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Technological, Pedagogical and Content Knowledge in Online Training

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Abstract

The study examines the Technological, Pedagogical, and Content Knowledge (TPACK) of online training in government training institutions in Nepal. It assesses trainers' TPACK levels and technological proficiency in delivering online training programmes. The study applied a sequential mixed-methods design. A random sample of 30 trainers from eleven different training institutions participated in the quantitative strand. Three respondents were selected purposively for the qualitative strand. The TPACK framework has been instrumental in the analysis of data in this study. The findings were categorised into three themes: trainer perceptions and competencies; strategies for technological integration; and institutionalised approach. The study found that trainers possess extensive knowledge of pedagogical and content constructs, but struggle with incorporating new technologies due to time constraints, heavy workloads, and institutional environment. Advancement in this area depends more on institutions signalling through leadership behaviour and subject-specific professional development, investment in infrastructure, resources and culture of innovation.

Keywords: TPACK, online training, trainer perception, technology integration, content knowledge, pedagogical knowledge

Introduction

Government training institutes have been formed to achieve the goal of universal training as outlined in the Government Officials National Training Policy (2014) (Ministry of General Administration, 2014). Training and professional development is recognised as critical to enhancing the competence of government employees in Nepal in the context of changing governance and public service responsibilities. According to Zhong (2017), technology is considered an essential necessity for 21st-century learners, rather than merely a desire or choice. The Digital Nepal Framework (2019) provides guidelines to employ digital technologies to reduce costs and expand the scope of training. Government ministries and Nepal Administrative Staff College (NASC) have been listed as stakeholders in this framework (Ministry of Communication and Information Technology, 2019). The government's social distancing regulations during COVID-19 required the use of virtual platforms for government training institutions. The outbreak and the Digital Nepal Framework synchronised in a way that allowed government training institutes to offer online training. Several prominent government training institutions including Nepal Administrative Staff College, rolled out online delivery to maintain uninterrupted operation, and the practice spread to others across the sector. Despite the COVID-19 resolution, some institutions continue online training with traditional in-person instruction programmes, while others have stopped online training altogether. According to Pangeni and Karki (2021), the traditional education system primarily relies on face-to-face teaching, thus creating a gap in the design and implementation of online learning caused by a fixed mindset among people failing to recognise the potential of technology for pedagogical innovations. In an online training environment, trainers cannot depend solely on physical presence, facial cues, or spontaneous classroom adjustments to make up for poor content delivery or technical know-how; the design of a session, the selection of a digital tool, and the framing of subject content must all be decided together before a single trainee logs in. This makes Technological Pedagogical Content Knowledge (TPACK) i.e. the interaction of technological, pedagogical and content knowledge especially significant in online and blended delivery. A deficit in any one domain can no longer be compensated for by others. The empirical interest in TPACK in Nepal is concentrated at the school and university levels. Lakhe Shrestha et al. (2025) examined how English language educators in the Kathmandu Valley used TPACK to integrate generative AI tools into their classroom practice. Government training institutions are in an evidently different position as their trainers are subject-matter specialists, rather than career educators, and their trainees are practising government officials, rather than students, raising the question of whether the TPACK patterns observed among schoolteachers also hold in this setting. This prompted us to examine the technology integration capacity of trainers in government training institutions. The objective of this study was to explore the role of technological, pedagogical and content knowledge in using online tools and technologies to expand and enhance online training in the government training institutions responsible for developing the skills of government and public officials in Nepal. The study examined the application of digital technologies for online training from the trainers' viewpoints and included both synchronous online training (virtual or mixed) and asynchronous self-paced training, covering both virtual and blended training approaches. Two research questions guided the study.

- To what extent do trainers in government training institutions perceive themselves as proficient across the seven Technological Pedagogical and Content Knowledge (TPACK) constructs: technological, pedagogical, content, and their combined forms when delivering online training?
- How do trainers in government training institutes narrate their experiences in effectively using TPACK content constructs when delivering online training?

Literature Review

Online Learning and Technological Integration at Nepal's Government Training Institutions

Online learning is a crucial aspect of education, encompassing various terms such as 'e-Learning, internet learning, distributed learning, networked learning, virtual learning, computer assisted learning, web-based learning, and distance learning' (Anderson, 2008, as cited in Wargadinata et al., 2020, p. 145). It involves using digital platforms like WhatsApp, Zoom, and Google Classroom to support the teaching and learning process between instructors and students. Online learning goes beyond direct learning and includes the provision of assignments and activities by the teacher online. There are three typologies of online integration in courses: marginal uses, integrated uses, and entirely online courses (Mason, 2003). Adebo (2018) discusses the use of Massive Open Online Courses (MOOCs) to engage learners through online teaching and learning. To deliver online training effectively, specific skills and requirements must be met, and government training institutions in Nepal are transforming their curricula using various e-learning technologies. This study aims to examine how trainers integrate technology in online training.

Nepal's policy landscape has been making progressive commitments to the digital transformation of government services. The National Information and Communications Technology (ICT) Policy (2015) offered a base for e-governance and digital literacy, but there were no practical guidelines on technology-based training (Ministry of Communication and Information Technology, 2015). The Digital Nepal Framework (2019) proposed a government eLearning platform and incorporated digital skill development in eight priority sectors (Ministry of Communication and Information Technology, 2019), while the National Training Policy for Government Officials (2014) specifically recognised distance learning, internet-based training and virtual classrooms as valid training modalities (Ministry of General Administration, 2014). These offer a policy mandate for government training integration of technologies, but lack concrete guidelines for conducting training programmes using online technologies.

The study by Akram et al. (2021) explored the transition from traditional to online education during COVID-19, focusing on teachers' digital competencies. It found overall knowledge satisfactory, with strengths in content knowledge (CK) and weaknesses in technological knowledge (TK). The authors recommend professional development to enhance teachers' TPACK by integrating ICT into pedagogical practices. Ward and Kushner Benson (2010) emphasise the need for aligning existing knowledge to support online learning, while stressing the importance of institutional backing. Voithofer et al. (2019) noted that many teacher educators lack TPACK understanding and suggested further investigation into the impact of technology integration and institutional plans on educator behaviors, advocating for the ISTE Standards as foundational competencies across disciplines.

The literature review indicates that whatever model is applied, facilitators who are content creators are crucial. The proper implementation of the Technological Pedagogical Content Knowledge (TPCK) framework in the design and delivery of training programmes can ensure the effective use of technology for online training purposes.

TPACK for Exploring Effective Technology Integration in Nepali Training

The Technological Pedagogical Content Knowledge (TPACK) Framework is a comprehensive approach developed by Mishra and Koehler (2006)while addressing the complex, multifaceted, and situated nature of this knowledge. We argue, briefly, that thoughtful pedagogical uses of technology require the development of a complex, situated form of knowledge that we call Technological Pedagogical Content Knowledge (TPCK to address the roles of content, pedagogy, and technology in teacher knowledge. The framework was built on the work of (Shulman, 1986, 1987) who 'first claimed that teachers needed content knowledge (CK), pedagogy knowledge (PK), and pedagogical content knowledge (PCK) (Joo et al. 2018, p. 49) teacher self-efficacy, perceived ease of use, and perceived usefulness for preservice teachers who intend to use technology, based on the Technology Acceptance Model (TAM. The framework consists of seven domains: content knowledge (CK), pedagogical knowledge (PK), technological knowledge (TK), pedagogical content knowledge (PCK), technological content knowledge (TCK), technological pedagogical knowledge (TPK), and technological pedagogical content knowledge (TPCK). 'TPACK addresses each of the three major components (CK, PK, and TK) and their combinations (PCK, TCK, TPK, and TPACK) needed to ensure high quality instruction' (Dalal et al., 2017, p. 104). The study aimed to explore how teachers can enhance their content development practices by incorporating technology, emphasizing the importance of capturing essential qualities of teacher knowledge. Thus, this model was applied at theoretical, pedagogical, and methodological levels to examine the integration of technology in Nepal's training context, effectively addressing associated challenges and opportunities.

Methodology

Explanatory sequential mixed method involves collecting and assessing quantitative data first, followed by the analysis of qualitative data in a subsequent phase (Ivankova et al., 2006; Dawadi et al., 2021). The research questions required two different types of evidence to be collected in a particular sequence. The first question was about how trainers rate themselves on the seven TPACK constructs, which is best answered by a structured Likert-scale survey to generate descriptive statistics and guide the qualitative phase. The second question was about how trainers narrate and make sense of their own technology use, which called for open-ended interviews. This method was selected because it enables the quantitative and qualitative strands to serve complementary functions, resulting in a comprehensive data analysis.Site Selection and Population

Site Selection and Population

The study examined government training institutions in Nepal, which provide capacity-building training for government and public officials. The government-affiliated, semi-autonomous, or autonomous training institutions established under specific acts, laws, and policies for capacity development of government officials were referred as government training institutions. The population was sampled from all government training institutions that provide online training. The information on the existing training institutes in Nepal was obtained from a repository of permanent list at the Nepal Administrative Staff College (NASC). Google forms surveys and telephone enquiries were conducted to identify training institutions offering online training. A total of 23 training institutions were identified for the study. The training institutions included training faculties from different levels of hierarchy, equivalent to Class I, Class II, and Class III officers.

Quantitative Approach

The study was carried out by administering a questionnaire to trainers at 23 government training institutions in Nepal that offer online training. Using the central limit theorem, which stipulates that the form of the distribution of the mean tends to be normal as the sample size increases, regardless of the shape of the population distribution (Field, 2018; Pallant, 2020), a minimum sample size of 30 was maintained. The survey was closed once 30 complete responses were received, according to the norms of statistical validity, which allowed robust data analysis. This decision makes it possible to apply parametric statistical techniques (e.g. statistical comparisons of means, reliability estimation) to the data on the Likert scale collected from the trainers on their TPACK scores.

Qualitative Approach

The study utilised purposive sampling and selected three trainers for in-depth interviews, representing three different hierarchical levels of Class I, Class II and Class III government officers. It follows a sequential explanatory mixed methods design in which a small, selected qualitative sample is used to provide a richer understanding of the findings of a larger previous quantitative investigation (Creswell & Plano Clark, 2018; Ivankova et al., 2006). The respondents were selected from a sample of thirty quantitative participants, according to their TPACK (Technological Pedagogical Content Knowledge) construct scores and their willingness to be involved in follow-up interviews to include at least one trainer from each hierarchical level. This technique was developed to examine any differences in perceptions of technology integration across different levels of seniority and duties.

Data Collection and Analysis

The quantitative and qualitative data were analysed independently over time, providing different results analysis phases. The initial phase involved collecting numerical data through a Google forms questionnaire via email, SMS, and social media platforms. Participants were notified of the research objective and reminded one week after delivery to increase response. With the consent of the researchers, the survey instrument developed by Dalal et al. (2017) was contextualised and applied to understand trainers' perceived ability to integrate technology in instruction. This instrument was a modified version based on the validated TPACK measure by Archambault and Crippen (2009). The study by Dalal et al. (2021) was also referred to for conducting the research. The designed questionnaire was sent to experts for content validity analysis. The questionnaire comprised 24 items distributed across the seven TPACK constructs, with three items each for Technological Knowledge, Pedagogical Content Knowledge, Technological Content Knowledge, and Technological Pedagogical Content Knowledge; four items each for Pedagogical Knowledge, Content Knowledge, and Technological Pedagogical Knowledge preceded by a demographic and organisational profile section covering gender, age, designation, years of service, technology usage experience, and training modality. Respondents rated each TPACK item on a five-point Likert scale ranging from 1 (not at all able) to 5 (most of the time able). The instrument's validity and reliability were ensured through expert content review prior to deployment and Cronbach's alpha reliability technique. The survey data were analysed using SPSS (Statistical Package for the Social Sciences) through descriptive statistics (mean and standard deviation). Quantitative findings were used to inform the qualitative interviews, focusing on areas of lower mean scores. Open-ended questions were developed within an interview guide to explore trainers' opinions on the use of technology in online training, including issues such as history of use of technology, perceived barriers, institutional support, and recommendations for improvement. Face-to-face and telephone interviews were performed, transcribed for credibility and analysed to reveal meaningful patterns and themes. Follow up questions were used for deeper study.

The research met the quality standards of mixed-methods research by ensuring validity of both quantitative and qualitative data through thorough analysis of results, addressing potential validity issues before and after data collection. Both phases of a sequential explanatory approach were used to ensure validity and reliability.[1] Validity threats were dealt with through

[1] In the quantitative strand, validity and reliability were maintained through quality standards, component analysis, construct and content validity. Generalisability was achieved by selecting diverse participants. In the qualitative strand, trustworthiness was ensured through credibility, transferability, dependability, and reflexivity. Credibility was reinforced through rigorous design, member checks, and transparency, while dependability was reinforced through systematic and transparent research practices.

appropriate measurement, variables and expert opinion.[2] Data integration, interpretation and reporting produced metainferences, preserved mixed methods quality criteria.[3] Joint displays, especially themes-by-statistics joint displays, offered new perspectives and enabled meta-inferences. Data integrity protocols were strictly observed and objectively interpreted. Research questions were evaluated for intrusiveness, severity and duration. Participants' ethical consent, safety, anonymity, respect for intellectual property, honesty, quality assurance and ethical standards were emphasised.

Findings and Analysis

The quantitative strand's findings were analysed using descriptive statistics, followed by the qualitative strand's data collection. The result of the analysis initiated the process of connecting which is the mixing between data analysis of QUAN and data collection of QUAL. The findings of the qualitative strand were presented, followed by the analysis of the qualitative data based on the quantitative findings. The overall interpretation was then conducted.

Quantitative Strand Findings

The descriptive statistics is presented in the form of charts, tables and texts.

Table 1 : Profile of participants

Profile of Participants	Response count	Response %
Gender		
Male	20	67
Female	10	33
Age in range		
20-29	2	6.7
30-39	18	60.0
40-49	5	16.7

[2] Validity threats, defined here through the lens of legitimation in mixed methods research where internal and external threats can compromise the inferences drawn from quantitative and qualitative strands alike (Onwuegbuzie & Johnson, 2006) were addressed by recruiting random participants for the quantitative strand to reduce selection bias, applying the central limit theorem-based sample size threshold described in Section 3.2 to support reliable inference from a bounded population and drawing on the purposive selection criteria described in Section 3.3 as well as expert review of the instrument to support the credibility of conclusions across both strands.

[3] For metainferences, a three-step process for validating sequential QUAN → QUAL mixed methods design was followed, including systematic participant selection, delving into unanticipated quantitative results, and exploring the interplay between the two strands.

Profile of Participants	Response count	Response %
50 and above	5	16.7
Designation		
Equivalent to Class I officer	10	33.3
Equivalent to Class II officer	6	20.0
Equivalent to Class III officer	14	46.7
Years of Service		
0-5	7	23.3
5-10	12	40.0
10-15	3	10.0
15-20	3	10.0
above 20 years	5	16.7

Eleven training institutions were represented including the Ministry of Land Management, Cooperatives and Poverty Alleviation, Nepal Administrative Staff College, Agricultural Development Bank Limited, Public Financial Management Training Centre, Centre for Education and Human Resource Development, Nepal Police, Local Development Training Academy, Forest Research and Training Centre, Nepali Army, National Judicial Academy, and undisclosed.

Table 2 : Technology Usage Experience

Technology usage experience	Response count	Response %
Exposure to computers		
10-15	4	13.3
15-20	10	33.3
above 20	16	53.3
Comfort level using computer		
Comfortable	16	53.3
very comfortable	14	46.7
Started using technology in training		
0-5	9	30.0
5-10	13	43.3

Technology usage experience	Response count	Response %
10-15	5	16.7
15-20	2	6.7
above 20	1	3.3
Time spent on computer to develop training contents		
less than 1 hour	1	3.3
1-2 hours	6	20.0
3-4 hours	11	36.7
5-6 hours	8	26.7
more than 6 hours	4	13.3

Respondents facilitated training across a wide range of substantive domains, spanning areas of public administration, management, governance, judicial functions, military disciplines, organisation specific subject matters, and Training of Trainers (ToT) among others.

Table 3 : Number of Training Programmes Conducted Based on Modality

Modality/Number of training programmes	0-5	5-10	10-15	15-20	above 20
Face-to-face modality	2	3	2	4	19
Online (virtual) modality	11	5	5	2	7
Blended modality	18	4	2	3	3
Self-paced modality	24	2	2	0	2

Cronbach Alpha

The study used Likert-scale TPACK elements with values of not at all able, rarely able, sometimes able, often able, and most of the time able. Descriptive statistics were calculated for each item and Cronbach's alpha was used to confirm internal reliability. The Cronbach's alpha value for the seven TPACK constructs exceeded 0.8, indicating stronger relationships between the constructs. The Cronbach's alpha values for individual items within the constructs were above 0.7, indicating consistency among items, contributing to the instrument's reliability.

Descriptive Statistics for All Individual Items and Reliability Scores

Table 4 : Descriptive Statistics for TPACK Individual Items, Reliability Scores and Decision

Construct	Individual Items	Mean	Std. Deviation	Cronbach's Alpha if Item Deleted	Decision
Technological Knowledge (TK)	I can solve technical problems associated with my computer or network connection	3.87	0.819	0.882	Low Perception
	I can address various computer issues related to software (e.g. downloading appropriate plug-ins, installing programmes)	3.90	0.885	0.881	Low Perception
	I can assist trainee participants with solving technical problems with their personal computers.	3.70	0.988	0.881	Low Perception
Pedagogical Knowledge (PK)	I can use a variety of teaching strategies to share different concepts with trainees.	4.00	0.983	0.901	High Perception
	I can modify instruction based on my assessment of trainees’ knowledge and skills.	4.13	0.937	0.93	High Perception
	I can determine a particular teaching or learning strategy best suited for a particular concept.	4.10	0.923	0.912	High Perception
	I can adjust my teaching methodology based on trainee performance or feedback.	4.27	0.828	0.945	High Perception

Construct	Individual Items	Mean	Std. Deviation	Cronbach's Alpha if Item Deleted	Decision
Content Knowledge (CK)	I can create materials that align with the concepts trainees need to learn in a course	4.23	0.858	0.921	High Perception
	I can decide on the concepts in my content area that should be facilitated in the training.	4.17	0.874	0.902	High Perception
	I can plan the sequence of concepts facilitated within my training session.	4.33	0.922	0.928	High Perception
	I can produce written lesson plans for the sessions I facilitate.	4.03	1.033	0.944	High Perception
Technological Pedagogical Knowledge (TPK)	I can create a technology-rich learning environment where trainees can build new knowledge and skills.	3.57	0.774	0.801	Low Perception
	I can implement different methods of teaching with technology.	3.70	0.877	0.831	Low Perception
	I can use technology to facilitate communication and interactions among trainees.	3.97	0.718	0.763	High Perception
	I can motivate trainees to want to use technology for communication and interactions with each other.	3.97	0.850	0.802	High Perception

Construct	Individual Items	Mean	Std. Deviation	Cronbach's Alpha if Item Deleted	Decision
Pedagogical Content Knowledge (PCK)	I can distinguish between correct and incorrect problem solving attempts by trainees.	3.93	0.691	0.857	Low Perception
	I can anticipate likely trainee misconceptions regarding a particular concept.	4.03	0.718	0.79	High Perception
	I can assist trainees in noticing connections between various concepts in a curriculum.	4.03	0.765	0.772	High Perception
Technological Content Knowledge (TCK)	I can use technological representations (like an online video, an interactive map, or an online science experiment simulation) to demonstrate particular concepts in my content area	3.97	0.809	0.733	High Perception
	I can implement curriculum using technology.	3.90	0.845	0.714	Low Perception
	I can use various online courseware programmes to deliver instruction (e.g. Moodle, Google Classroom)	3.97	0.765	0.858	High Perception

Construct	Individual Items	Mean	Std. Deviation	Cronbach's Alpha if Item Deleted	Decision
Technological Pedagogical Content Knowledge (TPCK)	I can use technology to predict trainees' skill/ understanding of a concept.	3.70	0.877	0.897	Low Perception
	I can use technology to create effective representations of content that expand on the content as per set objective.	3.77	0.898	0.866	Low Perception
	I am able to meet the overall demands of facilitating a training session, using technology.	3.77	0.817	0.879	Low Perception

Note. Mean and standard deviations computed from responses (N = 30) on the following scale: 1 (*not at all able*), 2 (*rarely able*), 3 (*sometimes able*), 4 (*often able*), and 5 (*most of the time able*). Decision – weighted average = 95/24 = 3.96

The study's decision-making process relies on respondents' perceptions, utilizing the weighted average value.

Descriptive Statistics for TPACK Constructs and Reliability Scores

Table 5 : Descriptive statistics for TPACK Constructs, Reliability Scores and Decision

Construct	Cronbach's Alpha if Item Deleted	Mean	Std. Deviation	Decision
Technological Knowledge (TK)	0.833	3.8222	0.83383	Low Perception
Pedagogical Knowledge (PK)	0.866	4.1250	0.84779	High Perception
Content Knowledge (CK)	0.850	4.1917	0.85269	High Perception
Technological Pedagogical Knowledge (TPK)	0.835	3.8000	0.66436	Low Perception
Pedagogical Content Knowledge (PCK)	0.846	4.0000	0.64327	High Perception

Construct	Cronbach's Alpha if Item Deleted	Mean	Std. Deviation	Decision
Technological Content Knowledge (TCK)	0.832	3.9444	0.70076	Low Perception
Technological Pedagogical Content Knowledge (TPCK)	0.840	3.7444	0.80078	Low Perception

Note. Mean and standard deviations computed from responses (*N* = 30) on the following scale: 1 (*not at all able*), 2 (*rarely able*), 3 (*sometimes able*), 4 (*often able*), and 5 (*most of the time able*). Decision – weighted average = 27.63/7 = 3.95

Quantitative Strand Analysis

The study demonstrates that respondents prioritise content and pedagogical knowledge but also value technical knowledge and its intersection showing the importance of technical knowledge. Instructors demonstrate confidence in general computer use, but gaps remain in technical problem-solving and broader technology integration. The respondents are skilled in using technology to enhance trainee involvement and communication. However, they acknowledge their technological shortcomings and struggle to successfully integrate technology into the teaching and learning process. Across the seven constructs, Pedagogical Knowledge (M = 4.13, SD = 0.85), Content Knowledge (M = 4.19, SD = 0.85), and Pedagogical Content Knowledge (M = 4.00, SD = 0.64) were rated above the weighted-average threshold of 3.95, placing them in the High Perception category, while Technological Knowledge (M = 3.82, SD = 0.83), Technological Pedagogical Knowledge (M = 3.80, SD = 0.66), Technological Content Knowledge (M = 3.94, SD = 0.70), and Technological Pedagogical Content Knowledge (M = 3.74, SD = 0.80) fell below it. The gap between the highest-rated construct (CK) and the lowest-rated construct (TPCK) was modest in absolute terms (0.45 points on a five-point scale) but consistent in direction: every construct that combines technology with another domain scored lower than every construct that does not. This pattern echoes Akram et al.'s (2021) finding that teachers' competency during the shift to online instruction was highest in content knowledge and lowest in technological knowledge, suggesting that the gap observed here is not unique to Nepal's government training institutions but reflects a broader tendency for content and pedagogical expertise to outpace technological fluency during rapid transitions to online delivery. Training programmes targeting elements of TPACK could help develop these skills.

Qualitative Strand Findings

Three respondents were carefully selected from the pool of respondents of the quantitative study to gather insights into the perception of trainers on technological pedagogical and content knowledge (TPACK). The selected respondents representing the hierarchy equivalent to Class I, Class II and Class III are labelled as Respondent 1, Respondent 2 and Respondent 3 for this study.

Respondent 1:

He shared that technology has been embraced in the workplace for the past 2 decades. However, more effective streamlining of technology in sessions has been achieved over the past 6–7 years along with the introduction of online training. The extensive use of technology was instigated by COVID-19. He said, ‘I mandatorily use polling in my face-to-face sessions... In my scenario, familiarizing with new technologies is difficult because it demands more time, and I have many engagements. But isn’t the use of PowerPoint, email and printers also about technology integration?’ Moreover, he says that there is a trade-off between the time spent integrating new and existing technologies. He elaborated, ‘It could take around 1 to 2 hours to prepare technological tools for implementation in the session… I can prepare 4 slides within that duration. So, given my hectic schedule, I would rather create slides and focus on content. He explains that the trainer's comfort zone and the feeling of having to do more work may lead to reluctance to integrate technologies, lowering their perception of technological competency. Additionally, the lack of clear instructions from institutions regarding technology integration in the curriculum also impacts this integration. He said, ‘The institutional culture also drives technology integration. If we do not know what difference it is going to make, obviously, technology integration will be low.’

He also spoke about the importance of proper ICT infrastructure to implement technology in the curriculum. He said, ‘I had to use mobile data to receive polling data in the classroom because the internet was not working. I don’t think every trainer would be willing to spend their own resources.’ He discussed the challenges trainers face in adopting technology in training, including workload, compliance issues, and difficulty explaining technology usage to trainees. He emphasised the importance of institutions in online training programmes and suggested that institutions can help eliminate barriers to technology use by implementing strategies for procuring and updating new technologies, providing incentives for mobile data use, and creating a technology-rich environment. However, the respondent believes that trainers' proficiency in technology integration can be increased if the institution endorses and develops it as a culture.

He said, ‘trainers should be provided with opportunities to use technology for online or blended sessions, intact ICT services, well-equipped rooms to encourage technology integration for trainees outside the valley’. He expressed that the target audience, their background i.e. a person who is introduced to technology in the later phases of their life also affects technology integration, especially in online training programmes. He further added, ‘may be language intervention is required for trainees who can self-navigate the system if the instructions and system interface are in Nepali.’

Respondent 2:

The respondent suggested that trainers may perceive technology as a burden, despite its ease of use, thereby lowering their perceived competency in technology. Tools like Moodle and Learning Management Systems (LMS) are pre-designed for online, blended, or self-paced training programmes, allowing trainers to focus more on pedagogy and content. He pointed that trainers need to engage in innovation in methodology to facilitate content by integrating technology, ensuring high technological knowledge. However, he said, 'trainers' lack awareness on how technology integration could develop creative, entertaining and effective course content for effective teaching learning.' He added, 'a campaign or informal course or content-based Master Training of Trainers (MToT) should be provided to trainers so that they can integrate technology as desired.' He also highlighted that people who have had their educational background in IT-related topics or had access to technology in the past few years would enjoy using technology and has the aptitude to integrate technology in the curriculum. A trainer in self-paced course design and delivery emphasises the need for increased technological engagement and integration of pedagogical and content knowledge in the design phase. Unlike face-to-face training, trainers don't need to be present during the course, as they can monitor progress through feedback, comments, and information provided by online systems. He shares, 'face-to-face training also has its own beauty, trainers can evaluate whether the content was delivered effectively through interaction and facial expression of trainees.' He also expressed that technology integration can be done effectively in lecture method as well through interactive slides and images. He said that online learning or technology integration in curriculum should be bound by policy and nurtured by a conducive environment from colleagues. 'It should be made mandatory through policy, he said. However, the trainers need to understand the issues related to infrastructure and connectivity.

He emphasised policy compliance, content effectiveness, and relevant ICT infrastructure. He opined that institutions can influence online training programme implementation by implementing new technologies, providing incentives for trainers to integrate new technologies, allowing mobile data usage for uninterrupted internet access, and creating a technology-rich environment.

He pointed out the challenges of time management, which often lead trainers to view the learning of new technologies and existing systems as a burden, thereby reducing technology use in training. To motivate and encourage trainers to integrate technology in learning, he stated, 'exposure to trainers… at least 4 times yearly... could be self-paced or face-to-face… that can be incentivised… such training is required for trainers… they should have the opportunity to visit places and learn emerging technologies to integrate in curriculum.'

Respondent 3:

The respondent shares that a person's education and personal grooming have an unconscious impact on their perception. ‘I remember using an Overhead Projector (OHP) for my undergraduate studies, and then using PowerPoint for my master's thesis,’ he remarked. Learning computer skills became popular after School Leaving Certificate (SLC). That is not what I did. Everything I've discovered is through self-learning. He said that the ease with which technology is changing has made it possible to study through YouTube videos and other social media tutorials. However, he believes it has posed challenges for trainers in adopting and using new technology in the classroom. ‘I think trainers feel that it wouldn’t be wise to change from the status quo because there is an existing comfort zone.’ he stated. He also emphasised how risky it might be to use new technology right away as trainers might not be acquainted with the systems overnight. He made the observation that, although having the necessary skills to use technology, trainers occasionally choose not to use it due to reasons such as their mindset, capacity constraint, amount of time required for integrating technology in curriculum, ICT infrastructure and participants’ digital level.

Respondent 3 was aware of technology's potential for improving training but observed that the trainers often did not use it, limited by their mindset, time, ICT infrastructure and the digital preparedness of participants. He pointed that the essential focus of training remains in the transfer of the required knowledge, skills and attitudes (KSA) at all psychological, physical and social levels. He said, ‘Personal initiation could increase the integration of technology, but for a person to be motivated, institutional initiation is a must’. According to him, integration of technology in training should be tied to the professional growth and development of trainers. The recognition of their efforts would motivate and create behaviour level compliance among trainers. ‘Seniors talk about the importance of technology integration in training, especially because there is a demand for online training. But how frequently do they encourage online learning or include technology? It has a profound effect’.

He emphasised the importance of gradual change in training, stating that technology integration and developing technological competency are beneficial. He stressed the need for trainers to interact through workshops and guest lectures on efficient technology integration into the curriculum. He also highlighted the need for an institutionalised approach using performance metrics to promote technology integration in online training.

Qualitative Strand Analysis

The qualitative data reveal the intricate dynamics of integrating technology into training programmes, influenced by individual trainers' perspectives, institutional support, and the technological environment. To create successful technology-enabled learning environments, these issues must be addressed.

Trainer Perceptions and Competencies:

Trainers' approaches to integrating technology into training programmes are influenced by various factors, including their perspectives and competencies. Some trainers find technology cumbersome, leading to resistance to adopting new technologies. This resistance stems from doubts about the usefulness of technology in improving training outcomes or concerns about increased effort. Institutions can enhance technology adoption among trainers by aligning initiatives with policies. Trainers with prior exposure find it easier to adopt new tools, whereas those without struggle. Time constraints, heavy workloads, perceived higher workloads, and lack of institutional rules also hinder trainers' acceptance. Infrastructural issues, particularly internet connectivity issues, also pose barriers to efficient technology utilization. These challenges highlight the difficulty in integrating technology into training programmes. To effectively encourage and empower trainers, strategies and initiatives that consider trainers' beliefs and competencies about technology integration must be developed. Institutions can help build a culture of creativity and technical advancement in training programmes by removing barriers and delivering the right support and incentives. This resistance to technology, often based on a perception of its utility in relation to the work required, is similar to what Ertmer and Ottenbreit-Leftwich (2010) characterise as the effect of teachers' expertise, confidence, beliefs and culture on technology adoption decisions. The present findings extend that argument to the training field in showing that trainers do not distinguish between planned technology integration and tools such as PowerPoint, printers, and email that they already use on a routine basis. One finding specific to the context of government training in this study was that some trainers considered basic productivity software to be technology integration. This suggests that capacity-building efforts may need to reorient trainers' own notion of 'technology integration' before genuinely new technologies can be introduced.

Strategies for Technology Integration

The successful integration of technology in training programmes requires a multidimensional approach that enhances the technological competency of trainers and fosters a collaborative and innovative culture. A balanced approach to curricular integration should emphasise pedagogy and content delivery alongside a technology-centric approach. These strategies can assist training institutions in empowering trainers to successfully integrate technology into the curriculum, hence improving the efficacy and quality of training delivery and promoting a creative and exceptional classroom culture. Continual and comprehensive capacity building is consistent with Ward and Kushner Benson (2010) who argued that TPACK is a better paradigm for online instruction because it requires the integration of content, pedagogy and technology, rather than treating them as separate domains. One specific study finding was that trainers proposed a concrete institutional mechanism for this integration i.e. a content-based Master Training of Trainers (MToT) programme that would intentionally bring together subject-matter delivery and technology use, rather than providing generic software training detached from the trainers' actual teaching content.

Institutionalised Approach

Institutions play a crucial role in integrating technology into training programmes, influencing trainers' efforts. They should foster an environment that encourages experimentation and integration of cutting-edge techniques, resulting in better learning experiences. Access to essential ICT infrastructure, such as reliable internet connectivity and suitable hardware and software, is essential for efficient technology use in training. Institutions should adopt an institutionalised approach to promote technology integration, involving performance measurements and recognition systems. This strategy evaluates trainers' success in integrating technology and sets precise benchmarks and standards. Institutions can prioritise technological innovation in training by adding goals for technology integration into performance evaluations and recognizing trainers who excel. They can also collaborate with trainers by hosting guest lectures, seminars, and workshops on efficient technology integration techniques. This provides instructors with the skills and know-how to effectively integrate technology into their training programmes. This focus on measuring and recognising performance echoes Voithofer et al.'s (2019) broader argument that technology integration outcomes for teacher educators depend on more than the existence of a formal plan, with the attitudes and everyday practices of those in leadership roles shaping whether such plans take hold. One specific finding of the qualitative strand is that trainers related institutional commitment less to written policy and more to the visible behaviour of senior staff. Several respondents indicated that the extent to which seniors themselves modelled or encouraged online and technology-enabled training had a more direct impact on daily practice than the existence of a formal mandate.

Integrated Results

This section describes the process of the integration of the two strands, based on the guidance of Fetters, Curry & Creswell (2013) on connecting and integrating data in an explanatory sequential design. The three themes that emerged from the interview data were mapped against the seven TPACK constructs measured in the survey. This was done to identify where the qualitative theme spoke to the same construct the survey had already measured and where it introduced something the survey items were not intended to capture. Table 6 shows this mapping.

Table 6 : Integration of Quantitative and Qualitative Strands

Qualitative Theme.	Corresponding TPACK Construct(s)	Form of Integration
Trainer Perceptions and Competencies	Technological Knowledge (TK); Technological Pedagogical Knowledge (TPK); Technological Content Knowledge (TCK); Technological Pedagogical Content Knowledge (TPCK)	Confirmation — the theme accounts for why these four constructs were rated lower than Pedagogical and Content Knowledge.

Qualitative Theme.	Corresponding TPACK Construct(s)	Form of Integration
Strategies for Technology Integration	TPK, TCK, and TPCK, read against Pedagogical Knowledge (PK) and Content Knowledge (CK)	Expansion — adds a concrete mechanism, a content-based Master Training of Trainers programme, that the survey instrument was not designed to produce.
Institutionalised Approach	Cuts across all seven constructs as a contextual condition rather than a measured construct	Expansion — introduces an institutional and leadership dimension that sits outside the TPACK item set.

Joint Display

The construct-level pairing of the two strands is presented in the side-by-side joint display following the format Guetterman et al. (2015) recommend for explanatory sequential designs. The final column is done for the analytic purpose of the joint display which records for each construct whether the qualitative data confirm the survey result, expand on it, or are at odds with it in some way.

Table 7 : Joint display of Quantitative and Qualitative Findings by TPACK Construct

TPACK Construct	Quantitative Findings	Qualitative Findings	Integration Assessment
Technological Knowledge (TK)	The mean scores for items related to TK indicate a low perception among respondents.	Respondent 1 emphasises the challenges trainers face in adopting technology due to workload, lack of clear instructions, and institutional culture. Respondent 2 mentions that trainers might perceive technology as a burden despite being able to use it comfortably. Respondent 3 highlights the importance of personal and institutional initiation for technology integration and mentions the risks associated with rapid adoption of new technology.	Confirms — the qualitative accounts explain the source of the low score (workload, culture, risk-aversion) rather than contradicting it.

TPACK Construct	Quantitative Findings	Qualitative Findings	Integration Assessment
Pedagogical Knowledge (PK)	The mean scores for items related to PK indicate a high perception among respondents.	Respondents highlight the need for awareness and training on how to effectively use technology for teaching and learning purposes. They acknowledge the importance of integrating technology in training.	Expansion — the high score reflects general teaching skill, but respondents specifically asked for training in pedagogy that incorporates technology, a distinction the aggregate score does not capture on its own.
Content Knowledge (CK)	The mean scores for items related to CK indicate a high perception among respondents.	Respondents emphasize the importance of content effectiveness and relevant ICT infrastructure to integrate technology.	Expansion — strong content scores are qualified by respondents' insistence that content effectiveness depends on infrastructure conditions outside their control.
Technological Pedagogical Knowledge (TPK)	The mean scores for items related to TPK indicate a low perception among respondents.	Respondents stress the importance of engaging trainers in innovation and providing opportunities for learning and integrating technology effectively.	Confirms — the low score matches respondents' own description of limited opportunity to practise combining pedagogy with technology.

TPACK Construct	Quantitative Findings	Qualitative Findings	Integration Assessment
Pedagogical Content Knowledge (PCK)	The mean scores for items related to PCK indicate a high perception among respondents.	Trainers highlight the need for exposure to emerging technologies to facilitate effective integration into the curriculum along with time management challenges.	Partial divergence — high self-rated pedagogical-content integration coexists with reported time pressure that respondents say prevents them extending it into technology-rich formats.
Technological Content Knowledge (TCK)	The TCK construct mean (M = 3.94) falls fractionally below the construct-level threshold of 3.95 and is classified as low perception in Table 5, although two of its three individual items were classified as high perception at the item level in Table 4.	Trainers recognise the need for a gradual approach to technology integration. They emphasize the importance of institutional support and recognition for learning.	Confirms — read at the construct level, the cautious, gradual approach trainers describe matches a score that, like TK, TPK, and TPCK, falls below the threshold for constructs that combine technology with another domain.
Technological Pedagogical Content Knowledge (TPCK)	The mean scores for items related to TPCK indicate a low perception among respondents.	Trainers express the need for policy compliance, adequate infrastructure, and incentives to motivate technology integration in training.	Confirms — the lowest-rated construct overall. The respondents most directly tied it to policy, infrastructure, and incentive gaps.

Note. TCK's classification here follows the construct-level decision rule in Table 5 (M = 3.94 against an across-construct threshold of 3.95), since this is the level at which the joint display and the meta-inferences in 5.7 operate. Table 4 separately classifies two of the three individual

TCK items as high perception with (M= 3.97) for two high perception and (M=3.90) for low perception among the three items using an item-level threshold (3.96, the grand mean across all 24 items); both thresholds are calculated correctly, and the difference between them is a boundary effect of where each grand mean happens to fall, not an error in either table.

Metainference

The quantitative strand reveals the gap in self-perceived TPACK proficiency, specifically in the four constructs that require the combination of technology with pedagogy or content. The qualitative strand reveals the why i.e. trainers speak of time pressure, heavy workloads, lack of proper infrastructure and resources; and a lack of institutional signalling, and not a confessed lack of aptitude. When these two revelations are integrated, it answers the first research question of the study. The trainers in the training institutes of the government of Nepal are not weak in TPACK in a general sense; their confidence tends to be selectively, and consistently, lower when a construct requires them to incorporate technology into expertise they already possess.

The construct-level pairing yields a second meta-inference. Several trainers who rated their pedagogical and content knowledge highly also described, without being asked directly, a continuing reliance on a narrow set of tools such as slides, polling, email and limited experience redesigning a session to take advantage of the new possibilities offered by a given technology. The second research question is addressed with confident pedagogy and content knowledge, but low confidence specifically when technology must be integrated into that knowledge, with reports from themselves that stop the process of redesigning instruction together. Trainers narrate their own technology use as a story of constraint and habit, not capability. None of the respondents described technology integration as something they didn't know how to do, but as something their institution hadn't yet made worth the time it costs. The gap identified in this study is institutional and behavioural prior to being technical.

Discussion

The study examined the perceptions of Nepali trainers regarding their competence in integrating technological, pedagogical, and content knowledge (TPACK) in government training institutions. As the meta-inferences indicate, trainers perceived a consistently lower technological construct in comparison to content and pedagogical constructs, and this gap is more likely attributable to be due to time, workload, infrastructure deficit, resource constraint and institutional signals than as a straightforward skills deficit. While digital transformation is a clear requirement in written policies, the reality of daily operations sends a mixed message. Sometimes organisations practise symbolic compliance, projecting an image of innovation externally while leaving internal operational structures unchanged. The actors change their behaviour based on the incentives, structural realities, and cultural cues sent by management that are visible, rather than the stated rhetoric. The actual signals trainers receive in this study are: crushing administrative workloads, the absence of clear instructional guidance, and a complete lack of professional recognition or structural incentives for technical risk-taking.

The pattern still highlights the interconnectedness of TPACK domains and the need for technology, pedagogy, and content to be planned together rather than layered on afterwards, aligning with the conceptual model proposed by Mishra and Koehler (2006). This resonates with the broader claim that trainers' technological knowledge is shaped by exposure, training, and attitude, even where content and pedagogical knowledge are already sound (Koehler et al., 2013; Mishra & Koehler, 2006)now known as TPACK, or technology, pedagogy, and content knowledge.

Bajracharya (2021) reviewed a range of TPACK-based instructional design models, including TPACK-COPR and TPACK-IDDIRR, intended to help teachers translate the framework's macro-level constructs into classroom-ready steps, and found many of them intellectually rich but procedurally thin for practitioners. Bajracharya (2019) had already responded to a version of this gap with TPACK-integrated worked examples, testing a step-based instructional design approach with instructors in a Nepali teacher preparation programme. The study raised a comparable demand. Rather than asking for further exposure to TPACK as a concept, the trainers demanded a content-based Master Training of Trainers course built around the subject matter they already teach. This suggests the procedural gap Bajracharya identified extends into government training institutions providing online training programmes as well.

The shift to online delivery during the COVID-19 pandemic substantially increased trainers' exposure to digital platforms and made their use a practical necessity rather than an optional enhancement. This study did not measure whether that exposure produced a corresponding gain in technological competence, and the construct scores reported suggest it did not fully close the gap. Trainers who had used technology out of necessity for several years still rated themselves lower on every construct that combines technology with pedagogy or content than on pedagogy or content alone. Scherer et al. (2018) found that positive attitudes towards technology were a better predictor for TPACK than exposure alone, and Voogt et al.'s (2013) systematic review also found that teacher beliefs about pedagogy and technology are intertwined with TPACK development. Collectively, these studies imply that mindset and institutional environment influence the present results than the years of necessity-driven platform use that COVID-19 produced. Ertmer and Ottenbreit-Leftwich (2010) make a related argument about the role of institutional culture, norms, resources, and leadership in technology adoption. The present findings align with these previous studies in that trainers associated institutional commitment less with written policy and more with how visibly the senior staff used and modelled technology themselves.

Conclusion and Implications

Nepali government trainers bring strong content and pedagogical expertise to their training programmes. However, their confidence drops consistently on every construct that combines technology with that expertise. Rather than a recognised lack of skill, this is attributed to time constraints, workload, insufficiency of infrastructure and resources; and institutional signals that have not yet indicated that technology integration is required. The gap in professional development is primarily behavioural and institutional, suggesting that training should focus on trainers' existing subject matter within all TPACK constructs rather than generic software training. A content-based Master Training of Trainers (MToT) programme, such as the one proposed by the respondents, could enhance overall constructs of TPACK more effectively than a standalone digital literacy course. As trainers associate institutional commitment with the visible behaviour of senior staff as much as with written policy, it is unlikely that recognition and performance-measurement systems for technology integration will become embedded in practice. Until institutional leaders are seen to be utilising and embracing the tools they expect trainees to use, innovative culture with technology integration is unlikely to be promoted. We recommend that the public service training policy framework be amended to ensure trainers' instructional materials and performance assessments include digital competence and TPACK-aligned criteria. We further urge that future studies investigate the potential of a content-based MToT model to close the gap in trainers' scores on technology and pedagogical content.

References

Adebo, P. (2018). Online teaching and learning. *International Journal of Advanced Research in Computer Science and Software Engineering*, *8*(2), 73–77. https://doi.org/10.23956/ijarcsse.v8i2.549

Akram, H., Yingxiu, Y., Al-Adwan, A. S., & Alkhalifah, A. (2021). Technology integration in higher education during COVID-19: An assessment of online teaching competencies through technological pedagogical content knowledge model. *Frontiers in Psychology, 12*, Article 736522. https://doi.org/10.3389/fpsyg.2021.736522

Archambault, L., & Crippen, K. (2009). Examining TPACK among K-12 online distance educators in the United States. *Contemporary Issues in Technology and Teacher Education*, *9*(1), 71–88. https://www.citejournal.org/volume-9/issue-1-09/mathematics/examining-tpack-among-k-12-online-distance-educators-in-the-united-states/

Bajracharya, J. R. (2019). TPACK-integrated worked examples for technology integration. *Journal of Training and Development, 4*, 46–63. https://doi.org/10.3126/jtd.v4i0.26837

Bajracharya, J. R. (2021). Technology integration models and frameworks in teaching and training. *Journal of Training and Development, 6*(1), 3–11. https://doi.org/10.3126/jtd.v6i01.41674

Creswell, J. W., & Plano Clark, V. L. (2018). *Designing and conducting mixed methods research* (3rd ed.). Sage.

Dalal, M., Archambault, L., & Shelton, C. (2017). Examining technology integration decision-making processes and identifying professional development needs of international teachers. *Journal of Research on Technology in Education*, *49*(3–4), 117–133. https://doi.org/10.1080/15391523.2017.1314780

Dalal, M., Archambault, L., & Shelton, C. (2021). Fostering the growth of TPACK among international teachers of developing nations through a cultural exchange program. *Australasian Journal of Educational Technology*, *37*(1), Article 1. https://doi.org/10.14742/ajet.5964

Dawadi, S., Shrestha, S., & Giri, R. A. (2021). Mixed-methods research: A discussion on its types, challenges, and criticisms. *Journal of Practical Studies in Education*, *2*(2), 25–36. https://doi.org/10.46809/jpse.v2i2.20

Ertmer, P. A., & Ottenbreit-Leftwich, A. T. (2010). Teacher Technology Change: How Knowledge, Confidence, Beliefs, and Culture Intersect. *Journal of Research on Technology in Education*, *42*(3), 255–284. https://doi.org/10.1080/15391523.2010.10782551

Fetters, M. D., Curry, L. A., & Creswell, J. W. (2013). Achieving integration in mixed methods designs—Principles and practices. *Health Services Research*, *48*(6, Pt. 2), 2134–2156. https://doi.org/10.1111/1475-6773.12117

Field, A. (2018). *Discovering statistics using IBM SPSS statistics* (5th ed.). Sage.

Guetterman, T. C., Fetters, M. D., & Creswell, J. W. (2015). Integrating quantitative and qualitative results in health science mixed methods research through joint displays. *Annals of Family Medicine*, *13*(6), 554–561. https://doi.org/10.1370/afm.1865

Ivankova, N. V., Creswell, J. W., & Stick, S. L. (2006). Using mixed-methods sequential explanatory design: From theory to practice. *Field Methods*, *18*(1), 3–20. https://doi.org/10.1177/1525822X05282260

Joo, Y. J., Park, S., & Lim, E. (2018). Factors influencing preservice teachers' intention to use technology: TPACK, teacher self-efficacy, and technology acceptance model. *Journal of Educational Technology & Society*, *21*(3), 48–59. https://www.jstor.org/stable/26458506

Koehler, M. J., Mishra, P., & Cain, W. (2013). What is technological pedagogical content knowledge (TPACK)? *The Journal of Education*, *193*(3), 13–19. https://www.jstor.org/stable/24636917

Lakhe Shrestha, B. L., Dahal, N., Hasan, M. K., Paudel, S., & Kapar, H. (2025). Generative AI on professional development: A narrative inquiry using TPACK framework. *Frontiers in Education, 10*, Article 1550773. https://doi.org/10.3389/feduc.2025.1550773

Mason, R. (2003). Models and methodologies in distance education. *Universidade Aberta*. https://core.ac.uk/download/pdf/303039286.pdf

Ministry of Communication and Information Technology. (2015). *National information and communication technology policy, 2015* (p. 33) [Policy Document]. Government of Nepal. https://doit.gov.np/en/detail/post/9

Ministry of Communication and Information Technology. (2019). *2019 Digital Nepal framework* (V8.4, p. 360) [Policy Document]. Government of Nepal. https://drc.gov.np/resources/other-view/8

Ministry of General Administration. (2014). *National training policy for government officials* [Office of the Prime Minister and Council of Ministers]. https://www.opmcm.gov.np/national-acts/

Mishra, P., & Koehler, M. J. (2006). Technological pedagogical content knowledge: A framework for teacher knowledge. *Teachers College Record*, *108*, 1017–1054. https://doi.org/10.1111/j.1467-9620.2006.00684.x

Onwuegbuzie, A. J., & Johnson, R. B. (2006). The validity issue in mixed research. *Research in the Schools, 13*(1), 48–63.

Pallant, J. (2020). *SPSS survival manual: A step by step guide to data analysis using IBM SPSS* (7th ed.). Routledge.

Pangeni, S. K., & Karki, G. (2021). E-learning initiatives at CTEVT: An attempt at innovation and paradigm shift in TVET pedagogy. *Journal of Technical and Vocational Education and Training*, *1*(15), 134–147. https://doi.org/10.3126/tvet.v1i15.45175

Scherer, R., Tondeur, J., Siddiq, F., & Baran, E. (2018). The importance of attitudes toward technology for pre-service teachers' technological, pedagogical, and content knowledge: Comparing structural equation modeling approaches. *Computers in Human Behavior*, *80*, 67–80. https://doi.org/10.1016/j.chb.2017.11.003

Shulman, L. (1987). Knowledge and teaching: Foundations of the new reform. *Harvard Educational Review*, *57*(1), 1–23. https://doi.org/10.17763/haer.57.1.j463w79r56455411

Shulman, L. S. (1986). Those who understand: Knowledge growth in teaching. *Educational Researcher*, *15*(2), 4–14. https://doi.org/10.2307/1175860

Voithofer, R., Nelson, M. J., Han, G., & Caines, A. (2019). Factors that influence TPACK adoption by teacher educators in the US. *Educational Technology Research and Development*, *67*(6), 1427–1453. https://doi.org/10.1007/s11423-019-09652-9

Voogt, J., Fisser, P., Pareja Roblin, N., Tondeur, J., & Van Braak, J. (2013). Technological pedagogical content knowledge – a review of the literature. *Journal of Computer Assisted Learning*, *29*(2), 109–121. https://doi.org/10.1111/j.1365-2729.2012.00487.x

Ward, C. L., & Kushner Benson, S. N. (2010). Developing new schemas for online teaching and learning: TPACK. *MERLOT Journal of Online Learning and Teaching, 6*(2), 482–490. https://jolt.merlot.org/vol6no2/ward_0610.pdf

Wargadinata, W., Maimunah, I., Dewi, E., & Rofiq, Z. (2020). Student's Responses on Learning in the Early COVID-19 Pandemic. *Tadris: Jurnal Keguruan Dan Ilmu Tarbiyah*, *5*, 141–153. https://doi.org/10.24042/tadris.v5i1.6153

Zhong, L. (2017). Indicators of digital leadership in the context of K-12 education. *Journal of Educational Technology Development and Exchange*, *10*(1). https://doi.org/10.18785/jetde.1001.03