Mohammed, E. Y., Al Arab, A. R., Alara, M., & Al-Rawashdeh, B. (2021). Advantages and disadvantages of using e-learning in university education: Analyzing students' perspectives. Electronic Journal of E-learning, 19(3), 107-117.

3. Al-Abdullatif, A. M., & Gameil, A. A. (2021). The Effect of Digital Technology Integration on Students' Academic Performance through Project-Based Learning in an E-Learning Environment. International Journal of Emerging Technologies in Learning, 16(11).
4. Alenezi, A. (2020). The role of e-learning materials in enhancing teaching and learning behaviors. International Journal of Information and Education Technology, 10(1), 48-56.
5. Alghizzawi, M., Habes, M., Salloum, S. A., Ghani, M. A., Mhamdi, C., & Shaalan, K. (2019). The effect of social media usage on students'e-learning acceptance in higher education: A case study from the United Arab Emirates. Int. J. Inf. Technol. Lang. Stud, 3(3), 13-26.
6. Asuo-Baffour, H., Daayeng, A., & Agyemang, O. (2019). Mentorship in teacher education: Challenges and support provided. European Journal of Education Studies.
7. Bice, H., & Tang, H. (2022). Teachers' beliefs and practices of technology integration at a school for students with dyslexia: A mixed methods study. Education and Information Technologies, 27(7), 10179-10205.
8. Bringman-Rodenbarger, L., & Hortsch, M. (2020). How students choose E-learning resources: The importance of ease, familiarity, and convenience. Faseb Bioadvances, 2(5), 286.
9. Castéra, J., Marre, C. C., Yok, M. C. K., Sherab, K., Impedovo, M. A., Sarapuu, T., ... & Armand, H. (2020). Self-reported TPACK of teacher educators across six countries in Asia and Europe. Education and Information Technologies, 25, 3003-3019.
10. Chaipidech, P., Kajonmanee, T., Chaipah, K., Panjaburee, P., & Srisawasdi, N. (2021). Implementation of an andragogical teacher professional development training program for boosting TPACK in STEM education. Educational Technology & Society, 24(4), 220-239.
11. Chou, P. N., & Feng, S. T. (2019). Using a tablet computer application to advance high school students' laboratory learning experiences: A focus on electrical engineering education. Sustainability, 11(2), 381.
12. Colón, A. M. O., Rus, T. I., Moreno, J. R., & Montoro, M. A. (2023). TPACK model as a framework for in-service teacher training. Contemporary Educational Technology, 15(3), ep439.
13. Edmonds, W. A., & Kennedy, T. D. (2016). An applied guide to research designs: Quantitative, qualitative, and mixed methods. Sage Publications.
14. Francom, G. M. (2020). Barriers to technology integration: A time-series survey study. Journal of Research on Technology in Education, 52(1), 1-16.
15. Hodges, C. B., Moore, S., Lockee, B. B., Trust, T., & Bond, M. A. (2020). The difference between emergency remote teaching and online learning.
16. Hrabovskyi, Y., Brynza, N., & Vilkhivska, O. (2020). Development of information visualization methods for use in multimedia applications. Physics and Engineering, 1, 3-17.
17. Humaera, I., Safei, N. H., Adisaturrahim, A., & Suparto, W. P. (2023). Capturing Technological Pedagogical Content Knowledge (TPACK) Implementation in English Classroom: Necessity or Responsibility?. British Journal of Teacher Education and Pedagogy, 2(2), 26-35.
18. Mohanty, A., Alam, A., Sarkar, R., & Chaudhury, S. (2021). Design and development of digital game-based learning software for incorporation into school syllabus and curriculum transaction. Design Engineering, 8, 4864-4900.
19. Moubayed, A., Injadat, M., Shami, A., & Lutfiyya, H. (2020). Student engagement level in an e-learning environment: Clustering using k-means. American Journal of Distance Education, 34(2), 137-156.
20. Nassar, H. M., & Tekian, A. (2020). Computer simulation and virtual reality in undergraduate operative and restorative dental education: A critical review. Journal of dental education, 84(7), 812-829.
21. Parsons, Marlee, et al. "Reporting of Participant Demographics in Clinical Trials Published in General Radiology Journals." Current Problems in Diagnostic Radiology (2023).
22. Paskins, A. (2023). Classroom Teachers' Perceptions of Their Knowledge of Content and Pedagogy in Terms of a Technology-Driven Lesson (Doctoral dissertation, Walden University).
23. Preece, S., & Bullingham, R. (2022). Gender stereotypes: The impact upon perceived roles and practice of in-service teachers in physical education. Sport, Education and Society, 27(3), 259-271.
24. Resch, K., & Schrittesser, I. (2023). Using the Service-Learning approach to bridge the gap between theory and practice in teacher education. International Journal of Inclusive Education, 27(10), 1118-1132.
25. Rodríguez Moreno, J., Agreda Montoro, M., & Ortiz Colon, A. M. (2019). Changes in teacher training within the TPACK model framework: A systematic review. Sustainability, 11(7), 1870.

26. Santos, J. M., & Castro, R. D. (2021). Technological Pedagogical content knowledge (TPACK) in action: Application of learning in the classroom by pre-service teachers (PST). Social Sciences & Humanities Open, 3(1), 100110.
27. Schmid, M., Brianza, E., & Petko, D. (2020). Developing a short assessment instrument for Technological Pedagogical Content Knowledge (TPACK. xs) and comparing the factor structure of an integrative and a transformative model. Computers & Education, 157, 103967.
28. Schmid, M., Brianza, E., & Petko, D. (2021). Self-reported technological pedagogical content knowledge (TPACK) of pre-service teachers in relation to digital technology use in lesson plans. Computers in Human Behavior, 115, 106586.
29. Shahid, F., Aleem, M., Islam, M. A., Iqbal, M. A., & Yousaf, M. M. (2019). A review of technological tools in teaching and learning computer science. Eurasia journal of mathematics, science and technology Education, 15(11), em1773.
30. Tatli, Z., Akbulut, H. İ., & Altinisik, D. (2019). Changing Attitudes towards Educational Technology Usage in Classroom: Web 2.0 Tools. Malaysian Online Journal of Educational Technology, 7(2), 1-19.
31. Tuma, F. (2021). The use of educational technology for interactive teaching in lectures. Annals of Medicine and Surgery, 62, 231-235.
32. Yeung, K. L., Carpenter, S. K., & Corral, D. (2021). A comprehensive review of educational technology on objective learning outcomes in academic contexts. Educational psychology review, 1-48.
33. Zaretsky, R., & Katz, Y. J. (2019). The Relationship between Teachers' Perceptions of Emotional Labor and Teacher Burnout and Teachers' Educational Level. Athens Journal of Education, 6(2), 127-144.
34. Zhang, W., & Tang, J. (2021). Teachers' TPACK development: A review of literature. Open Journal of Social Sciences, 9(7), 367-380.