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Extent of digital technology integration in the instructional practices of high school educators in the Schools Division of Aklan, Philippines

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Abstract

This study aimed to determine the extent of digital technology integration in the instructional practices of educators in the Schools Division of Aklan, Philippines. Specifically, it examined the educators' level of integration when digital technologies replaced, amplified, and transformed their instructional practices as a whole group and when grouped according to gender, educational attainment, type of school, years of teaching experience, and relevant training in information and communication technologies (ICT). The study also identified significant differences in the level of digital technology integration among educators based on these variables. Results showed that the 224 educators across the Division, identified through cluster random sampling, demonstrated low levels of digital technology replacement, amplification, and transformation in their instructional practices. Further findings revealed a significantly higher level of replacement among male educators, significantly higher levels of both replacement and amplification among educators with 0–3 years of teaching experience compared to those with 11–20 years, and among those with 4–10 years compared to those with 11–20 years; and a significantly higher level of transformation between the 0–3 years and 11–20 years groups. The findings underscore the impact and influence of digital technologies on modern instructional practices, highlighting their role in reshaping education to align with the demands of 21st-century learning. They also emphasize the importance of sustained professional development for educators to keep pace with technological advancements and innovations, enabling them to confidently teach digital-native learners in the 21st century.

Keywords: digital technology, instructional practices, replacement, amplification, transformation

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1. Introduction

From the beginning of the 20th century through the 21st century, the integration of digital technology has profoundly transformed the educational landscape. Since 1971, when information and telecommunications technologies began to emerge with the invention of microprocessors (Miller, 2021), the widespread adoption of digital technology has extended to various aspects of human life, including education. As the technological revolution introduced a new era of digitalization, it has simultaneously reshaped the landscape of teaching and learning (Bansal, 2023; Fitria & Suminah, 2020; Julita & Zulyusri, 2023). Learning is no longer confined to textbooks or physical libraries as digitalization has made vast amounts of information instantly accessible through the internet, online libraries, and databases (Gul & Bano, 2019; Klain Gabbay, 2024; Li et al., 2019; Ternenge & Kashimana, 2019). Digitalization also evolved into a range of knowledge-creation tools, including smartphones, drones, wearable devices (Xiang, 2018), big data technologies (Zharkova et al., 2022), educational software (Alabdulaziz, 2021; Haleem et al., 2022), and digital applications (Kalimullina et al., 2021).

Digital technology has been found to enhance traditional teaching methods with innovative tools and resources (Sarker et al., 2019; Suleimanova, 2020). Its integration into academic experiences has transformed teaching and learning by enriching the practices inside the classroom and the delivery of instruction (Haidir, 2023; Haleem et al. 2022; Vysochan et al., 2024). Studies indicate that digital technology provides educators with innovative ways for their students to be more creative (Selfa-Sastre et al., 2022; Srivastava & Dey, 2018), build on their digital literacy skills (Kmecová, 2020), differentiate the way they learn (Vouglanis & Driga, 2023), and improve their interest and involvement in the learning process (Abbasova & Narmin, 2019; Pinto & Leite, 2020). Additionally, educators report an increase in confidence in developing interactive digital instructional material, delivering distance learning courses (Borba et al., 2018), and cultivating positive dynamics in the use of various digital tools (Alberola-Mulet et al., 2021; Bay, 2022; Vakaliuk & Antoniuk, 2023). However, school climate has been found to predict technology integration, with teachers' attitudes serving as a mediating factor (Raygan & Moradkhani, 2020).

Despite these advantages, digital technology has exacerbated disparities among school systems that lack the necessary infrastructure to support its integration. These challenges include limited internet access, insufficient personal devices (Afzal et al., 2023), increased social tension, and imitation of activity rather than engagement that is meaningful to students (Frolova et al., 2019). Mercader (2020) identified several barriers to technology integration, including technophobia, lack of time, absence of planning, insufficient incentives, limited evaluation mechanisms, work overload, and constraints imposed by university accreditation models. Furthermore, the UNESCO Background Paper for the Futures of Education Initiatives, as cited by Facer & Selwyn (2021), emphasizes that digital technology alone cannot create sustainable educational futures amid persistent injustices, excessive individualization, and global unsustainability.

In some countries, digital technology is highly integrated into teaching practices (Arhin et al., 2024; Riyanda et al., 2025; Tabingo et al., 2025). Research has shown that such integration can improve the quality and quantity of elementary students' writing (Wen & Walters, 2022) and enhance academic achievement in mathematics (Ali et al., 2023). However, despite its benefits, excessive use of technology may negatively affect learning by contributing to health issues (Strom, 2021), reduced concentration and deep thinking (Shanmugasundaram & Tamilarasu, 2023), and delays in fine motor development and problem-solving skills (Carstens et al., 2021). Moreover, the integration and use of digital technology in classrooms have not consistently improved student performance on standardized tests (Davies & West, 2013).

Research on gender differences in technology integration presents mixed findings. Some studies report differences in methods and perception between male and female teachers (Ahmad & Rathakrishnan, 2025; Almekhlafi & Almeqdadi, 2010; Guillén-Gámez & Rodríguez-Fernández, 2022; Palomares-Ruiz et al., 2020), whereas others find no significant difference between the two groups (Gebhardt et al., 2019; Ibrahim & Husnin, 2025; Kosiol & Ufer, 2024; Oguezue, 2025; Tarman et al., 2019). Similarly, gender differences in students' digital knowledge, attitudes, and skills are evident in some contexts (Cai et al., 2017; Campos & Scherer, 2024; Jones & Procter, 2023; Prosper, 2024; Siddiq & Scherer, 2019), while other studies report no significant differences (Ayite et al, 2022; Bećirović et al., 2021; Goreth & Vollmer, 2022).

Although teacher training has not consistently shown a significant relationship with teaching styles (Reyes, 2023), it is strongly associated with instructional strategies and improved students' learning outcomes (Althauser, 2014; Garcia, 2025; Gul et al., 2021; Lattuca et al., 2014; Sibomana & Ndyambaje, 2024). Research on digital technology integration frequently identifies inadequate teacher training as a major barrier to effective implementation (Chao, 2015; Gómez-Trigueros, 2023; Iqbal & Ali, 2024; Mathebula et al., 2025; Ruggiero & Mong, 2015). Consequently, professional development and training are commonly recommended to address gaps in digital knowledge and pedagogical skills of teachers (Akram et al., 2022; Amemasor et al., 2025; Bowman et al., 2020; Celeste & Osias, 2024; De Vera et al., 2021; Gomez et al, 2021; Hero, 2019; Li et al., 2019; Mpuangnan, 2024).

The use of digital technologies encompasses both static and dynamic teaching and learning approaches (Dyrvold & Bergvall, 2023; Vahey et al., 2020; Yu et al., 2023). It has proven particularly effective during remote learning (Engel et al., 2023; Goles et al., 2023; Imran et al., 2025; Nkoala et al., 2023). Several studies indicate that digital technologies increase access to educational opportunities (Haleem et al., 2022; Hussain et al., 2024; Hushin, 2025; Mah & Groß, 2024; Zou et al., 2025) and enhance the teaching and learning processes (Akram et al., 2022; Çelik & Baturay, 2024; Getenet et al., 2024; Goles et al., 2023; Gottschalk & Weise, 2023; Mhlongo et al., 2023; Okoye et al., 2022; Salas-Pilco et al., 2022; Timotheou, 2022). However, these are accompanied by challenges (Colegado, 2025; Johnson et al., 2016; Mustafa et al., 2024; Silva et al., 2024; Yadav, 2024), especially related to ethical concerns (Marin & Tur, 2024; Mâţă, 2022; Mexhuani, 2024; Richard & Julian, 2024; Rodrigues et al., 2024), assessment and evaluation practices (Agtarap et al., 2024; Handrayani, 2022; Jurane-Bremane, 2021), technology infrastructure (Alda et al., 2020; Chirimbana et al., 2022; Del Mundo, 2022; Ghavifekr et al., 2016), and instructional practices (Amemasor et al., 2025; Ibrahim & Husnin, 2025; Mananay et al., 2024; Marín et al., 2025).

Higher levels of digital competence among teachers are associated with increased motivation for teaching (Gómez-Trigueros et al., 2024; Raave et al., 2024; Tabingo & Palma, 2025), more effective technology integration (Ghavifekr & Rosdy, 2015; Singh, 2021; Wohlfart & Wagner, 2024), and improved student learning outcomes (Balalle, 2024; El Ouaddane et al., 2025; Fuentes & LaBad, 2025; Guaña-Moya et al., 2024; Shalgimbekova et al., 2024). Beyond perceived usefulness, psychological and social factors also influence teacher integration of digital technologies (Bui, 2022; Giac et al., 2025; Pelila et al., 2022).

Purpose of the Study **-** This quantitative, descriptive cross-sectional study determined the extent of digital technology practices of high school educators in the Schools Division of Aklan, Philippines. It specifically determined the level of digital technology replacement, amplification, and transformation of these educators' instructional practices. It also determined the significant difference in the replacement, amplification, and transformation levels when these educators were grouped by gender, educational attainment, type of school, years of teaching service, and relevant training in information and communication technologies (ICTs). The results of this study can shed light on the influence of digital technology on modern instructional practices. Through the evaluation of how digital technologies are replacing, amplifying, and transforming the educators' instructional practices, it is hoped that the educational landscape of the Division can be redefined, the learning environment can be more digital-technology adaptive, and educators' pedagogy can be envisioned to reflect the realities of integrating and aligning with the expectations of 21st-century learning. Moreover, the results can highlight the

critical need for ongoing, target-based professional development for educators. As technology continues to be integrated and to evolve into more innovative roles, educators must receive continuous training to remain adept and agile in their instructional approaches. Only then can they effectively engage and inspire their students, who are the digital native-learners of this generation, and successfully bridge the gap between traditional instruction and modern, technologically-adaptive pedagogy.

Frameworks of the Study - This study is anchored on two complementary theoretical frameworks that elucidate the integration of digital technology into the educators' instructional practices. The Substitution, Augmentation, Modification, and Redefinition or SAMR model (Puentedura, 2006) anchors the extent of digital technology integration among educators to how the different technologies have replaced, amplified, and transformed their instructional practices. As this model proposes four levels of technological integration, i.e., substitution and augmentation representing the enhancement phase, and modification and redefinition representing the transformation phase. This model can best explain how educators' instructional practices can be viewed along a scale of technology integration, by replacing existing, often non-digital practices; amplifying productivity, efficacy, or effectiveness of existing practice; and reinventing teaching, learning, or curricular goals (Lynch, 2023; Read, 2022). Complementing this model, the Technological, Pedagogical, and Content Knowledge or TPACK Framework (Mishra & Koehler, 2006) emphasizes that the interaction of three core knowledge domains, i.e., technology knowledge, pedagogical knowledge, and content knowledge, can effectively integrate digital technology into teaching. Thus, the framework explains the ability of educators to effectively replace, amplify, or transform their instructional practices based on how these three knowledge domains have effectively influenced their integration of technology.

2. Methodology

This quantitative, descriptive cross-sectional design collected data from a sample of high school educators from the Schools Division of Aklan, Philippines, which were used to determine the level of digital technology replacement, amplification, and transformation of these educators' instructional practices. They were also used to determine the significant difference in the replacement, amplification, and transformation levels when these educators were grouped by gender, educational attainment, type of school, years of teaching service, and relevant training in ICTs. Three Likert-scale questionnaires were used to measure the levels of replacement, amplification, and transformation of instructional practices as outcome dimensions. Descriptive statistics, such as frequency, mean, and standard deviation, were used to determine the levels of replacement, amplification, and transformation of educators' instructional practices. Inferential statistical tools, i.e., t-test for independent sample means, and one-way Analysis of Variance (ANOVA) with Scheffe test for post hoc analysis, were used to determine significant differences in the outcome dimension based on the grouping variables.

The study sought prior approval from the Schools Division administration, and the research-informed consent that included the purpose of the study and stipulated voluntary participation and confidentiality of information was provided to the respondents before the conduct of the study. Three research instruments from the study of Cadornigara (2025) were employed to gather data from the respondents of this study. These questionnaires consisted of 12 items each, which included common digital technologies in the replacement and amplification questionnaires, and popular technologies that reinvent the curriculum and pedagogical practices in the transformation questionnaire. These questionnaires underwent face- and content-validation by five educational experts in digital technology integration and pilot-tested with 34 educators from a non-representative high school. The reliability testing using Cronbach's alpha yielded 0.926, 0.944, and 0.961 levels for the three questionnaires, respectively. The level of replacement, amplification, and transformation scores was rated as very low (1.00 - 1.79), low (1.8 - 2.59), moderate (2.60 - 3.39), high (3.40 - 4.19), and very high (4.20 - 5.00).

The 19 sample schools from 96 public high schools in the Division of Aklan were then determined through cluster random sampling, which is 20% of the total number of schools in the Division. A total of 224 high school educators were identified and grouped by gender (male or female), educational attainment (Bachelor's, Master's,

or Doctoral degree holders), type of school (urban or rural), years of teaching experience (0 - 3 years, 4 - 10 years, 11 - 20 years, or 20+ years), and relevant training in ICTs (no training, self-study, seminars/webinars/conference, or diploma/graduate course). They were then invited to participate in the study and provided with the Research-Informed Consent Form before they completed the three survey instruments. The research data were collected using Google Forms and analyzed using the Statistical Package for the Social Sciences software.

3. Results and Discussion

A total of 224 educators were selected through a cluster random sampling method from among 19 sample schools that represented 20% of the 96 Division of Aklan public high schools. The distribution of respondents by gender, educational attainment, type of school, teaching styles, and relevant training in ICTs is presented in Table 1.

3.1 Levels of integrating digital technology as a replacement, amplification, and transformation of educators' instructional practices

The results revealed that high school educators of the Division of Aklan had a low level of integrating digital technology as a replacement for their instructional practices as a whole group (*N*= 224, *Mean*= 2.46, *S. D.*= 0.783). Based on these data, most of the grouping variables showed a low level of replacement, although male educators, doctoral degree holders, and educators in the 0-3 years of teaching service showed a moderate level of replacement. The results also revealed that these educators had a low level of integration of digital technology as an amplification of their instructional practices as a whole group (*N*= 224, *Mean*= 2.58, *S. D.*= 0.943). Table 1 shows these data. Based on these data, though, more educators in their grouping variables showed a moderate level of amplification, i.e., male educators, Master's degree holders, Doctoral degree holders, educators who teach in the urban schools, educators who belong to the 0-3 and 4-10 years of teaching service groups, and educators who self-study and who attend seminars and diploma programs on ICTs. Female educators, Bachelor's degree holders, educators who teach in the rural schools, educators who belong to the 11-20 and 20+ years of teaching service group, as well as educators who receive no training on ICTs, all showed a low level of amplification.

Table 1
Levels of digital technology integration as a replacement, amplification, and transformation of instructional practices of high school educators of the Division of Aklan

		Level of Replacement		Level of Amplification		Level of Transformation	
Groups	N	%	Means S. D. Level	Means S. D. Level		Means S. D. Level	
Whole Group	224	100.00	2.46 0.783 Low	2.58 0.943 Low		2.37 0.934 Low	
Male	52	23.21	2.66 0.746 Moderate	2.76 0.959 Moderate		2.54 0.941 Low	
Female	172	76.79	2.40 0.786 Low	2.53 0.936 Low		2.31 0.928 Low	
Bachelor's	140	62.50	2.42 0.779 Low	2.54 0.943 Low		2.37 0.988 Low	
Master's	80	35.71	2.51 0.791 Low	2.66 0.959 Moderate		2.36 0.878 Low	
Doctoral	4	1.79	2.79 0.822 Moderate	2.67 0.685 Moderate		2.48 1.064 Low	
Urban	80	35.71	2.51 0.761 Low	2.65 0.967 Moderate		2.46 0.940 Low	
Rural	44	64.29	2.43 0.796 Low	2.54 0.932 Low		2.31 0.930 Low	
0 - 3 years	41	18.30	2.75 0.700 Moderate	2.96 0.745 Moderate		2.62 0.796 Moderate	
4 - 10 years	105	46.88	2.54 0.814 Low	2.67 0.814 Moderate		2.47 1.027 Low	
11 - 20 years	52	23.21	2.13 0.697 Low	2.18 0.888 Low		2.09 0.845 Low	
20+ years	26	11.61	2.31 0.710 Low	2.47 0.914 Low		2.11 0.734 Low	
No training	35	15.63	2.18 0.750 Low	2.34 0.919 Low		2.10 1.060 Low	
Self-study	44	19.64	2.52 0.706 Low	2.60 0.934 Moderate		2.21 0.802 Low	
Seminars, etc.	136	60.71	2.51 0.816 Low	2.62 0.949 Moderate		2.46 0.926 Low	
Diploma, etc.	9	4.02	2.43 0.615 Low	2.93 0.972 Moderate		2.70 0.963 Moderate	

Furthermore, these educators showed a low level of integration of digital technology as a transformation of their instructional practices as a whole group (*N*= 224, *Mean*= 2.37, *S. D.*= 0.934). Table 1 shows these data. Among these grouping variables, only the educators who belong to the 0-3 years of teaching service and educators

who train in ICTs through diploma or graduate programs showed a moderate level of transformation. Educators in all other grouping variables showed a low level of transformation.

3.2 Significant difference in the levels of digital technology replacement, amplification, and transformation of educators' instructional practices based on gender and type of school

The significant differences in the levels of digital technology replacement, amplification, and transformation of educators' instructional practices were determined between male and female educators, and educators who teach in the urban and rural public high schools using the independent sample t-test, which was set at 0.05 alpha level of significance. The independent sample t-test showed that there was a significant difference in the level of digital technology replacement of educators' instructional practices ($t_{(222)}$ = 2.146, p= 0.033 <0.05) between male educators (*N*= 52, *Mean*= 2.66, *S.D.*= 0.746) and female educators (*N*= 172, *Mean*= 2.40, *S.D.*= 0.786). Male educators' moderate level of replacement was significantly higher than female educators' low level of replacement. Table 2 shows these data. However, the independent sample t-test showed that there was no significant difference in the level of digital technology amplification of educators' instructional practices ($t_{(222)}$= 1.531, p=0.127 >0.05) between male educators (*N*= 52, *Mean*= 2.76, *S.D.*= 0.959) and female educators (*N*= 172, *Mean*= 2.53, *S.D.*= 0.936). The moderate level of amplification of male educators was not significantly higher than the low level of amplification of female educators.

The independent sample t-test likewise showed that there was no significant difference in the level of digital technology transformation of educators' instructional practices ($t_{(222)}$ = 1.546, p= 0.123 <0.05) between male educators (*N*= 52, *Mean*= 2.54, *S.D.*= 0.941) and female educators (*N*= 172, *Mean*= 2.31, *S.D.*= 0.928). Both male and female educators had low levels of digital technology transformation. Table 2 shows these data. The independent sample t-test also showed that there was no significant difference in the level of digital technology replacement of educators' instructional practices ($t_{(222)}$ = 0.764, p= 0.448 >0.05) between educators who teach in the urban schools (*N*= 80, *Mean*= 2.51, *S.D.*= 0.761) and educators who teach in the rural schools (*N*= 144, *Mean*= 2.43, *S.D.*= 0.796). Educators who teach in both urban and rural schools had low levels of digital technology replacement. The independent sample t-test also showed that there was no significant difference in the level of digital technology amplification of educators' instructional practices ($t_{(222)}$= 0.798, p=0.426>0.05) between educators who teach in the urban schools (*N*= 80, *Mean*= 2.65, *S.D.*= 0.967) and educators who teach in the rural schools (*N*= 144, *Mean*= 2.54, *S.D.*= 0.932). Although educators who teach in urban schools showed a moderate level of amplification of their instructional practices, this was not significantly higher than the low level of amplification of educators who teach in the rural schools.

Table 2
t-test for independent sample means of the difference in the levels of educators' integration of digital technology as replacement, amplification, and transformation of their instructional practices

Comparison	Grouping	N	Mean	S.D.	t	*p*
	Male	52	2.66	0.746		
Levels of replacement	Female	172	2.40	0.786	2.146	0.033*
	Male	52	2.76	0.959		
Levels of amplification	Female	172	2.53	0.936	1.531	0.127
	Male	52	2.54	0.941		
Level of transformation	Female	172	2.31	0.928	1.546	0.123
	Urban	80	2.51	0.761		
Levels of replacement	Rural	144	2.43	0.796	0.764	0.448
	Urban	80	2.65	0.967		
Levels of amplification	Rural	144	2.54	0.932	0.798	0.426
	Urban	80	2.46	0.940		
Level of transformation	Rural	144	2.31	0.930	1.175	0.241

*Significant at 0.05 alpha

The independent sample t-test likewise showed that there was no significant difference in the level of digital technology transformation of educators' instructional practices ($t_{(222)}$= 1.175, p= 0.241>0.05) between educators

who teach in the urban schools (*N*= 80, *Mean*= 2.46, *S.D.*= 0.940) and educators who teach in the rural schools (*N*= 144, *Mean*= 2.31, *S.D.*= 0.930). Both groups of educators showed a low level of transformation of their instructional practices. In comparing the levels of replacement, amplification, and transformation of these educators' instructional practices, the only significant difference was observed in the moderate replacement level of male educators over the low replacement level of female educators, which was significantly higher. Male and female educators did not differ significantly in the levels of amplification and transformation of their instructional practices. Likewise, educators who teach in urban and rural high schools did not differ significantly in the levels of replacement, amplification, and transformation of their instructional practices.

3.3 Significant difference in the levels of digital technology replacement, amplification, and transformation of educators' instructional practices based on their highest educational attainment, years of teaching service, and relevant training in ICTs

The significant differences in the levels of digital technology replacement, amplification, and transformation of educators' instructional practices were also determined among Bachelor's degree, Master's degree, and Doctoral degree holders; among educators who belong to the 0 - 3, 4 - 10, 11 - 20 and 20+ years of teaching service groups; and among educators who do not receive training, who self-study, and who receive ICT training through seminars, webinars, and conferences, and through diploma or graduate courses, using one-way ANOVA and Scheffe test as its post hoc analysis, both set at 0.05 alpha level of significance. The one-way ANOVA showed that there was no significant difference in the level of digital technology replacement of educators' instructional practices ($\boldsymbol{F}_{(2,\ 221)}$= 0.703, *p*= 0.496 >0.05) among educators who completed a bachelor's degree (*N*= 140, *Mean*= 2.42, *S.D.*= 0.779), educators who completed a Master's degree (*N*= 80, *Mean*= 2.51, *S.D.*= 0.791), and educators who completed a doctoral degree (*N*= 4, *Mean*= 2.79, *S.D.*= 0.822). Table 3 shows these data.

The one-way ANOVA also showed that there was no significant difference in the level of digital technology amplification of educators' instructional practices ($\boldsymbol{F}_{(2,\ 221)}$= 0.483, *p*= 0.618 >0.05) among educators who completed a bachelor's degree (*N*= 140, *Mean*= 2.54, *S.D.*= 0.943), educators who completed a Master's degree (*N*= 80, *Mean*= 2.66, *S.D.*= 0.959), and educators who completed a doctoral degree (*N*= 4, *Mean*= 2.67, *S.D.*= 0.685). Table 3 shows these data. The one-way ANOVA likewise showed that there was no significant difference in the level of digital technology transformation of educators' instructional practices ($\boldsymbol{F}_{(221)}$= 0.035, *p*= 0.966 >0.05) among educators who completed a bachelor's degree (*N*= 140, *Mean*= 2.37, *S.D.*= 0.988), educators who completed a Master's degree (*N*= 80, *Mean*= 2.36, *S.D.*= 0.878), and educators who completed a doctoral degree (*N*= 4, *Mean*= 2.48, *S.D.*= 1.064). Table 3 shows these data.

Table 3
One-way analysis of variance of the difference in the levels of educators' integration of digital technology as replacement, amplification, and transformation of their instructional practices

Comparison	Grouping	N	Mean	S.D.	F	*p*
	Bachelor's	140	2.42	0.779		
	Master's	80	2.51	0.791		
Level of replacement	Doctoral	4	2.79	0.822	0.703	0.496
	Bachelor's	140	2.54	0.943		
	Master's	80	2.66	0.959		
Level of amplification	Doctoral	4	2.67	0.685	0.483	0.618
	Bachelor's	140	2.37	0.988		
	Master's	80	2.36	0.878		
Level of transformation	Doctoral	4	2.48	1.060	0.035	0.966
	0 - 3 years	41	2.75 a	0.700		
	4 - 10 years	105	2.54 b	0.814		
	11 - 20 years	52	2.13 ab		0.697	
Level of replacement	20+	26	2.311	0.710	6.193	<0.001**
	0 - 3 years	41	2.96 a	0.745		
	4 - 10 years	105	2.67 b	0.981		
	11 - 20 years	52	2.18 ab		0.888	
Level of amplification	20+	26	2.47	0.914	6.148	<0.001**

	0 - 3 years	41	2.62 a		0.796	
	4 - 10 years	105	2.47	1.027		
	11 - 20 years	52	2.09 a	0.845		
Level of transformation	20+	26	2.11	0.734	3.798	0.011*
	No training	35	2.18	0.750		
	Self-study	44	2.523	0.706		
	Seminars, etc.	136	2.51	0.816		
Level of replacement	Diploma, etc.	9	2.43	0.615	1.753	0.157
	No training	35	2.34	0.919		
	Self-study	44	2.59	0.934		
	Seminars, etc.	136	2.62	0.949		
Level of amplification	Diploma, etc.	9	2.93	0.972	1.202	0.310
	No training	35	2.10	1.056		
	Self-study	44	2.21	0.802		
	Seminars, etc.	136	2.46	0.926		
Level of transformation	Diploma, etc.	9	2.70	0.963	2.302	0.078

*Significant at 0.05 alpha
**Significant at 0.01 alpha
a are significant with each other in the post hoc
b are significant with each other in the post hoc

The one-way ANOVA showed that there was a significant difference in the level of digital technology replacement of educators' instructional practices ($F_{(3, 220)}$= 6.193, p <0.001) among educators who taught for 0 to 3 years (*N*= 41, *Mean*= 2.75, *S.D.*= 0.700), educators who taught for 4 to 10 years (*N*= 105, *Mean*= 2.54, *S.D.*= 0.814), educators who taught for 11 to 20 years (*N*= 52, *Mean*= 2.13, *S.D.*= 0.697), and educators who taught for more than 20 years (*N*= 26, *Mean*= 2.31, *S.D.*= 0.710). The post hoc comparison further showed that there was a significant difference between the moderate level of replacement of educators who taught for 0 to 3 years and the low level of replacement of educators who taught for 11 to 20 years (p=0.002 <0.05). There was also a significant difference between the level of replacement of educators who taught for 4-10 years and the level of replacement of educators who taught for 11 to 20 years (p=0.016 <0.05), even though both were of low levels of replacement. Table 3 shows these data.

The one-way ANOVA showed that there was a significant difference in the level of digital technology amplification of educators' instructional practices ($F_{(3, 220)}$= 6.148, p <0.001) among educators who taught for 0 to 3 years (*N*= 41, *Mean*= 2.96, *S.D.*= 0.745), educators who taught for 4 to 10 years (*N*= 105, *Mean*= 2.67, *S.D.*= 0.814), educators who taught for 11 to 20 years (*N*= 52, *Mean*= 2.18, *S.D.*= 0.888), and educators who taught for more than 20 years (*N*= 26, *Mean*= 2.47, *S.D.*= 0.914). The post hoc comparison further showed that there was a significant difference between the moderate level of amplification of educators who taught for 0 to 3 years and the low level of amplification of educators who taught for 11 to 20 years (p=0.001<0.05). There was also a significant difference between the moderate level of amplification of educators who taught for 4-10 years and the low level of amplification of educators who taught for 11 to 20 years (p=0.021<0.05). Table 3 shows these data.

The one-way ANOVA further showed that there was a significant difference in the level of digital technology transformation of educators' instructional practices ($F_{(3, 220)}$= 3.798, p= 0.011 <0.05) among educators who taught for 0 to 3 years (*N*= 41, *Mean*= 2.62, *S.D.*= 0.796), educators who taught for 4 to 10 years (*N*= 105, *Mean*= 2.47, *S.D.*= 1.027), educators who taught for 11 to 20 years (*N*= 52, *Mean*= 2.09, *S.D.*= 0.845), and educators who taught for more than 20 years (*N*= 26, *Mean*= 2.11, *S.D.*= 0.734). The post hoc comparison further showed that there was a significant difference between the moderate level of amplification of educators who taught for 0 to 3 years and the low level of amplification of educators who taught for 11 to 20 years (p=0.035 <0.05). Table 3 shows these data.

The one-way ANOVA showed that there was no significant difference in the level of digital technology replacement of educators' instructional practices ($F_{(3, 220)}$= 1.753, p=0.157 >0.05) among educators with no training in ICTs (*N*= 35, *Mean*= 2.18, *S.D.*= 0.750), educators who train in ICTs through self-study (*N*= 44, *Mean*= 2.52, *S.D.*= 0.706), educators who train in ICTS through seminars, webinars, and conferences (*N*= 136,

Mean= 2.51, *S.D.*= 0.816), and educators who train in ICTs through diploma or graduate courses (*N*= 9, *Mean*= 2.43, *S.D.*= 0.615). Table 3 shows these data.

Likewise, the one-way ANOVA showed that there was no significant difference in the level of digital technology amplification of educators' instructional practices ($F_{(3, 220)}$= 1.202, $p=0.310$ >0.05) among educators with no train in ICTs (*N*= 35, *Mean*= 2.34, *S.D.*= 0.919), educators who train in ICTs through self-study (*N*= 44, *Mean*= 2.60, *S.D.*= 0.934), educators who train in ICTs through seminars, webinars, and conferences (*N*= 136, *Mean*= 2.62, *S.D.*= 0.949), and educators who train in ICTs through diploma or graduate courses (*N*= 9, *Mean*= 2.93, *S.D.*= 0.972). Table 3 shows these data.

Furthermore, the one-way ANOVA showed that there was no significant difference in the level of digital technology transformation of educators' instructional practices ($F_{(3, 220)}$= 2.302, $p= 0.078$ >0.05) among educators with no training in ICTs (*N*= 35, *Mean*= 2.10, *S.D.*= 1.06), educators who train in ICTs through self-study (*N*= 44, *Mean*= 2.21, *S.D.*= 0.802), educators who train in ICTs through seminars, webinars, and conferences (*N*= 136, *Mean*= 2.46, *S.D.*= 926), and educators who train in ICTs through diploma or graduate courses (*N*= 9, *Mean*= 2.70, *S.D.*= 0.963). Table 3 shows these data.

Educators who completed a Bachelor's, Master's, and doctoral degrees did not differ significantly in the levels of replacement, amplification, and transformation of their instructional practices. However, educators who belong to the 0 - 3 years of teaching service showed a significantly higher level of both replacement and amplification over those who belong to the 4 - 10 years and 11 - 20 years of teaching service. Educators who belong to the 0 - 3 years of teaching service showed a significantly higher level of transformation than those who belong to the 4 - 10 years. Educators who have no training, who self-study, and who receive training in ICTs through seminars, webinars, or conferences, and through diploma or graduate courses, did not differ in the level of replacement, amplification, and transformation of their instructional practices.

3.4 Discussion

The findings of this study offer a simple view of how high school educators in the Division of Aklan integrated digital technology into their instructional practices across three dimensions, i.e., replacements, amplification, and transformation. The whole group mean score suggests that educators demonstrated low levels of technology integration across all three dimensions. With results consistent with some studies in the Philippines (Celeste & Osias, 2024; Del Mundo, 2022; Goles et al., 2023; Pedida & Diaz, 2023; Reyes, 2023) and in other countries (Abedi, 2024; Aleksieva et al., 2025; Dele-Ajayi et al., 2021; Mercader & Gairin, 2020), this means that while digital technologies are being utilized in the classroom, they are not fully implemented to influence technological decisions and drive digital learning innovations. Although the amplification level was highest among replacement and transformation levels, the extent to which the efficiency, effectiveness, and productivity of instructional practices were not fully supported by common and popular digital technologies (Caoile et al., 2025; Figueroa, 2024; Kaminskienė et al., 2022; Perez, 2023; Valverde-Berrocos et al., 2022). Both the replacement and transformation levels were low, indicating that although a few educators may have access to digital technologies to be used in the classroom, these are not fully utilized (Baylen & Junsay, 2022; Meyerink & Luo, 2025; Okoye et al., 2023; Pérez Echeverría et al, 2025; Plantado, 2023; Tortola, 2024), more so, not even transformative (Alshammary & Alhalafawy, 2023; Pozo et al., 2021; Vidal-Esteve & Martín-Gómez, 2023).

When disaggregated by gender, both male and female educators showed similar trends, with slightly higher replacement levels among male educators across three components and male educators' replacement level was significantly higher than female educators. Only in the practical use of digital technology over traditional practices does a gender-based disparity exist (Jamias et al., 2022; Peña & Yao, 2022; Policarpio & Magpantay, 2024; Qazi et al., 2021; van Deursen & Helsper, 2023), indicating that male educators have higher confidence and self-efficacy in integrating technology to enhance instruction (Gebhardt et al., 2019; Mahawan et al., 2025; Masry-Herzallah, 2025; Scherer et al., 2023; Šabić et al., 2021), possibly due to a wider exposure to (Adeoye, 2023; Zhuo and Xu,

2007) or higher interest in digital tools (Gomez-Trigueros & Yañez de Aldecoa, 2021; Sahu & Bankira, 2025). However, the overall trend suggests that both male and female educators have utilized technology at relatively modest levels in their respective classrooms.

Based on the educators' educational attainment, educators with doctoral degrees displayed consistently high scores compared to those with master's and bachelor's degrees, with moderate levels of both replacement and amplification. Higher educational qualifications may contribute to greater awareness (Tiwari, 2024; Tzafilkou et al., 2023), higher competency (Hafeez et al., 2025; Li et al., 2022; Moreira-Choez et al., 2024; Suzer & Koc, 2024), or strengthened training in the pedagogy of digital technology (Kabaran & Uşun, 2021; Pongsakdi et al., 2021); conversely, the lower educational attainment may translate to fewer opportunities for continuous professional development and training (Admiraal et. al., 2023; Akiri & Dori, 2022; Paniagua & Sanchez-Marti, 2018). The level of replacement, amplification, and transformation among these educators, nonetheless, does not show significant differences. This could mean that educational attainment does not necessarily define mastery of digital technology integration (Cadornigara, 2025; Horrigan, 2016), or the actual utilization of these technologies may not have fully replaced, effectively enhanced, or skillfully transformed their instructional practices (Blundell et al., 2020; Laufer et al., 2021; Useche et al., 2022).

Educators in urban public schools exhibited a higher level of amplification in their instructional practices compared to their rural public-school counterparts. However, both groups demonstrate low levels of replacement and transformation. In all three dimensions, though, no significant differences had been observed, although significant differences were observed in studies in other countries (Kormos & Wisdom, 2023; Li, 2024; Suwanajote & Saikham, 2023). In both school types, access to technology resources may play a crucial role in shaping their integration practices (Ceballos, 2024; Oliver, 2022), including limited connectivity, outdated devices, or a lack of institutional support (Ahiaku et al., 2025; Amirova et al., 2023; Bustillo & Aguilos, 2022; Del Mundo, 2022; Tomaro, 2018). The moderate level of amplification in the light of a low level of replacement may suggest a higher perception of the enhancement of instructional practices by digital technology, rather than actual utilization (Kim et al., 2017; Chukwuemeka & Samaila, 2020; Mercader & Gairín, 2020).

What is quite revealing is the result of the replacement, amplification, and transformation levels of educators in the 0 - 3 years group, which was the highest among groups for the three dimensions. Additionally, the levels of replacement, amplification, and transformation among these early-career educators were significantly higher than those in the longer service groups, which is corroborative of similar studies (Abella & Dela Rosa, 2023; Aduka, 2023; Wong et al., 2025; Marrero Galván et al., 2023*;* Mission et al., 2021). This suggests that educators in their early teaching careers may be more confident and comfortable at incorporating digital technology (Lopez et al., 2022) in filling in, enhancing, and modifying their instructional practices, possibly because they are digital natives or have been trained in digital technology earlier in their educational journey. Furthermore, educators with longer years of teaching service, i.e., 11 - 20 and 20+ years, showed the lowest level scores in all three dimensions, indicating that digital integration decreases with years of teaching service (Lei & Jiang, 2025), presumably due to the lack of experience or exposure to digital technology competencies among veteran educators.

The results of the integration of digital technology among educators based on their training background in ICT use in the classroom highlight the influence of training in driving the technological pedagogy of these educators. Although the levels of their replacement, amplification, and transformation did not show significant differences, educators who show interest in personally studying ICTs and those who receive training through seminars, webinars, conferences, or through diploma or graduate courses show higher levels of amplification, and those who train through diploma or graduate courses, furthermore, show the highest transformation scores. This suggests that training and exposure to digital technology strengthen the perception of an enhanced and transformed technological pedagogy (Alcontin, 2021).

4. Conclusion and Recommendations

The findings of this study reveal that the level of digital technology integration among high school educators in the Schools Division of Aklan was generally low across the replacement, magnification, and transformation dimensions of their instructional practices. While digital technologies were evidently available in the classroom, they were not being maximized and utilized to full advantage to influence technologically-responsive pedagogy or drive technologically-innovative teaching practices. Among the three dimensions of digital technology integration, amplification emerged as the most apparent; thus, educators utilize digital technologies mainly to improve the efficacy of existing instructional practices rather than to transition from traditional to technology-mediated instruction or reinvent the learning process through practice.

Differences in integration levels based on gender, educational attainment, type of school, years of teaching service, and relevant training in ICTs provided an insightful evaluation of the technology-integrated pedagogy in the Division. While male and early-career educators exercise a significantly higher degree of replacing their traditional practices with digital technology alternatives, and these early career educators utilize the available technologies to significantly increase the effectiveness, efficiency, or efficacy of their traditional practices through digital technology use, other grouping variables, i.e., type of school, educational attainment, and relevant training in ICTs do not substantially prove to indicate a significant advantage in technology integration, competence, or pedagogical innovation. Furthermore, confidence in, familiarity with, and even upskilling for digital technology may play a greater role in its integration in pedagogy. As digital technology is not fully integrated in the instructional practices among the high school educators in the Schools Division of Aklan, it is recommended that schools and educational leaders of both Department of Education and the Division strengthen their support systems to encourage more meaningful integration of digital technology in the classroom instruction, through professional development training, technology access and infrastructure, and digital collaboration.

Specifically, the professional development training that could be provided to educators may not only be confined to using the basic digital technologies, but also the application of these technologies to pedagogical practices and innovative decision-making that is geared towards creativity, critical thinking, student engagement, and collaboration. Aside from formal professional development training, educators may also benefit from short-term grassroots workshops, coaching sessions from head teachers, and peer mentoring from colleagues and instructional facilitators on digital technology use. While younger educators may already possess the skills and confidence, veteran and experienced educators may benefit from training initiatives where technological competence meets seasoned pedagogy through the sharing of technology-enabled best practices in teaching. Educators may well benefit from an efficient use of learning management systems that enhance access, communication, assessment, and collaboration among students. Training in the use of assessment and feedback tools, such as Kahoot, Quizizz, Google Forms, EdPuzzle, among others, may be useful for educators to focus on efficient grading, feedback, and data-driven instruction. Training in project-based digital tools, such as Canva, Padlet, and Adobe Express, may likewise fortify educators' integration of creativity, collaboration, and real-world application into their pedagogy. Ultimately, school and district leaders are enjoined to encourage and support educators to pursue tool-specific certification programs, like Google Certified Educator, Microsoft Innovative Educator, or Apple Teacher Program.

It is recommended that the Education department provide sustained and extensive technological infrastructure in schools with fundamental and substantial technical assistance, not only in urban public high schools but in rural public schools as well, where reliable internet and upgraded devices remain a challenge in availability and access. When the Department ensures that devices and internet connectivity are in place, equitable access to technological resources not only benefits the educators who need them in teaching but also provides students with a learning infrastructure that responds to the demands of 21st-century learning and helps minimize disparities between rural and urban schools. With partnerships with non-government organizations and grant institutions, technological pedagogy can best benefit from fiber-optics or long-term evolution broadband communications to overcome geographical limitations and internet-enabled devices and facilities, such as laptops, tablets, and their charging

carts, smart TVs, interactive and smart projector boards, as well as skilled information technology personnel and monitoring systems to secure these facilities.

School administrators are also encouraged to build and foster a culture of innovation, exploration, and collaboration. When schools recognize and honor the innovative teaching practices of schools and educators, it increases the motivation and validation of educators to explore and discover more ways to enhance the teaching of educators and the learning of students in the present digital scenarios, not just merely tools for classroom efficacy and productivity, but as a stimulus for redefining and revolutionizing the learning experience. Ultimately, when educators are provided with autonomy and agency, they can nurture their own creativity and confidence in digital pedagogy, without fear of failure or censure.

5. References

Abbasova, M. & Narmin, M. (2019, March). The role of digital technology in English language teaching in Azerbaijan. *International Journal of English Linguistics, 9*(2). https://doi.org/10.5539/ijel.v9n2p364.

Abedi, E.A. (2024). Tensions between technology integration practices of teachers and ICT in education policy expectations: implications for change in teacher knowledge, beliefs and teaching practices. *Journal of Computer Education, 11*, 1215–1234. https://doi.org/10.1007/s40692-023-00296-6.

Abella, J., & Dela Rosa, E. (2023 September). Digital literacy and digital competence of selected Filipino teachers: Basis for a post-pandemic pedagogy. *International Journal of Recent Educational Research, 4*(5), 548-569. https://doi.org/10.46245/ijorer.v4i5.378.

Adeoye, M. A. (2023, August). Gender differences in teachers' digital literacy skills in teaching STEAM. *Journal of Education Technology, 7*(3), 462-469.

Admiraal, W., Kittelsen Røberg, K. I., Wiers-Jenssen, J., & Saab, N. (2023, July). Mind the gap: Early-career teachers' level of preparedness, professional development, working conditions, and feelings of distress. *Social Psychology of Education, 26*, 1759–1787. https://doi.org/10.1007/s11218-023-09819-6.

Aduka, J. B. (2023, March). Technological and pedagogical literacy and challenges of teachers in information communication technology (ICT). *E-Saliksik*. https://e-saliksik.deped.gov.ph/wp-content/uploads/2023/05/CAR_2023_Aduca_Technological-and-Pedagogical-Literacy-and-Challenges-of-Teachers.pdf.

Afsal, A., Khan, S., Daud, S., Ahmad, Z., & Butt, A. (2023). Addressing the digital divide: Access and use of technology in education. Journal of Social Sciences Review, 3(2), 883-895. https://doi.org/10.54183/jssr.v3i2.326.

Akiri, E., & Dori, Y.J. (2022). Professional growth of novice and experienced STEM teachers. *Journal of Science Education and Technology, 31*, 129–142. https://doi.org/10.1007/s10956-021-09936-x.

Alabdulaziz, M.S. (2021). COVID-19 and the use of digital technology in mathematics education. *Education and Information Technologies,* 26, 7609–7633 https://doi.org/10.1007/s10639-021-10602-3.

Alberola-Mulet, I., Iglesias-Martínez, M. J., & Lozano-Cabezas, I. (2021, May). Teachers' beliefs about the role of digital educational resources in educational practice: A qualitative study. *Education Sciences, 11*(5), 239.

Alcontin, T. (2021, December). Philippines teachers' beliefs on digital teaching competence in post-pandemic recovery: Still prefer online? *Journal of Educational Management and Instruction, 1*(2), 71-82. https://doi.org/10.22515/jemin.v1i2.4287.

Ahiaku, P. K. A., Uleanya, C., & Muyambi, G. C. (2025, January). Rural schools and tech use for sustainability: the challenge of disconnection. *Education and Information Technologies, 30*, 12557–12571. https://doi.org/10.1007/s10639-024-13311-9.

Ahmad, N. S., & Rathakrishnan, M. (2025, March). Digital technology integration in teaching and learning among teachers in Kedah, Malaysia. *International Journal of Instruction Technology and Social Sciences, 4*:83-94. https://doi.org/10.47577/ijitss.v4i.144.

Agtarap, H. J., Januto, A. C., Aglibot, K. A., & Toquero, C. M. (2024). Assessment strategies and challenges of teachers in evaluating students during online learning. *Journal of Digital Educational Technology, 4*(2),

2418. https://doi.org/10.30935/jdet/14863.

Akram, H., Abdelrady, A. H., Al-Adwan, A. S., & Ramzan, M. (2022, June 5). Teachers' perceptions of technology integration in teaching-learning practices: A systematic review. *Frontiers in Psychology, 13*, 920317. https://doi.org/10.3389/fpsyg.2022.920317.

Alda, R., Boholano, H., & Dayagbil, F. (2020, August 31). Teacher education institutions in the Philippines towards education 4.0. *International Journal of Learning, Teaching and Educational Research, 19*(8).

Aleksieva, L., Racheva, V. & Peytcheva-Fosyth, R. (2025). Talking tech, teaching with tech: How primary teachers implement digital technologies in practice. *Informatics, 12*(3), 99; https://doi.org/10.3390/informatics12030099.

Ali, M. S. B., Yasmeen, R., & Munawar, Z. (2023, March). The impact of technology integration on student engagement and achievement in Mathematics education: A systematic review. I*nternational Journal of Computer Integrated Manufacturing 6*(3):222-232.

Almekhlafi, A. G., & Almeqdadi, F. A. (2010). Teachers' perceptions of technology integration in the United Arab Emirates school classrooms. *Educational Technology & Society*, *13*(1), 165-175. https://www.jstor.org/stable/jeductechsoci.13.1.165.

Alshammary, F., & Alhalafawy, W. (2023, January). Digital platforms and the improvement of learning outcomes: Evidence extracted from meta-analysis. *Sustainability, 15*(2), 1-21.

Althauser, K. (2014, January 10). Job-embedded professional development: its impact on teacher self-efficacy and student performance. *Teacher Development, 19*(2), 210–225. https://doi.org/10.1080/13664530.2015.1011346.

Amemasor, S. K., Oppong, S. O., Ghansah, B., Benuwa, B-B., & Essel, D. D. (2025, May 11). A systematic review on the impact of teacher professional development on digital instructional integration and teaching practices. *Frontiers in Education, 10*. https://doi.org/10.3389/feduc.2025.1541031.

Amirova, A., Nurumov, K., Kasa, R., Akhmetzhanova, A., & Kuzekova, A. (2023, January 9). The impact of the digital divide on synchronous online teaching in Kazakhstan during COVID-19 school closures. *Frontiers in Education, 7*. https://doi.org/10.3389/feduc.2022.1083651.

Arhin, J., Boateng, F. O., Akosah, E. F., & Gyimah, K. (2024). Perceptions and readiness of high school mathematics teachers for integration of ICT tools in the teaching and learning of mathematics. *Pedagogical Research, 9*(1). https://doi.org/10.29333/pr/14032.

Ayite, D. M. K., Aheto, S. P. K., & Nyagorme, P. (2022). Gender dimensions of emerging technologies for learning in a University. *Cogent Social Sciences*, *8*(1). https://doi.org/10.1080/23311886.2022.2071389.

Balalle, H. (2024). Exploring student engagement in technology-based education in relation to gamification, online/distance learning, and other factors: A systematic literature review. *Social Science & Humanities Open, 9*(100870). https://doi.org/10.1016/j.ssaho.2024.100870.

Bansal, S. K. (2023, December 13). Significance and advancement of the educational technology: Holistic development of learners in the digital age. *SSRN*. http://dx.doi.org/10.2139/ssrn.4863716.

Bay, D. N. (2022). The perspective of preschool teachers on the use of digital technology. *Southeast Asia Early Childhood Journal, 11,* 87-111. https://doi.org/10.37134/saecj.vol11.2.6.2022.

Baylen, D. M., & Junsay, M. L. (2022). An inquiry into K-12 graduates' technology use and skills in the Philippines. *International Journal for Educational Media and Technology*, *16*(2), 77-85.

Bećirović, S., Brdarević-Čeljo, A., & Delić, H. (2021). The use of digital technology in foreign language learning. *SN Social Science, 1,* 246. https://doi.org/10.1007/s43545-021-00254-y.

Blundell, C., Lee, K., & Nykvist, S. (2020). Moving beyond enhancing pedagogies with digital technologies: Frames of reference, habits of mind and transformative learning. *Journal of Research on Technology in Education, 52*(2): 178-196. https://doi.org/10.1080/15391523.2020.1726235.

Borba, M., Chiari, A. S., & de Almeida, H. (2018, July). Interactions in virtual learning environments: new roles for digital technology. *Education Studies in Mathematics, 98*(5). https://doi.org/10.1007/s10649-018-9812-9.

Bowman, M. A., Vongkulluksn, V. W., Jiang, Z., & Xie, K. (2020). Teachers' exposure to professional development and the quality of their instructional technology use: The mediating role of teachers' value

and ability beliefs. *Journal of Research on Technology in Education*, *54*(2), 188–204. https://doi.org/10.1080/15391523.2020.1830895.

Bui, T. H. (2022). English teachers' integration of digital technologies in the classroom. *International Journal of Educational Research Open, 3*. https://doi.org/10.1016/j.ijedro.2022.100204.

Bustillo, E., & Aguilos, M. (2022). The challenges of modular learning in the wake of COVID-19: A digital divide in the Philippine countryside revealed. *Education Sciences, 12*(7): 449. https://doi.org/10.3390/educsci12070449.

Cadornigara, M. (2025). Digital technology: Level of replacement, amplification, and transformation of instructional practices among Filipino-American educators. *International Journal of Research Studies in Education, 14*(5), 57-75. https://doi.org/10.5861/ijrse.2025.25846.

Cai, Z, Fan, X., & Du, J. (2017). Gender and attitudes toward technology use: A meta-analysis. *Computers and Education, 105*, 1-13. https://doi.org/10.1016/j.compedu.2016.11.003.

Campos, D.G., & Scherer, R. (2024, November 13). Digital gender gaps in students' knowledge, attitudes and skills: An integrative data analysis across 32 countries. *Education and Information Technologies, 29*, 655–693 (2024). https://doi.org/10.1007/s10639-023-12272-9.

Caoile, A. A., Baes, J. O., & Naparota, L. C. (2025). Technology integration, teaching effectiveness and teachers' performance in Sirawai District Schools Division of Zamboanga del Norte, Philippines. *European Journal of Education Studies, 12*(1). http://dx.doi.org/10.46827/ejes.v12i1.5753.

Carstens, K. J., Mallon, J. M., Bataneih, M., & Al-Bataneh, A. (2021, January). Effects of technology on student learning. *The Turkish Online Journal of Educational Technology, 20*(1). https://files.eric.ed.gov/fulltext/EJ1290791.pdf.

Ceballos, X. D. (2024, August 31). Philippine public schools lag in internet, computer access compared to Asian peers. *Manila Bulletin*. https://mb.com.ph/2024/8/31/article-2676pidsphpublicschoolsamonglow internetcomputeraccessinasia.

Celeste, R. J. C., & Osias, N. (2024, June). Challenges and implementation of technology integration: Basis for enhanced instructional program. *American Journal of Arts and Human Sciences, 3*(2), 106-130. https://doi.org/10.54536/ajahs.v3i2.2656.

Çelik, F., & Baturay, M. H. (2024, November 20). Technology and innovation in shaping the future of education. *Smart Learning Environments, 11*(54). https://doi.org/10.1186/s40561-024-00339-0.

Chao, G. M. (2015). Impact of teacher training on information communication technology integration in public secondary schools in Mombasa County. *Human Resource Management Research 2015, 5*(4): 77-94. http://doi.org/10.5923/j.hrmr.20150504.01.

Chirimbana, M., Nghipandulwa, L. L. T., & Shikusho, S. P. (2022, July). Investigating the challenges faced by teachers in the implementation of digital technology in secondary schools in Rundu Circuit, Kavango East Region Namibia. *International Research in Higher Education, 7*(1), 23. https://doi.org/10.5430/irhe.v7n1p23.

Chukwuemeka, E. J., & Samaila, D. (2020). Teachers' perception and factors limiting the use of high-tech assistive technology in special education schools in North-West Nigeria. *Contemporary Educational Technology, 11*(1), 99-109. https://doi.org/10.30935/cet.646841.

Colegado, J. C. (2025). Digital innovations in science education in the Philippines: A scoping review of teaching practices and tools. *International Journal of Research and Innovation in Social Science.* https://dx.doi.org/10.47772/IJRISS.2025.903SEDU0479.

Davies, R. S., & West, R. E. (2014). Technology integration in schools. In J. M. Spector, M. D. Merrill, J. Elen, & M. J. Bishop (Eds.), *Handbook of research on educational communications and technology* (pp. 841–853). Springer. https://doi.org/10.1007/978-1-4614-3185-5_68.

Dele-Ajayi, O., Fasae, O.D., & Okoli, A. (2021, May). Teachers' concerns about integrating information and communication technologies in the classrooms. *PLoS One, 16*(5), 0249703. https://doi.org/10.1371/journal.pone.0249703.

De Vera, J. L., Andrada, M. D., Bello, A. Q., & De Vera, M. G. D. (2021, June). Teachers' competencies in educational technology integration on instructional methodologies in the new normal. *Lukad: An Online*

Journal of Pedagogy, 1(1), 63-84. https://lukad.org/wp-content/uploads/2021/07/volume1_ _issue1_devera_et_al_June2021.pdf.

Del Mundo, H. J. (2022, May 5). 21st Century digital skills, technology integration in instruction and challenges encountered by senior high school teachers in Muntinlupa National High School. *International Journal of Multidisciplinary Research and Analysis, 5*(5), 1169-1182. https://doi.org/10.47191/ijmra/v5-i5-35.

Dyrvold, A., & Bergvall, I. (2023). Static, dynamic and interactive elements in digital teaching materials in mathematics: How do they foster interaction, exploration and persistence?. *LUMAT: International Journal on Math, Science and Technology Education, 11*(3), 103–131. https://doi.org/10.31129/LUMAT.11.3.1941.

El Ouaddane, K., El Morabit, N., Oumaira, I., & Chekour, M. (2025). The impact of digital skills on university students' motivation: A systematic review. *Educational Process: International Journal, 17*, e2025384. https://doi.org/10.22521/edupij.2025.17.384.

Engel, O., Zimmer, L. M., Lörz, M., & Mayweg-Paus, E. (2023). Digital studying in times of COVID-19: teacher- and student-related aspects of learning success in German higher education. *International Journal of Educational Technology in Higher Education, 20*(12). https://doi.org/10.1186/s41239-023-00382-w.

Facer, K., & Selwyn, N. (2021). *Digital Technology and the Futures of Education: Towards 'Non-Stupid' Optimism*. UNESCO. https://unesdoc.unesco.org/ark:/48223/pf0000377071.

Figueroa, P. A. (2024). Teachers' utilization of digital resources and students' performance in a research project: Basis for research teacher training workshop. Proceedings of the International Conference on Education and Business (ICEB). *Asia Pacific Journal of Advanced Education and Technology*. https://www.apjaet.com/wp-content/ uploads/2024/08/Teachers-Utilization-of-Digital-Resources-and-Students-Performance-in-a- Research-Project.pdf.

Fitria, H., & Suminah, S. (2020). Role of teachers in the digital instructional era. *Journal of Social Work and Science Education, 1*(1), 70-77. https://doi.org/10.52690/jswse.v1i1.11.

Frolova, E. V., Ryabova, T. M., & Rogach, O. V. (2019). Digital technologies in education: Problems and prospects for Moscow Electronic School project implementation. *European Journal of Contemporary Education*, *8*(4), 779-789.

Fuentes, R. P., & LaBad, R. (2025, July 26). Impact of digital learning tools on student engagement and academic achievement in higher education: A systematic review. *Ennoia Advances in Social Science, Technology and Education, 1*(1). https://doi.org/10.5281/zenodo.16430142.

Garcia, E. C. (2025, March). Teacher training and support, classroom management strategies, and innovative teaching methods in junior high school Science education. *Asia Pacific Journal of Management and Sustainable Development, 13*(1), 17-29. https://doi.org/10.70979/ODVW4459.

Gebhardt, E., Thomson, S., Ainley, J., Hillman, K. (2019, September 14). Introduction to gender differences in computer and information literacy. *Gender Differences in Computer and Information Literacy*. *IEA Research for Education, 8*. Springer, Cham. https://doi.org/10.1007/978-3-030-26203-7_1.

Getenet, S., Cantle, R., Redmond, P., & Albion, P. (2024). Students' digital technology attitude, literacy and self-efficacy and their effect on online learning engagement. *International Journal of Educational Technology in Higher Education, 21*. Article 3. https://doi.org/10.1186/s41239-023-00437-y

Ghavifekr, S., & Rosdy, W. A. W. (2015). Teaching and learning with technology: Effectiveness of ICT integration in schools. *International Journal of Research in Education and Science, 1*(2), 175-191.

Ghavifekr, S., Kunjappan, T., Ramasamy, L., &Anthony, A. (2016). Teaching and learning with ICT tools: Issues and challenges from teachers' perceptions. *Malaysian Online Journal of Educational Technology, 4*(2), p38-57. https://eric.ed.gov/?id=EJ1096028.

Giac, C. C., Giang, C. T. V., Hoang, L. H., Ngan, T. T. T. (2025, February 6). A study on teachers' acceptance of digital technology in Vietnamese secondary education: An assessment using the Technology Acceptance Model. *International Journal of Learning, Teaching and Educational Research, 24*,(2), 38-62. https://doi.org/10.26803/ijlter.24.2.3.

Goles, C., Sanchez, J. M., Sumalinog, G., Mananay, J., & Alejandro, I. M. (2023, November 21). Beyond the

pandemic: The changing landscape of technology integration in higher education in Central Visayas, Philippines. *CTU Journal of Innovation and Sustainable Development, 16*(1), 150-159. https://doi.org/10.22144/ctujoisd.2024.262.

Gomez, F. C., Trespalacios, J., Hsu, Y. C., & Yang, D. (2021, August). Exploring teachers' technology integration self-efficacy through the 2017 ISTE Standards. *TechTrends, 66*(2). https://doi.org/10.1007/s11528-021-00639-z.

Gómez-Trigueros, I. M. (2023, April). Digital skills and ethical knowledge of teachers with TPACK in higher education. *Contemporary Educational Technology, 15*(2). https://doi.org/10.30935/cedtech/12874.

Gomez-Trigueros, I. M. & Yañez de Aldecoa, C. (2021). The digital gender gap in teacher education: The TPACK framework for the 21st century. *European Journal of Investigative Health, Psychology and Education, 11*(4), 1333–1349.

Gómez-Trigueros, I. M., Ruiz-Bañuls, M., Esteve-Faubel, J. M., & León, F. M. (2024). Teacher motivation: Exploring the integration of technology and didactics in the narratives of future teachers. *Social Sciences, 13*(4), 217. https://doi.org/10.3390/socsci13040217.

Goreth, S., & Vollmer, C. (2022, August 11). Gender does not make the difference: Interest in STEM by gender is fully mediated by technical socialization and degree programs. *International Journal of Technology and Design Education, 33*, 1675-1697. https://doi.org/10.1007/s10798-022-09772-z.

Gottschalk, F., & Weise, C. (2023). Digital equity and inclusion in education: An overview of practice and policy in OECD countries. *Organisation for Economic Co-operation and Development, 14*. https://one.oecd.org/document/EDU/WKP(2023)14/en/pdf.

Guaña-Moya, J., Arteaga-Alcívar, Y., Criollo, S., & Cajamarca-Carrazco, D. (2024). Use of interactive technologies to increase motivation in university online courses. *Education Sciences, 14*(12), 1406; https://doi.org/10.3390/educsci14121406

Guillén-Gámez, F. D., & Rodríguez-Fernández, R. (2022, January). Meta-analysis on the attitudes of active teachers about the use of educational technology according to gender. *Contemporary Educational Technology, 14*(1). https://doi.org/10.30935/cedtech/11408

Gul, F., Yousaf, A., Masood, S., & Yaqub, S. (2021). Relationship between teachers' professional development, instructional strategies and its impact on students' learning outcomes. *Elementary Education Online, 19*(4), 5107–5114. https://ilkogretim-online.org/index.php/pub/article/view/5870

Gul, S., & Bano, S. (2019). Smart libraries: an emerging and innovative technological habitat of 21st century. *The Electronic Library*, 37(5), 764-783. https://doi.org/10.1108/EL-02-2019-0052

Hafeez, M., Naz, V., & Tahira, F. (2025). Analysis of teachers' technological competencies and their performance at higher education level. *Jurnal Cakrawala Pendidikan, 44*(2). https://doi.org/10.21831/cp.v44i2.70976

Haidir, N. K. H. (2023, November). Bridging the gap: How technology integration is transforming the classroom experience. *International Journal of English Language and Pedagogy*, *1*(2), 100-109. https://doi.org/10.33830/ijelp.v1i2.6502

Haleem, A., Javaid, M., Qadri, M. A., & Suman, R. (2022). Understanding the role of digital technologies in education: A review. *Sustainable Operations and Computers, 3*, 275-285. https://doi.org/10.1016/j.susoc.2022.05.004

Handrayani, D. (2022, November 10–13). Teachers' problems and challenges in conducting online assessment. In A. Ben Attou, M. L. Ciddi, & M. Unal (Eds.), *Proceedings of the International Conference on Studies in Education and Social Sciences (ICSES 2022)* (pp. 1–13). ERIC.

Hero, J. L. (2019). The impact of technology integration in teaching performance. *International Journal of Sciences: Basic and Applied Research, 48* (1), 101-114.

Horrigan, J. B. (2016, September 20). Digital readiness gap. *The Pew Research Center.* https://www.pewresearch.org/internet/2016/09/20/digital-readiness-gaps/.

Hushin, H. (2025, March). Increasing global access to education with digital technology. *International Journal of Education and Digital Learning, 3*(4), 167-176. https://doi.org/10.47353/ijedl.v3i4.259

Hussain, M., Qureshi, Z. M., & Malik, S. (2024). The impact of educational technologies on modern education:

Navigating opportunities and challenges. *Global Educational Studies Review, 9*(3), 21–30. https://doi.org/10.31703/gesr.2024(IX-III).03

Ibrahim, S. M., & Husnin, H. (2025, April 27). Challenges of integrating digital technology based teaching among secondary school teachers in Petaling Perdana. *International Journal of Academic Research in Business and Social Sciences, 15*(4), 1311-1324. http://dx.doi.org/10.6007/IJARBSS/v15-i4/25341

Imran, M., Almusharraf, N., & Abbasova, M. Y. (2025). Digital learning transformation: A study of teachers' post-Covid-19 experiences. *Social Sciences & Humanities Open, 11*, 101228. https://doi.org/10.1016/j.ssaho.2024.101228

Iqbal, S., & Ali, A. (2024, March 26). Education and professional development: Opportunities and challenges for inservice teachers: A review. *Gomal University Journal of Research, 40*(1). http://gujr.com.pk/index.php/GUJR/article/view/1660

Jamias, A. F. B., Flor, B., Jamias, S., & Dizon, J. (2022). Digital literacy enhancement of rural women in Luna, Apayao, Philippines. *Silliman Journal, 58*(1). https://sillimanjournal.su.edu.ph/index.php/sj/article/view/62

Johnson, A. M., Jacovina, M. E., Russell, D. E., & Soto, C. M. (2016). Challenges and solutions when using technologies in the classroom. In S. A. Crossley & D. S. McNamara (Eds.), *Adaptive educational technologies for literacy instruction* (pp. 13–29). Taylor & Francis.

Jones, S., & Procter, R. (2023). Young peoples' perceptions of digital, media and information literacies across Europe: gender differences and the gaps between attitudes and abilities. *Technology, Pedagogy and Education*, *32*(4), 435–456. https://doi.org/10.1080/1475939X.2023.2210152

Julita, W., & Zulyusri, Z. (2023). Analysis of the importance of enhancing the qualifications of Biology teachers as professional educators in the 21st-century digital era. *Journal of Digital Learning and Education*, *3*(2), 117-128. https://doi.org/10.52562/jdle.v3i2.744

Jurane-Bremane, A. (2021, November). The digital transformation of assessment: Challenges and opportunities. *Human, Technologies and Quality of Education*. https://doi.org/10.22364/htqe.2021.25

Kabaran, G. G., & Uşun, S. (2021). Evaluation of the professional development program in digital material design according to Kirkpatrick's model. *International Journal of Curriculum and InstructionalStudies, 11*(*1*), 65-88, https://doi.org/10.31704/ijocis.2021.004

Kalimullina, O., Tarman, B., & Stepanova, I. (2021). Education in the context of digitalization and culture. *Journal of Ethnic and Cultural Studies*, *8*(1), 226-238. https://www.jstor.org/stable/48710281

Kaminskienė, L., Järvelä, S., & Lehtinen, E. (2022, December). How does technology challenge teacher education? *International Journal of Educational Technology in Higher Education, 19*(1). https://doi.org/10.1186/s41239-022-00375-1

Kim, K., Kang, Y., & Kim, G. (2017). The gap between medical faculty's perceptions and use of e-learning resources. *Medical Education Online, 22*(1). https://doi.org/10.1080/10872981.2017.1338504

Klain Gabbay, L. K. (Ed.). (2024). *Aspects of digital libraries- Digitization, standards, open access, repositories and user's skills. IntechOpen*. dx.doi.org/10.5772/intechopen.1000554

Kmecová, I. (2020). Digitization, digital technology, and importance of digital technology in teaching. In S. Ashmarina, M. Vochozka, & V. Mantulenko (Eds.), *Digital age: Chances, challenges and future* (Lecture Notes in Networks and Systems, Vol. 84). Springer. https://doi.org/10.1007/978-3-030-27015-5_63

Kormos, E., & Wisdom, K. (2023, January 19). Digital divide and teaching modality: It's role in technology and instructional strategies. *Education and Information Technologies*, *28*, 9985-10003. https://doi.org/10.1007/s10639-022-11488-5

Kosiol, T., & Ufer, S. (2024, December). Teachers' self-reported and actual content-related TPACK – new results on their relation and gender differences. *Computers and Education Open*, 7. https://doi.org/10.1016/j.caeo.2024.100205

Laufer, M., Leiser, A., Deacon, B., Perrin de Brichambaut, P., Fecher, B., Kobsda, C., & Hesse, F. (2021). Digital higher education: a divider or bridge builder? Leadership perspectives on edtech in a COVID-19 reality. *International Journal of Educational Technology in Higher Education, 18*, 51.

https://doi.org/10.1186/s41239-021-00287-6

Lattuca, L., Bergom, I., & Knight, D. (2014, September 19). Professional development, departmental contexts, and use of instructional strategies. *The Research Journal for Engineering Education.* https://doi.org/10.1002/jee.20055

Lei, H., & Jiang, Z. (2025). Assessing the digital competence and its influencing factors among foreign language teachers in Chinese universities. *Humanities and Social Sciences Communications, 12*(966). https://doi.org/10.1057/s41599-025-05394-7

Li, M. (2024, July 12). Exploring the digital divide in primary education: A comparative study of urban and rural mathematics teachers' TPACK and attitudes towards technology integration in post-pandemic China. *Education and Information Technologies, 30*, 1913–1945. https://doi.org/10.1007/s10639-024-12890-x

Li, S., Jiao, F., Zhang, Y., & Xu, X. (2019). Problems and changes in digital libraries in the age of big data from the perspective of user services. *The Journal of Academic Librarianship, 45*(1), 22-30. https://doi.org/10.1016/j.acalib.2018.11.012

Li, S., Liu, Y., and Su, Y. (2022, June). Differential analysis of teachers' Technological Pedagogical Content Knowledge (TPACK) abilities according to teaching stages and educational levels, *Sustainability, 14*(12), 1-15.

Li, S., Yamaguchi, S., Sukhbaatar, J., &Takada, J. (2019, April 12). The influence of teachers' professional development activities on the factors promoting ICT integration in primary schools in Mongolia. *Education Sciences, 9*(2), 78.https://doi.org/10.3390/educsci9020078

Lopez, L. S., Agustin, L. V., Bag-oyen, R. A., Calado, A. B, & Bautista, R. G. (2022). Are our teachers ready in going online? *American Journal of Educational Research, 10*(4), 201-207.

Lynch, M. (2023, January 18). RAT model: Everything you need to know. *The Edvocate.* https://www.theedadvocate.org/rat-model-everything-you-need-to-know/

Mah, D.-K., & Groß, N. (2024). Artificial intelligence in higher education: exploring faculty use, self-efficacy, distinct profiles, and professional development needs. *International Journal of Educational Technology in Higher Education, 21*(58). https://doi.org/10.1186/s41239-024-00490-1

Mahawan, A. M., De Guzman, M. D. , Delavin, E. A., & Celedonio, M. A. (2025). Gender mainstreaming in ICT education: Exploring teachers' competence in selected academic institutions in Masbate, Philippines. *Pakistan Journal of Life and Social Sciences, 23*(1): 6318-6334. https://doi.org/10.57239/PJLSS-2025-23.1.00492

Mananay, J., Sanchez, J. M., Sumalinog, G., Goles, C., & Alejandro, I. M. (2024). Factors affecting technology use in teaching functions in higher education institutions: A regression analysis. *Journal of Education and Innovation, 26*(3), 46–58.

Marin, V. I., & Tur, G. (2024, May). Ethical issues in the use of technologies in education settings: A scoping review. *Education in the Knowledge Society, 25*. https://doi.org/10.14201/eks.31301

Marín, Y. R., Cruz Caro, O., Maicelo Rubio, Y., Alva Tuesta, J. N., Sánchez Bardales, E., Carrasco Rituay, Á. M., & Chávez Santos, R. (2025). Artificial intelligence as a teaching tool in university education. *Frontiers in Education, 10*. https://doi.org/10.3389/feduc.2025.1578451

Marrero Galván, J. J., Negrín Medina, M. A., Bernárdez-Gómez, A., & Portela Pruaño, A. (2023, April 19). The impact of the first millennial teachers on education: views held by different generations of teachers. *Education and Information Technologies, 28*, 14805–14826. https://doi.org/10.1007/s10639-023-11768-8

Masry-Herzallah, A. (2025, February 19). TPACK, technological self-efficacy, gender, and online teaching effectiveness: Insights from the COVID-19 crisis. *Humanities and Social Sciences Communications, 12* (227). https://doi.org/10.1057/s41599-025-04546-z

Mâţă, L. (2022, January). Ethical use of information technology in higher education. *Springer Innovations in Communications and Computing*. https://www.researchgate.net/publication/357486160_Ethical_Use_of_Information_Technology_in_Higher_Education.

Mathebula, N. Z., Moila, O., Maile, S., & Mnisi, S. (2025). Inadequate teacher training as a barrier to ICT integration in early childhood education: A case of selected primary schools in Tshwane West District

Circuit 4. *International Journal of Learning, Teaching and Educational Research, 4*(23) https://doi.org/10.26803/ijlter.24.3.3

Mercader, C. (2020). Explanatory model of barriers to integration of digital technologies in higher education institutions. *Education and Information Technologies, 25*, 5133–5147. https://doi.org/10.1007/s10639-020-10222-3

Mercader, C., & Gairín, J. (2020, March 9). University teachers' perception of barriers to the use of digital technologies: the importance of the academic discipline. *International Journal of Educational Technology in Higher Education, 17*(4). https://doi.org/10.1186/s41239-020-0182-x

Mexhuani, B. (2024, October 27). Adopting digital tools in higher education: Opportunities, challenges and theoretical insights. *European Journal of Education*. https://doi.org/10.1111/ejed.12819

Meyerink, M., & Luo, F. (2025). K-8 pre-service teachers' technology integration in Mathematics: Perspectives and anticipated practices. *Journal of Research in Science, Mathematics and Technology Education, 8*(SI), 195-227. https://doi.org/10.31756/jrsmte.4112SI

Mhlongo, S., Mbatha, K., Ramatsetes, & Dlamini, R. (2023, June). Challenges, opportunities, and prospects of adopting and using smart digital technologies in learning environments: An iterative review. *Systematic Review and Meta-Analysis, 9*(6). https://doi.org/10.1016/j.heliyon.2023.e16348

Miller, M. J. (2021, November 15). The microprocessor at 50: How the 4004 changed the world. *PC Mag*. https://www.pcmag.com/news/how-the-4004-changed-the-world

Mishra, P., & Koehler, M. J. (2006). Technological Pedagogical Content Knowledge: A framework for teacher knowledge. *Teachers College Record, 108*(6), 1017–1054. https://doi.org/10.1111/j.1467-9620.2006.00684.x

Mission, R. M., Mission II, V. V., & Medenceles, R. Y. (2021). Educational technology utilization and effectiveness in public elementary schools in District I, Isabela, Negros Occidental, Philippines. *Journal of Multidisciplinary in Social Sciences, 17*(1), 58-66.

Moreira-Choez, J. S., Lamus de Rodríguez, T. M., Arias-Iturralde, M. C., Vega-Intriago, J. O. Mendoza-Fernandez, V. M., Zambrano-Acosta, J. M., & Cardenas-Hinojosa, R. D. (2024, August 20). Influence of gender and academic level on the development of digital competencies in university teachers: a multidisciplinary comparative analysis. *Frontiers in Education, 9*. https://doi.org/10.3389/feduc.2024.1436368

Mpuangnan, K. N. (2024). Teacher preparedness and professional development needs for successful technology integration in teacher education. *Cogent Education*, *11*(1). https://doi.org/10.1080/2331186X.2024.2408837

Mustafa, F., Nguyen, H. T. M., & Gao, X. (2024). The challenges and solutions of technology integration in rural schools: A systematic literature review. *International Journal of Educational Research, 126*(102380). https://doi.org/10.1016/j.ijer.2024.102380

Nkoala, M., Magoda, Z., Makwambeni, B. Mshayisa, V., & Mugobo, V. (2023). Use of digital tools for social engagement in remote learning during the COVID-19 pandemic: A case study of a South African university. *International Journal of Education and Development using Information and Communication Technology, 19*(1), 61-79.

Oguezue, N. K. (2025). Unveiling teacher competence: A mixed-method exploration of technology integration in upper-basic education in Nigeria. *Indonesian Society for Science Educator, 8*(1), 50-67.

Okoye, K., Hussein, H., Arrona-Palacios, A., Quintero, H. N., Ortega, L. O. P., Sánchez, A. L., Ortiz, E. A., Escamilla, J., & Hosseini, S. (2023). Impact of digital technologies upon teaching and learning in higher education in Latin America: an outlook on the reach, barriers, and bottlenecks. *Education and Information Technologies, 28*, 2291–2360. https://doi.org/10.1007/s10639-022-11214-1

Oliver, C. (2022). Digital divide on emergent readers in the Last Mile Schools. *American Journal of Interdisciplinary Research and Innovation, 1*(1).https://doi.org/10.54536/ajiri.v1i1.460

Palomares-Ruiz, Cebrián, A., López-Parra, E., & García-Toledano, E. (2020). ICT integration into science education and its relationship to the digital gender gap. *Sustainability, 12*(13), 5286. https://doi.org/10.3390/su12135286

Paniagua, A., & Sánchez-Martí, A. (2018). Early career teachers: Pioneers triggering innovation or compliant professionals? OECD education working papers No. 190. *OECD Publishing*. https://www.oecd.org/content/dam/oecd/en/publications/reports/2018/12/early-career-teachers_b75662c3/4a7043f9-en.pdf

Pedida, S. B., & Diaz, R. M. H. (2023). Plights of tenured teachers in integrating technology in classroom instruction - A phenomenological inquiry. *American Journal of Multidisciplinary Research and Innovation*, *2*(6), 1–20. https://doi.org/10.54536/ajmri.v2i6.1793

Pelila, J. R. O., Bag-ongan, Q. F. L., Talania, J. L., & Wakat, G. S. (2022). Factors and barriers influencing technology integration in the classroom. *Journal of Language Education and Educational Technology, 7*(1). https://doi.org/10.33772/jleet.v7i1.18704

Peña, P. J. M., & Yao, V. E. C. (2022, August 25). DigitALL for her: Futurecasting platform work for women in rural Philippines. Discussion Paper DP 2022-24. *Philippine Institute for Development Studies*. https://doi.org/10.62986/dp2022.24

Perez, E. G. (2023). Effects of virtual tools in teaching: The case of Commonwealth High School, Quezon City Philippines. *AIDE Interdisciplinary Research Journal, 2*(1). https://doi.org/10.56648/aide-irj.v2i1.23

Pérez Echeverría, M., Cabellos, B. & Pozo, J. I. (2025). The use of ICT in classrooms: The effect of the pandemic. *Education and Information Technology, 30*, 14069–14093.https://doi.org/10.1007/s10639-024-13124-w

Pinto, M. & Leite, C. (2020). Digital technologies in support of students' learning in higher education. *Digital Education Review*, *37*, 343-360. https://dialnet.unirioja.es/servlet/articulo?codigo=7615204

Plantado, J. C. (2023). Usage of classroom technology and the Technological Pedagogical Content Knowledge (TPACK) of Mathematics teachers. *Southeast Asia Mathematics Education Journal, 13*(1). https://journal.qitepinmath.org/index.php/ seamej/article/ view/175

Policarpio, R. J., & Magpantay, E. (2024). The impact of digital access and literacy on women's e-commerce adoption in the Philippines. *Universal Journal of Science and Technology, 3*(2), 53–69.https://ujost.org/index.php/journal/article/view/154

Pongsakdi, N., Kortelainen, A., & Veermans, M. (2021, February 11). The impact of digital pedagogy training on in-service teachers' attitudes towards digital technologies. *Education and Information Technologies, 26*, 5041–5054. https://doi.org/10.1007/s10639-021-10439-w

Pozo, J. I., Pérez-Echeverría, M. P., Cabellos, B., & Sánchez, D. L. (2021, April 29). Teaching and learning in times of COVID-19: Uses of digital technologies during school lockdowns. *Frontiers in Psychology, 12*, 656776. https://doi.org/10.3389/fpsyg.2021.656776

Prosper, A. (2024). Gender and digital technology use in higher education: A case study of distance learners in Tanzania. *Journal of Research Innovations and Implications in Education, 8*(4), 623-631. https://doi.org/10.59765/v84hyt

Puentedura, R. R. (2006). *Transformation, technology, and education.* https://hippasus.com/resources/tte/puentedura_tte.pdf

Qazi, A., Hasan, N., Abayomi-Alli, O., Hardaker, G., Scherer, R., Sarker, Y., Paul, S. K., & Maitama, J. Z. (2021). Gender differences in information and communication technology use & skills: A systematic review and meta-analysis. *Education and Information Technologies, 27*, 4225-4258. https://doi.org/10.1007/s10639-021-10775-x

Raave, D. K., Saks, K., Pedaste, M., & Roa, E. R. (2024). How and why teachers use technology: Distinct integration practices in K-12 education. *Education Sciences, 14*(12), 1301. https://doi.org/10.3390/educsci14121301

Raygan, A., & Moradkhani, S. (2020). Factors influencing technology integration in an EFL context: investigating EFL teachers' attitudes, TPACK level, and educational climate. *Computer Assisted Language Learning, 35*(8), 1789–1810. https://doi.org/10.1080/09588221.2020.1839106

Read, M. (2022). RAT. *EdTechnica*. https://www.semanticscholar.org/paper/RATRead/

Reyes, J. D. C. (2023, July). Teachers' ability, attitude, and acceptance towards distance learning. *Journal of Digital Educational Technology, 3*(2), 2307.https://doi.org/10.30935/jdet/13349

Richard, K., & Julian, N. (2024, April). Ethical dimensions of ICT integration in higher education: A comprehensive review. *Newport International Journal of Engineering and Physical Sciences, 4*(2), 1-9. https://doi.org/10.59298/NIJEP/2024/421922.2.2200

Riyanda, A. R., Dewi, I. P. D., Jalinus, N., Ahyanuardi, Sagala, M. K., Rinaldi, R. A., Prasetya, R. A., & Yanti, F. (2025). Digital skills and technology integration challenges in vocational high school teacher learning. *Data and Metadata, 4*. https://doi.org/10.56294/dm2025553

Rodrigues, A. L., Cavaco, C., & Pereira, C. (2024). Exploring generative AI tools in higher education: insights for policies. *Journal of e-Learning and Knowledge Society, 21*(2).

Ruggiero, D., & Mong, C. J. (2015). The teacher technology integration experience: Practice and reflection in the classroom. *Journal of Information Technology Education Research, 14*, 161-178.

Šabić, J., Baranović, B., & Rogošić, S. (2021, June). Teachers' self-efficacy for using information and communication technology: The interaction effect of gender and age. *Informatics in Education, 21*(2). doi:10.15388/infedu.2022.11

Sahu, R. P., & Bankira, S. (2025). Digital pedagogy in classroom teaching: Variation in relation to gender, year of teaching experience and location of school. *i-manager's Journal of Educational Technology, 22*(1), 32-43. https://doi.org/10.26634/jet.22.1.21650

Salas-Pilco, S. Z., Xiao, K., & Hu, X. (2022). Artificial Intelligence and learning analytics in teacher education: A systematic review. *Education Science, 12*(8), 569. https://doi.org/10.3390/educsci12080569

Sarker, M. N. I., Wu, M., Cao, Q., Alam, G. M., & Li, D. (2019, July). Leveraging digital technology for better learning and education: A systematic literature review. *International Journal of Information and Education Technology, 9*(7). https://doi.org/10.18178/ijiet.2019.9.7.1246

Scherer, R., Siddiq, F., Howard, S. K., & Tondeur, J. (2023, July). Gender divides in teachers' readiness for online teaching and learning in higher education: Do women and men consider themselves equally prepared? *Computer and Education, 199*. https://doi.org/10.1016/j.compedu.2023.104774

Selfa-Sastre, M., Pifarré, M., Cujba, A., Cutillas, L., & Falguera, E. (2022). The role of digital technologies to promote collaborative creativity in language education. *Frontiers in Psychology, 13*, 828981. https://doi.org/10.3389/fpsyg.2022.828981

Shalgimbekova, K., Smagliy, T., Kalimzhanova, R., & Suleimenova, Z. (2024). Innovative teaching technologies in higher education: efficiency and student motivation. *Cogent Education, 11*(1). https://doi.org/10.1080/2331186X.2024.2425205

Shanmugasundaram, M., & Tamilarasu, A. (2023, November 23). The impact of digital technology, social media, and artificial intelligence on cognitive functions: a review. *Frontiers in Cognition, 2*. https://doi.org/10.3389/fcogn.2023.1203077

Sibomana, J. P., & Ndayambaje, I. (2024). Teachers' professional development and job performance in public secondary schools of Kicukiro District, Rwanda. *African Journal of Empirical Research, 5*(3), 444-459.

Siddiq, F., & Scherer, R. (2019, June). Is there a gender gap? A meta-analysis of the gender differences in students' ICT literacy. *Educational Research Review, 27*, 205-217. https://doi.org/10.1016/j.edurev.2019.03.007

Silva, A. A. U., Farias, R. S., Silva, A. C. G., Sousa, T. S. R., Xavier, R. M. L., Araujo, J. C., Lima, L. F., Fagundes, E. C., Braz, K. A., Campelo, K. A., Silva, E. J. C., Silva, L. V., Figueiroa, S. L. S. (2024, September-October). The impact of digital technologies on education: Opportunities and challenges. *IOSR Journal of Research & Method in Education, 14*(5). https://www.iosrjournals.org/iosr-jrme/papers/Vol-14%20Issue-5/ Ser-6/A1405060104.pdf

Singh, M. N. (2021). Inroad of digital technology in education: Age of digital classroom. *Higher Education for the Future, 8*(1), 20-30. https://doi.org/10.1177/2347631120980272

Srivastava, K., & Dey, S. (2018). Role of digital technology in teaching-learning process. *IOSR Journal of Humanities and Social Science (IOSR-JHSS), 23*(1), 74-79. 10.9790/0837-2301057479

Strom, A. (2021). The negative effects of technology for students and educators. *NW Commons*. https://nwcommons.nwciowa.edu/cgi/viewcontent.cgi?article=1322&context=education_masters

Suleimanova, O. A. (2020). Towards synergetic combination of traditional and innovative digital teaching and

research practices. *Training, Language and Culture, 4*(4), 39-50. https://doi.org/10.22363/2521-442X-2020-4-4-39-50

Suwanajote, N., & Saikham, S. (2023). Digital divide and educational inequality in Northeast Thailand: A mixed-methods research and development study in four provinces. *Insights into Modern Education, 1*(1), 76–104.

Suzer, E., & Koc, M. (2024, May 7). Teachers' digital competency level according to various variables: A study based on the European DigCompEdu framework in a large Turkish city. *Education and Information Technologies, 29*, 22057–22083. https://doi.org/10.1007/s10639-024-12711-1

Tabingo Jr., Cesar P., & Palma, R. C. (2025). 21st century teaching, digital readiness, and motivation: Insights from Filipino high school teachers". *Asian Journal of Language, Literature and Culture Studies*, 8 (1):40–59. https://doi.org/10.9734/ajl2c/2025/v8i1218

Tarman, B., Kilinc, E., & Aydin, H. (2019). Barriers to the effective use of technology integration in social studies education. *Contemporary Issues in Technology and Teacher Education, 19*(4). https://citejournal.org/volume-19/issue-4-19/social-studies/barriers-to-the-effective-use-of-technology-integration-in-social-studies- education

Ternenge, T. S., & Kashimana, F. (2019). Availability, accessibility, and use of electronic information resources for research by students in Francis Sulemanu Idachaba Library University of Agriculture, Makurdi. *Library Philosophy and Practice, 2352*, 1-41.

Timotheou, S., Miliou, O., Dimitriadis, Y., Sobrino, S. V., Giannoutsou, N., Cachia, R., Mones, A. M., & Ioannou, A. (2022, November 21). Impacts of digital technologies on education and factors influencing schools' digital capacity and transformation: A literature review. *Education and Information Technologies, 28*, 6695-6726. https://doi.org/10.1007/s10639-022-11431-8

Tiwari, H. P. (2024, June). English language teachers' awareness and practice of digital teaching. *Tamaddum Life, 23*(1). https://doi.org/10.33096/tamaddun.v23i1.718

Tomaro, Q. P. V. (2018). ICT integration in the educational system of Philippines. *Journal of Governance and Public Policy, 5*(3), 259–282. https://doi.org/10.18196/jgpp.5399

Tortola, R. L. (2024). Evaluating technology integration in the Philippines: A narrative review on enhancing elementary teachers' classroom management practices. *International Journal of Multidisciplinary Approach and Studies, 11*(4). http://ijmas.com/upcomingissue/05.04.2024.pdf

Tzafilkou, K., Perifanou, M., & Economides, A. (2023, May). Assessing teachers' digital competence in primary and secondary education: Applying a new instrument to integrate pedagogical and professional elements for digital education. *Education and Information Technologies, 12*, 1-24. https://doi.org/10.1007/s10639-023-11848-9

Useche, A. C., Galvis, A. H., Díaz-Barriga, F., Patiño A. E., & Muñoz-Reyes, C. (2022). Reflexive pedagogy at the heart of educational digital transformation in Latin American higher education institutions. *International Journal of Educational Technologies in Higher Education, 19*(62). https://doi.org/10.1186/s41239-022-00365-3

van Deursen, A., & Helsper, E. (2023). Digital gender gaps in students' knowledge, attitudes and skills: An integrative data analysis across 32 countries. *Education and Information Technologies, 29*, 655–693. https://doi.org/10.1007/s10639-023-12272-9

Vahey, P., Kim, H., Jackiw, N., & Sela, H. (2020, July 31). From the static to the dynamic: teachers' varying use of digital technology to support conceptual learning in a curricular activity system. *ZDM Mathematics Education* 52, 1275–1290. https://doi.org/10.1007/s11858-020-01182-6

Vakaliuk, T. & Antoniuk, D. (2023). The use of digital technology in general secondary education in Ukraine: current state and future prospects. *VIII International Workshop on Professional Retraining and Life-Long Learning using ICT: Personoriented Approach.* https://ceur-ws.org/Vol-3535/paper01.pdf

Valverde-Berrocoso, J., Acevedo-Borrega, J., & Cerezo-Pizarro, M. (2022, June 27). Educational Technology and Student Performance: A Systematic Review. *Frontiers in Education, 7*. https://doi.org/10.3389/feduc.2022.916502

Vidal-Esteve, M. I., & Martín-Gómez, S. (2023). Digitalization of classrooms: A comparative study on teachers'

perceptions about the use of digital teaching materials in early childhood and primary education. *Education Sciences, 13*(11), 1156. https://doi.org/10.3390/educsci13111156

Vouglanis, T., & Driga, A. M. (2023). Factors affecting the education of gifted children and the role of digital technologies. *TechHub Journal*, *6*, 28–39.

Vysochan, L., Koziar, M., Stelmah, N., & Vasylyuk-Zaitseva, S. (2024). Digital transformation in education: Using technologies for enhancement of efficiency of teaching. *Futurity Education, 4*(1). 186-209. https://doi.org/10.57125/FED.2024.03.25.10

Wen, X., & Walters, S. (2022). The impact of technology on students' writing performances in elementary classrooms: A meta-Analysis. *Computers and Education Open, 3*. https://doi.org/10.1016/j.caeo.2022.100082

Wohlfart, O., & Wagner, I. (2024, September 27). Longitudinal perspectives on technology acceptance: Teachers' integration of digital tools through the COVID-19 transition. *Education and Information Technologies,* 30, 6091–6115. https://doi.org/10.1007/s10639-024-12954-y

Wong, A. M., Sy, F. I., & Wong, J. (2025, October). Examining digital competence among Filipino public school teachers: Generational gaps, institutional support and ICT perceptions. *Journal of Interdisciplinary Perspectives*, *3*(10):156-163. https://doi.org/10.69569/jip.2025.617

Xiang, Z. (2018, January). From digitalization to the age of acceleration: On information technology and tourism. *Tourism Management Perspectives, 25*, 147-150.https://doi.org/10.1016/j.tmp.2017.11.023

Yadav, N. (2024, January). The impact of digital learning on education. *International Journal of Multidisciplinary Research in Arts, Science and Technology, 2*(1), 2584-0231. https://doi.org/10.61778/ijmrast.v2i1.34

Yu, J., Vidal, Q., & Vincent-Lancrin, S. (2023, December 13). Digital teaching and learning resources. OECD *Digital Education Outlook 2023*. https://www.oecd.org/en/publications/oecd-digital-education-outlook-2023_c74f03de-en.html#abstract

Zharkova, E., Ksenofontova, T., & Aleksandrova, N. (2022). Digitalization tools: Big data. In A. Manakov & A. Edigarian (Eds.), *International Scientific Siberian Transport Forum TransSiberia–2021* (Lecture Notes in Networks and Systems, Vol. 403, pp. 180–188). Springer. https://doi.org/10.1007/978-3-030-96383-5_20

Zhuo, G. & Xu, J. (2007). Adoption of educational technology: How does gender matter? *International Journal of Teaching and Learning in Higher Education, 19*(2), 140-153.

Zou, Y., Kuek, F., Feng, W., & Cheng, X. (2025, March 27). Digital learning in the 21st century: trends, challenges, and innovations in technology integration. *Frontiers in Education, 10*. https://doi.org/10.3389/feduc.2025.1562391