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Modeling the Integration of Educational Technology in Vocational Colleges: Influencing factors among in-service teachers

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Abstract
This investigation examined the integration of digital technology by 681 vocational teachers in Guangzhou, focusing on Attitudes Towards Technology, Self-Efficacy in Digital Realms, Digital Literacy, and Technology Utilization. Employing Partial Least Squares Structural Equation Modeling, the study revealed how these key factors profoundly influence and enhance digital technology strategies among occupational teachers. It identified attitudes, digital literacy, and technology applications as crucial intermediaries facilitating integration, providing a foundational model for improving educational technology practices in vocational institutions.

Keywords: Attitudes Towards Technology; Self-Efficacy in Digital Realms; Digital Literacy; Technology Utilization

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1.0 Introduction

1.1 Background of the study

The rapid adoption of digital technology in education presents both opportunities and challenges. While digital technology has the potential to modernize outdated educational practices, its effective integration into classrooms is contingent upon several factors(Consoli et al., 2023). In particular, teachers' attitudes towards technology, self-efficacy in digital realms, digital literacy, and technology utilization play crucial roles in determining the success of digital technology implementation. Despite teachers becoming increasingly comfortable with digital technology, their active use of technology in educational settings remains limited. This discrepancy has drawn the attention of researchers, especially in developing countries like China, where the impact of digital technology on education is of significant interest.

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Understanding these influencing factors is vital for creating strategies that will ensure the sustainable and effective use of digital technology in education(Msambwa & Daniel, 2024).

1.2 Problem of the statement

Although there has been a substantial investment in upgrading the technological infrastructure and digital technology tools within educational institutions, the anticipated benefits of digital technology integration are not always realized. Teachers' limited use of digital technology in the classroom, despite their improved competence and comfort with the technology, poses a significant challenge(Yu et al., 2024). Previous studies have identified various barriers to ICT integration, but there remains a gap in understanding the specific conditions and factors that influence teachers' effective use of technology. Therefore, it is critical to explore why and under what circumstances digital technology can be a transformative tool in education.

1.3 Research objectives and questions

This study seeks to investigate the factors influencing digital technology integration among in-service teachers, focusing on their attitudes toward technology, self-efficacy in digital realms, digital literacy, and technology utilization. The research is guided by the following main question:

How do attitudes toward technology, digital self-efficacy, digital literacy, and the application of technology correlate with ICT integration among practicing educators?

2.0 Literature Review

2.1 Theories and Models Applied in This Study

This study is grounded in Self-Determination Theory (SDT) and the Technological Pedagogical Content Knowledge (TPACK) framework. Self-Determination Theory (SDT) is a motivational theory that examines how intrinsic and extrinsic motivation influence individuals' engagement with technology. SDT highlights the importance of autonomy, competence, and relatedness in fostering sustained use of technology in educational settings (Ryan & Deci, 2000).

The Technological Pedagogical Content Knowledge (TPACK) framework integrates three core components—technology, pedagogy, and content—into a cohesive model that explains how teachers can effectively incorporate technology into their teaching practices. TPACK emphasizes that successful technology integration requires a deep understanding of how these three domains interact within specific educational contexts

Technology, pedagogy, and content are synthesized in the Technological Pedagogical Content Knowledge (TPACK) framework, which are integrated model that elucidates how educators can proficiently meld technology into their instructional methodologies. TPACK underscores that adept integration of technology necessitates a profound comprehension of the interplay among these domains within specific pedagogical scenarios. (Voogt et al., 2013).

By combining insights from SDT and TPACK, this study examines how attitudes toward technology, self-efficacy in digital realms, digital literacy, and technology utilization influence technology integration among in-service teachers. These frameworks provide a modern perspective on the motivational and pedagogical factors that drive effective technology integration in education.

2.2 Attitudes Towards Technology (ATT)

Attitudes constitute an individual's psychological evaluations regarding objects, persons, or events, and research extensively demonstrates that favorable perceptions toward technology significantly bolster digital tool integration(Scherer et al., 2021). For adept and inventive digital technology employment in educational frameworks, educators must maintain affirmative dispositions. Recent investigations reveal that educators' technological attitudes profoundly shape their digital literacy and engagement with technology, with proficient instructors typically exhibiting greater enthusiasm toward embedding digital tools into their teaching strategies (Zeng et al., 2022). These attitudes are pivotal predictors of a teacher's digital literacy level across genders, with less experienced educators often displaying a more favorable outlook compared to their seasoned counterparts. Nonetheless, certain studies report no significant disparities in technology usage or attitudes among instructors, thereby shaping corresponding hypotheses.

H1: ATT has a substantial positive direct influence on SEDR.
H2: ATT exerts a significant positive direct impact on TU.
H3: ATT has a considerable positive direct effect on TI.
H4: ATT significantly and positively influences practicing educators' digital TI indirectly through DL.
H5: ATT positively and significantly affects practicing educators' digital TI indirectly through both DL and TU.

2.3 Self-Efficacy in Digital Realms and Technology Integration (SEDR & TI)

Self-efficacy in digital realms, denoting an individual's confidence in their capability to execute digital technology tasks effectively within educational contexts, is consistently shown to correlate positively with teachers' attitudes towards technology during technology integration (Caner & Aydın, 2021). Nonetheless, discrepancies persist as some research indicates no substantial link between self-efficacy in digital realms and attitudes toward technology(Saienko et al., 2020). Furthermore, various studies underscore that teachers' digital self-efficacy influences their digital literacy while integrating technology, although others contest the impact of digital literacy on digital self-efficacy (Kao et al., 2020). Research exploring the nexus between digital self-efficacy and technology utilization during

technology integration remains scant, yet available evidence suggests a significant influence of self-efficacy on technology employment by teachers (Pramono et al., 2023). Moreover, while certain studies find no demographic differences in self-efficacy among teachers, others report variable findings across age, gender, and teaching experience during technology integration (Adebagbo et al., 2022).

H6: SEDR significantly and positively influences ATT during the TI by practicing educators.
H7: During the technology integration by practicing educators, SEDR exerts a significant positive direct effect on DL.
H8: In the context of practicing educators' technology integration, SEDR has a substantial positive direct impact on TU.
H9: SEDR has a considerable positive direct influence on TI of practicing educators.
H10: SEDR indirectly but significantly and positively affects TI of practicing educators through ATT.
H11: SEDR has a significant and positive indirect effect on TI of practicing educators through DL.
H12: SEDR significantly and positively influences TI of practicing educators indirectly through TU.

2.4 Digital Literacy of Teachers (DL)

Digital literacy, characterized by the adept utilization of digital knowledge, competencies, and attitudes in real-world applications, is acknowledged as pivotal for integrating technology effectively. Despite such recognition, there is an evident gap in the advanced skills educators need to impart knowledge effectively in digital environments. Research by Morey (2020) supports the idea that self-efficacy in digital domains, coupled with positive perceptions towards technology, significantly influences digital literacy levels. Educators lacking in digital self-efficacy or harboring negative sentiments towards technology often experience diminished confidence, adversely impacting their digital literacy and, consequently, their ability to facilitate digital learning opportunities for students. Although less explored, the interaction between digital literacy and demographic variables such as gender and age suggests that female educators might exhibit lower digital literacy levels than male counterparts, with younger educators generally more proficient in leveraging digital technologies than older ones.

H13: DL significantly and positively influences technology utilization TU directly.
H14: DL exerts a significant and positive direct impact on teachers' TI.
H15: DL substantially and positively affects teachers' TI indirectly via TU.

2.5 Technology Utilization of Teachers (TU)

The application of computers, the internet, and various electronic devices for classroom instruction, commonly known as technology utilization, plays a pivotal role in modern education, with tools like computers, laptops, printers, scanners, software applications, data projectors, and interactive teaching devices collectively enhancing the efficient delivery of information. These contemporary advancements have fundamentally altered the way individuals access and interact with information, making technology integration essential in shaping new educational initiatives and policies(Vo et al., 2023). By providing comprehensive training, educators are empowered to refine their digital competencies, enriching the teaching-learning process with dynamic and innovative methodologies that significantly elevate the effectiveness of both teaching and learning. There is a hypothesis based on this point as below,

H16: TU has a significant and positive direct effect on teachers' TI.

2.6 Research Model

Based on the hypothesis developed, there is a research model as below,

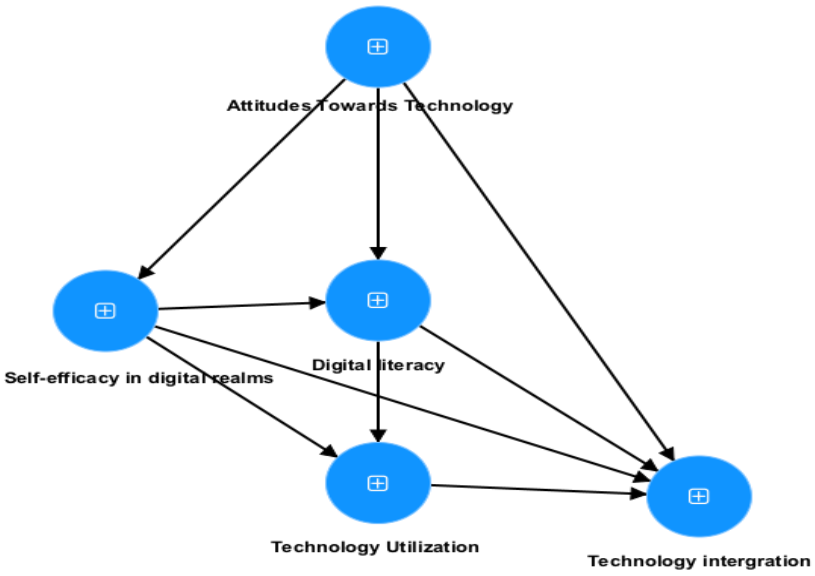

Figure 1. Research model of this research

3.0 Methodology

3.1 Modeling Approach and Justification

In this investigation, Partial Least Squares Structural Equation Modeling (PLS-SEM) is utilized to develop a predictive model that elucidates factors impacting the technology integration by practicing teachers. Recognized as a robust alternative to Covariance-based Structural Equation Modeling (CB-SEM), PLS-SEM is particularly valuable in scenarios characterized by a nascent understanding of structural model relationships, uncertain component measurement, or a primary emphasis on exploratory rather than confirmatory aims (Hair et al., 2020). The primary objective of employing PLS-SEM is to enhance the prediction of indicators by optimizing component structures. It is favored for forecasting pivotal target constructs or identifying essential elements, contrasting with CB-SEM, which excels in theory testing, validation, and comparing theoretical frameworks. PLS-SEM, free from identification and other technical constraints, offers superior statistical power over CB-SEM and is ideally suited for exploratory studies or refining existing theoretical models. Owing to its flexible model specification and less rigorous data characteristic requirements, PLS-SEM effectively reveals population correlations, making it optimally suited for exploratory research. The proposed model probes the interrelations among technology integration and four principal research variables: attitudes towards technology (ATT), self-efficacy in digital realms (SEDR), digital literacy (DL), and technology utilization (TU).

3.2 Sampling and data collection

The study was conducted in Guangzhou, a populous and resource-abundant province in China, known for having a significant number of educators. This demographic factor enhances the generalizability of the data collected. A snowball sampling technique was employed in this research, which involves current participants recruiting additional participants for the study. Specifically, the researchers initially contacted twenty in-service teachers from various colleges in Guangzhou, Guangdong Province, to assist with the data collection process. Each of these teachers was responsible for recruiting at least 35 other in-service teachers(Leighton et al., 2021). Data collection was facilitated through an online survey, with the survey link distributed via Chinese social networking platforms like WeChat and QQ. Participants were allowed to review a consent form before completing the survey, and their participation was confirmed by checking a box. The study strictly adhered to ethical standards by maintaining the confidentiality of all participant information. The survey was conducted over two months, beginning in February 2024 and concluding in May 2024, ultimately collecting and analyzing data from 681 in-service teachers.

3.3 Research instrument

Data were gathered through a questionnaire designed to predict factors influencing in-service teachers' technology integration. The items, adapted and modified from previous studies, encompassed constructs such as self-efficacy in digital realms (SEDR), attitudes toward technology (ATT), digital literacy (DL), technology utilization (TU), and technology integration (TI). A 5-point Likert scale, ranging from "strongly disagree" to "strongly agree," was employed to measure these factors. The results of Cronbach's alpha indicated that all constructs in the questionnaire were reliably measured(Pelila et al., 2022).

4.0 Results and Findings

4.1 Results

4.1.1 Descriptive Analysis

Table 1. Demographic information of the sample

Variables	No of participants	Proportion (%)
Gender		
Male	201	29.5
Female	480	70.5
Age		
1. 20–30	198	29.2
2. 31–35	231	33.9
3. 36–45	157	22.9
4. 46–55	65	9.5
5. >55	30	4.7
Teaching experience		
1. <3 years	423	62.2
2. 4–10 years	170	25.0
3. 11–20 years	57	8.4
4. 21–30 years	16	2.4
5. >30 years	15	2.1

Table 1 reveals that the demographic composition of the sample included 29.5% male and 70.5% female educators, predominantly younger than 45 years. Participants over 45 years constituted just 14.2%, with 62.2% possessing fewer than three years of teaching experience, and a mere 2.1% having over three decades of experience.

4.1.2 Measurement Model

Table 2 presents the measurement model results, including reliability and validity analyses for five constructs: attitudes towards technology, self-efficacy in digital realms, digital literacy, technology utilization, and technology integration. Table 3 provides the Heterotrait-Monotrait Ratio (HTMT) results for these constructs, indicating that the correlations are within acceptable limits, thereby confirming the discriminant validity of the model. The details are shown in Figure 2 for the Cronbach's α and factor loadings values.

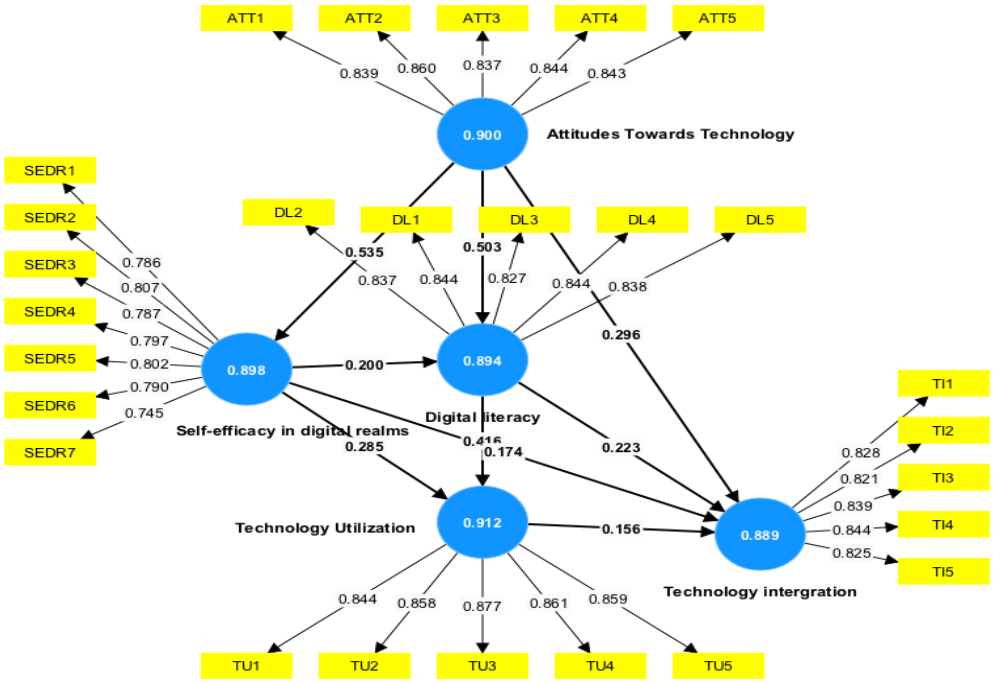

Figure 2. Cronbach's α and factor loading values

Table 2. Measurement model and results

Constructs	Items	Loadings	Cronbach's α	Composite Reliability	Average Variance Extracted
Attitudes towards technology	ATT1	0.839	0.9	0.926	0.714
	ATT2	0.86			
	ATT3	0.837			
	ATT4	0.845			
	ATT5	0.843			
Self-efficacy in digital realms	SEDR1	0.802	0.898	0.92	0.621
	SEDR2	0.79			
	SEDR3	0.745			
	SEDR4	0.786			
	SEDR5	0.807			
	SEDR6	0.787			
	SEDR7	0.797			
Digital literacy	DL1	0.844	0.894	0.922	0.702
	DL2	0.837			
	DL3	0.827			
	DL4	0.844			
	DL5	0.838	0.912	0.934	0.739
Technology utilization	TU1	0.846			
	TU2	0.856			
	TU3	0.876			
	TU4	0.861			
	TU5	0.858			
Technology integration	TI1	0.828	0.889	0.918	0.692
	TI2	0.821			

	TI3	0.839
	TI4	0.844
	TI5	0.825

Table 3. Heterotrait-Monotrait Ratio (HTMT) results

	ATT	DL	TU	TI	SEDR
ATT					
DL	0.680				
TU	0.646	0.608			
TI	0.689	0.640	0.594		
SEDR	0.594	0.522	0.530	0.572	

4.1.3 Structure Model

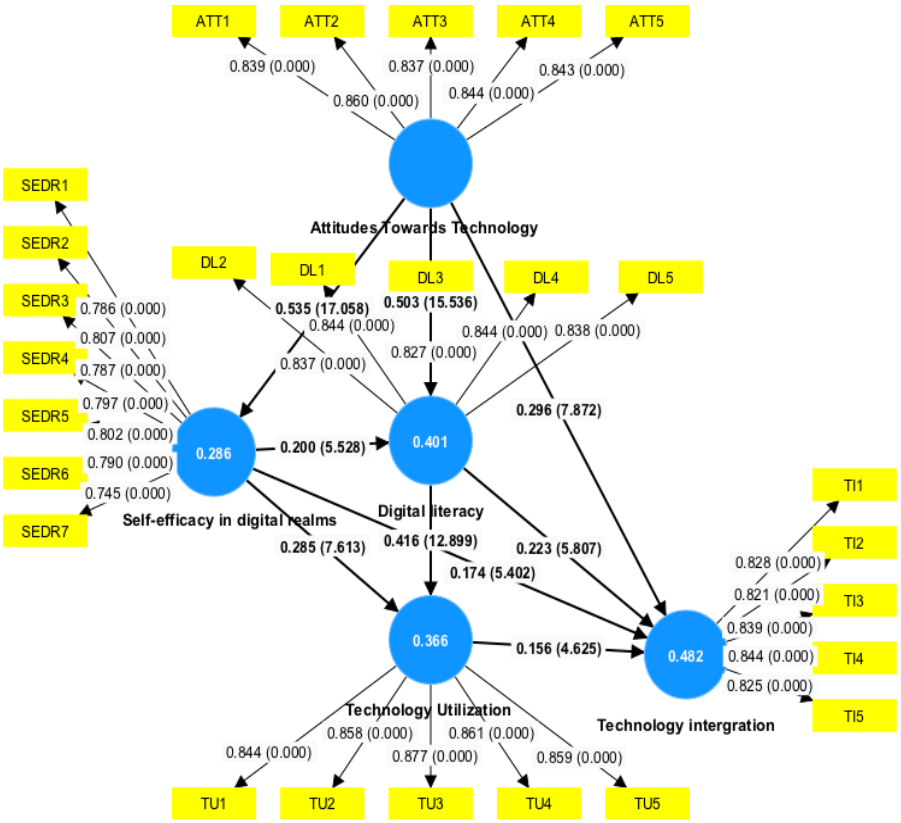

Figure 3. The structure model of this research

Table 4. Inner VIF for the predictors

	ATT	DL	TU	TI	SEDR
ATT		1.401	1.823	2.008	
DL			1.669	1.792	
TU				1.736	
TI					
SEDR	1	1.401	1.467	1.524	

Table 5. R2, Effect Sizes (f2) and Q^2

		f^2					
	R^2	ATT	DL	TU	TI	SEDR	Q^2
ATT	0.286		0.302	0.101	0.084		0.202
DL	0.401			0.074	0.053		0.279
TU	0.424				0.027		0.310
TI	0.482						0.329
SEDR		0.401	0.048	0.039	0.038		

Table 6. The results of path analysis and hypothesis.

Hypotheses	Paths	The Type of Effect	Beta	T-value	Results
H1	ATT -> DL	Direct	0.501	15.188***	supported
H2	ATT -> TU	Direct	0.325	8.153***	supported
H3	ATT->TI	Direct	0.295	7.387***	supported
H4	ATT->DL->TI	Indirect		5.357***	supported
H5	ATT->TU->TI	Indirect		3.839***	supported
H6	SEDR -> ATT	Direct	0.534	17.042***	supported
H7	SEDR -> DL	Direct	0.201	5.364***	supported
H8	SEDR->TU	Direct	0.180	4.648***	supported
H9	SEDR -> TI	Direct	0.173	5.474***	supported
H10	SEDR -> ATT->TI	Indirect		6.321***	supported
H11	SEDR -> DL->TI	Indirect		3.804***	supported
H12	SEDR-> TU->TI	Indirect		3.239***	supported
H13	DL -> TU	Direct	0.265	7.544***	supported
H14	DL -> TI	Direct	0.224	5.831***	supported
H15	DL ->TU-> TI	Indirect		3.984***	supported
H16	TU->TI	Direct	0.157	4.479***	supported

***p<0.01 **p<0.05 *p < 0.10.*

4.2 Findings

Referring to results of measurement model and structure model, which include table 2-6, the findings of the study reveal that **attitudes towards technology (ATT)** have a significant direct effect on **digital literacy (DL)** (β=0.503\beta = 0.503β=0.503, t=15.189t = 15.189t=15.189), **technology utilization (TU)** (β=0.326\beta = 0.326β=0.326, t=8.163t = 8.163t=8.163), and **technology integration (TI)** (β=0.296\beta = 0.296β=0.296, t=7.397t = 7.397t=7.397). Additionally, **self-efficacy in digital realms (SEDR)** positively impacts **ATT** (β=0.535\beta = 0.535β=0.535, t=17.061t = 17.061t=17.061), **DL** (β=0.200\beta = 0.200β=0.200, t=5.474t = 5.474t=5.474), **TU** (β=0.181\beta = 0.181β=0.181, t=4.749t = 4.749t=4.749), and **TI** (β=0.174\beta = 0.174β=0.174, t=5.444t = 5.444t=5.444). The model also highlights significant indirect effects, such as **ATT** influencing **TI** through **DL** (t=5.367t = 5.367t=5.367) and **TU** (t=3.939t = 3.939t=3.939), and **SEDR** affecting **TI** through **ATT** (t=6.423t = 6.423t=6.423), **DL** (t=3.904t = 3.904t=3.904), and **TU** (t=3.229t = 3.229t=3.229). The R^2 value of 0.482 for technology integration indicates that the model explains 48.2% of the variance in **TI**, demonstrating the substantial influence of these variables on technology integration in educational settings.

5.0 Discussion

The study's findings highlight the crucial role of teachers' attitudes towards technology (ATT) and self-efficacy in digital realms (SEDR) in successfully integrating technology into educational practices. Positive attitudes and high self-efficacy directly enhance digital literacy (DL), technology utilization (TU), and technology integration (TI), indicating that efforts to improve these areas are key to fostering effective technology use in education.

Moreover, the observed indirect effects show that ATT and SEDR not only have a direct impact but also influence TI through DL and TU, suggesting a need for holistic approaches that address multiple factors simultaneously. While the model explains a significant portion of the variance in TI, further research is needed to explore other contributing factors and to validate these findings across different educational contexts.

6.0 Conclusion & Recommendations

This study develops an innovative framework that combines Self-Determination Theory and the TPACK framework to enhance ICT integration in education, focusing on key motivational and educational factors for a sustainable adoption of technology in academic settings.

To enhance technology integration in vocational colleges, this study recommends strengthening professional development and training to boost teachers' digital literacy and self-efficacy through workshops focused on the practical applications of digital tools. Furthermore, advocating for policy adjustments that support technology integration, such as funding for technological upgrades and rewards for innovative teaching practices, is essential. Continuous research into the effectiveness of these integration strategies and maintaining an adaptive approach to educational practice and policy will ensure that interventions evolve based on empirical evidence and feedback, ultimately improving the teaching and learning experience in vocational colleges.

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References

Caner, M., & Aydın, S. (2021). Self efficacy beliefs of pre-service teachers on technology integration. Turkish Online Journal of Distance Education, 22(3), 79-94. https://doi.org/10.17718/tojde.961820

Hair, J. F., Howard, M. C., & Nitzl, C. (2020). Assessing measurement model quality in PLS-SEM using confirmatory composite analysis. Journal of Business Research, 109, 101-110. https://doi.org/10.1016/j.jbusres.2019.11.069

Leighton, K., Kardong-Edgren, S., Schneidereith, T., & Foisy-Doll, C. (2021). Using social media and snowball sampling as an alternative recruitment strategy for research. Clinical simulation in nursing, 55, 37-42. https://doi.org/10.1016/j.ecns.2021.03.006

Morey, T. (2020). Virtual Mentoring in Agricultural Education: Describing Digital Literacy, Technology Self-Efficacy, and Attitudes Towards Technology of Pre-Service and In-Service Agricultural Educators. The Pennsylvania State University.

Pelila, J. R. O., Bag-ongan, Q. F. L., Talania, J. L. P., & Wakat, G. S. (2022). Factors and barriers influencing technology integration in the classroom. Journal of Language Education and Educational Technology, 7(1), 1.

Ryan, R. M., & Deci, E. L. (2000). Self-determination theory and the facilitation of intrinsic motivation, social development, and well-being. American psychologist, 55(1), 68. https://doi.org/10.1037/0003-066X.55.1.68

Saienko, N., Lavrysh, Y., & Lukianenko, V. (2020). The impact of educational technologies on university teachers' self-efficacy. International Journal of Learning, Teaching and Educational Research, 19(6), 323-336. https://doi.org/10.26803/ijlter.19.6.19

Scherer, R., Howard, S. K., Tondeur, J., & Siddiq, F. (2021). Profiling teachers' readiness for online teaching and learning in higher education: Who's ready? Computers in human behavior, 118, 106675. https://doi.org/10.1016/j.chb.2020.106675

Vo, T., Truong, D., & Nguyen, P. (2023). The impact of digital technology on content and language integrated learning in higher education: a systematic review of literature. ICTE Conference Proceedings, 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