



American Journal of Education and Technology (AJET)

ISSN: 2832-9481 (ONLINE)

Volume 3 Issue 3 (2024)



PUBLISHED BY
E-PALLI PUBLISHERS, DELAWARE, USA



Assessment of the Impact of Technology Integration: Basis for Intervention Framework

S. B. Quintos^{1*}

Article Information

Received: July 25, 2024

Accepted: August 27, 2024

Published: August 30, 2024

Keywords

Student Engagement, Teachers' Commitment, Teaching Performance, Teaching Preference, Teachers' Style

ABSTRACT

This study aimed to develop an intervention framework that would serve as a guide on how teachers can adopt technology integration in the academic curriculum by looking into the level of effects and challenges during its implementation. The study utilized a quantitative method specifically the descriptive design to assess the effects of technology integration and to measure the significant difference when grouped according to the demographic profile of the respondents. A convenience sampling technique was used to select a sample size of 30 public secondary school teachers. Also, an adapted questions from the study of Sarker *et al.* (2019), Jakubek (2023), and Hero (2019) was utilized. The findings highlighted that all dimensions of technology integration in terms of teaching style, teaching performance, teaching preference, job satisfaction, teachers' commitment, teachers' acceptance, and student engagement have significant and positive effects. Moreover, the teachers faced different challenges specifically the limited resources, inadequate training, and concerns about digital equity. Therefore, the study came up with an intervention framework that can be noted to contain various activities such as teacher professional development programs, curriculum integration and resource allocation, support mechanisms, teacher reflection and feedback, digital equity and accessibility, and research and evaluation. Thus, the implementation of this framework is suggested for future research to ensure its effectiveness in the educational context.

INTRODUCTION

In the contemporary era, the integration of technology into teaching has fundamentally reshaped conventional methodologies, catalyzing a profound transformation in education (Smith, 2020; Jones, 2019). As technology permeated daily life, its impact on education became undeniable, prompting a harmonious fusion of technology and education that resonated throughout the educational realm. This convergence spurred an exploration into the intricate dynamics of integrating technology into educational administration, revealing its extensive implications for instructional methodologies and student engagement. Moreover, Sarker *et al.* (2019) emphasized the paramount importance of education in achieving Sustainable Development Goals (SDGs), with digital technology playing a pivotal role. In an era where digital technology became integral to education, its incorporation became imperative for elevating global education standards by 2030.

Globally, advancements in digital tools and online platforms catalyzed unprecedented opportunities for global collaboration, cultural exchange, and knowledge dissemination among educators and learners worldwide (Hwang & Wu, 2020). Notably, D' Angelo (2018) pointed out that over the years, researchers and educators devoted significant attention to exploring diverse methods and strategies aimed at enhancing the student learning environment. As the education system evolved and advanced, teachers invested considerable effort in devising innovative approaches to delivering course content in a manner that catered to the needs of all learners. The

increasing ubiquity of technology in contemporary society elevated the importance of effectively integrating digital tools into classroom practices, emerging as a primary focus within the educational community.

According to Yuen and Ma (2018), governments and educational authorities increasingly recognized the imperative of integrating technology to cultivate digitally literate citizens capable of navigating the complexities of the modern world. Within the traditional education system, limitations of time and place burdened learners to adapt to their learning environment. Digital technology offered a solution to meet the demands of the learning environment and overcome these barriers. Back then, it served as an effective tool for knowledge acquisition and capacity enhancement. Leveraging digital technology promoted advancements in e-learning, d-learning, m-learning, and u-learning by establishing connections between various technologies, such as computers, networks, ICT, multimedia, and artificial intelligence (Sarker *et al.*, 2019).

In the study of Hero (2019), the author emphasized that the integration of technology opened up new horizons in the field of education, offering exciting prospects for teaching and learning. It provided the potential for more engaging, interactive, and effective educational experiences, not only within the realm of Social Studies but across various subjects. This aligned with a broader movement advocating for technology-enhanced education experiences that were in sync with curriculum objectives and that enhanced overall teaching efficacy. Consequently, educators across disciplines increasingly

¹ Bataan Peninsula State University, Capitol Compound, Balanga City, 2100, Bataan, Philippines

* Corresponding author's e-mail: sbquintos@bpsu.edu.ph

embraced technology integration to strengthen their teaching methodologies. This infusion of technology into education played a central role in improving teacher productivity and enhancing classroom performance, regardless of the subject area.

Conversely, a digital learning environment eliminated the constraints of time and location, allowing learners to access digital resources like computers, mobile devices, the internet, e-readers, diverse facilities, video tutorials, mock exams, and various analytical software. Learners and educators benefited from these resources throughout the learning process, motivating and stimulating learning. Consequently, the digital learning environment had the potential to enhance capacity, creativity, collaboration, autonomy, and personalization. It also fostered interactive and creative thinking, making it a viable alternative to traditional lecture-based pedagogy.

In fact, the recent trend of embracing technology provided remote learning opportunities for students. Educators and policymakers reevaluated educational approaches and technology integration. The use of technology in schools continued to accelerate, and online education played a significant role in the learning landscape (McDiarmid & Zhao, 2022). In similar vein, technology integration has empowered educators to personalize learning experiences, engage students through interactive multimedia resources, and bridge gaps in educational equity and access (Johnson *et al.*, 2019).

With these considerations, the purpose of this study was to assess the effects of digital technology in teaching style, teaching performance, teacher preference, job satisfaction, teachers' commitment, acceptance, and student engagement (Hero, 2019). Another gap was highlighted by Jakubek (2023) on conducting more comprehensive research on the specific training and support requirements necessary for teachers to utilize technology in their instructional practices effectively. This study aimed to develop an intervention framework with different programs and requirements to ensure the adaptability and effectiveness of technology integration. This could be achieved by looking into the effects of technology integration and the challenges faced by the respondents.

Specifically, the researcher sought to answer the following specific research questions:

1. What is the demographic profile of the respondents in terms of:
 - 1.1 age;
 - 1.2 sex;
 - 1.3 years of teaching;
 - 1.4 educational background; and
 - 1.5 subject taught?
2. What is the level of effects of technology integration among the respondents in terms of:
 - 2.1 teaching style;
 - 2.2 teaching performance;
 - 2.3 teaching preference;
 - 2.4 job satisfaction;
 - 2.5 teachers' commitment;
 - 2.6 teachers; acceptance; and
 - 2.7 student engagement?

3. Is there a significant difference between the effects of technology integration when grouped according to the demographic profile of the respondents?
4. What are the challenges encountered by teachers in the technology integration in the school?
5. Based on the findings, what intervention framework can be proposed to overcome various challenges and effectively adopt technology integration in academic instruction?

LITERATURE REVIEW

Technology Integration and Trends

The recent surge in technology utilization opened up avenues for remote learning among students. And, there was a growing momentum towards expediting the integration of technology in schools, with online education emerging as a substantial and integral aspect of the learning landscape (McDiarmid & Zhao, 2022).

In the study of Jakubek (2023), explored the impact of technology integration, highlighting data-driven methodologies to quantify student engagement in virtual learning. Similar study of Solé-Beteta (2022) suggested strategies like task relevance, gamification, and comprehensive engagement assessments.

Further, Wallace-Spurgin (2020) focused on the effective incorporation of technology and the evaluation of student cognitive engagement. Wallace-Spurgin emphasized the challenges faced by school districts in optimizing technological devices to enhance student cognitive engagement and academic achievement. Collaborative efforts were deemed essential to reshape pedagogy, instructional methods, curriculum design, and assessment practices.

As highlighted by Lai (2022), the imperative for comprehensive tools to assess technology's impact on education, advocating for an evaluation framework that prioritized learning outcomes over mere technological presence. The evaluation process within the realm of technology-integrated learning was multifaceted and often contentious, as highlighted by Muller & Wulf (2020). While the educational technology literature covered a broad spectrum of dimensions, including learning, affective elements, behaviors, design, pedagogy, presence/community, and institutional environment, previous research, such as that by Lai & Bower (2019), revealed a tendency to focus on a subset of these dimensions.

To address this gap, Lai & Bower (2019) conducted a systematic literature review of 365 papers published in *Computers & Education* between 2015 and 2017. The review identified eight primary themes for evaluating technology use in education, encompassing learning outcomes, affective elements, behaviors, design, technology elements, pedagogy, presence/community, and institutional environment. Each theme comprised

various sub-dimensions, forming the foundation for the survey instrument. For instance, learning outcomes encompassed performance, knowledge acquisition, and skill development, as evidenced by studies like those of El-Maghraby (2021) and Komalawardhana *et al.* (2021). Affective elements related to learners' perceptions and attitudes, reflected in research by Hew *et al.* (2020) and Sun *et al.* (2021). Behaviors encompassed interaction and collaboration, evident in studies by Bergdahl *et al.* (2020), while design included aspects like course quality and accessibility, as discussed by Jahnke & Liebscher (2020). Pedagogy considerations included teaching strategies and quality, as explored by Undheim & Jernes (2020), while presence/community involved social interactions and environmental engagement, as demonstrated by Park & Song (2020). Lastly, the institutional environment considered policies and support for technology integration, as elucidated by Huang *et al.* (2020).

To validate these dimensions and items, Lai *et al.* (2022) conducted a field specialist validation survey involving 48 educational technology specialists. The results indicated a strong alignment between the identified constructs and specialists' perceptions, with 98% agreement on the relevance of items across the eight dimensions. In relevance, this validation considers multiple dimensions when evaluating technology integration in education, providing a comprehensive framework for assessing its impact on teaching performance, preferences, job satisfaction, teachers' commitment, and acceptance.

As observed in Lai *et al.* (2022) study, technology acceptance was evaluated through perceived usefulness and ease of use. The exploration of the impact of technology integration on teaching performance, teaching preference, job satisfaction, teachers' commitment, and acceptance was emphasized as crucial. Performance expectancy (PE) played a pivotal role, elucidating individuals' expectations regarding how technology could enhance their job performance (Tang, 2020). This perspective was reinforced by research conducted by Jung and Lee (2020) emphasizing the significance of individuals anticipating positive outcomes from technology utilization. Additionally, the Unified Theory of Acceptance and Use of Technology (UTAUT) model introduced key variables such as hedonic motivation, price value, and habit, extending the understanding of technology acceptance. However, the challenge lay in selecting a model that aptly interpreted technology acceptance within teacher education and professional development contexts, considering the contextual influences impacting findings (Granić & Marangunić, 2019; Scherer, Siddiq, & Tondeur, 2019).

Meta-analytical reviews accentuated the central role of performance expectancy (PE) and effort expectancy (PU) in shaping teachers' intentions to adopt technology, with a particular emphasis on PU's stronger effect on implementation intentions (Granić & Marangunić, 2019). Attitude toward technology (AT) emerged as a crucial mediator between intention (IN) and PE/

PU in educational settings (Scherer *et al.*, 2019). In the quantitative phase, the study focused on predicting K-12 teachers' intention to adopt Open Educational Resources (OER), where PE and PU were identified as significant predictors, with AT mediating their effects. The study not only validated the numerical results but also explored the intricate perspectives of educators using a qualitative approach. Through the integration of both methodologies, the research revealed significant insights regarding the adoption of Open Educational Resources (OER) in K-12 educational environments. Convincing teachers of the ease of using OER became paramount, with qualitative insights emphasizing the accessibility, user-friendliness, low costs, and abundance of resources associated with OER (Tang, 2020). The research solidified the link between teachers' performance expectancy and their perceptions of ease of use, ultimately impacting attitudes and intentions toward OER adoption, aligning with and extending existing literature (Jung & Lee, 2020). In the article of Kwok (2020), it was highlighted that the integration of information technology into teaching practices played a pivotal role in shaping educators' teaching styles, as highlighted by the Australian Christian College (2020). The use of online resources, software programs, and apps became a transformative element in facilitating student engagement and learning across diverse curriculum areas (Auld, 2019). The evolving landscape of technology-based learning processes presented a notable shift in teaching paradigms. For educators accustomed to low-tech approaches, embracing technology signified a crucial aspect of their growth and professional development. Conversely, for digital natives, technology intertwined seamlessly with their concept of modern teaching (Kwok, 2020).

Furthermore, some investigations thoroughly examined the intricate journey of transforming digital scholarship among educators, uncovering shifts in knowledge, organizational learning, pedagogy, and fundamental teaching methodologies (Kwok, 2020). The study highlighted the individualized nature of these changes, reflecting teachers' distinct knowledge and beliefs. A 2021 review on effective practice principles by ACER accentuated the need to blend technology with pedagogical strategies. The emphasis lay not only on using cutting-edge tools but also on integrating them harmoniously with traditional teaching methods. This delicate balance underscored the importance of educators being both tech-savvy and pedagogically sound (Kwok, 2020).

Additionally, Auld (2019) emphasized the significance of an effective teaching style in engaging students and fostering enjoyment in learning. Drawing from decades of educational research, effective teaching practices involved providing positive feedback, offering appropriately challenging tasks, helping students find meaning and value in learning materials, fostering a sense of community, and aligning instruction with students' strengths and interests. Ahmed *et al.* (2021) extended this perspective, highlighting that well-designed and

user-friendly online teacher resources enhanced learning outcomes by enabling effective knowledge transfer to classrooms.

In the ever-evolving realm of educational technology, researchers such as Agbo *et al.* (2023) explored immersive virtual reality (IVR), emphasizing its potential to enhance computational thinking through mini-games. Their research scrutinized the influence of game elements and IVR features on students' cognitive perceptions. As education technology continued to advance, IVR emerged as a potent tool with the capacity to shape student experiences and outcomes in innovative ways. The ongoing discourse on the integration of technology into teaching styles emphasized the need for educators to adapt, ensuring that technology served as an enhancer rather than a replacement for foundational teaching practices.

In this vein, Barba-Sánchez *et al.* (2022) pointed out that teachers' effectiveness in incorporating ICT into their classrooms facilitates the pedagogical utilization of these technologies, particularly in STEM subjects. In the current landscape, characterized by abundant opportunities and cost-saving potentials offered by technological advancements (Barba-Sánchez; Arias-Antúnez; Orozco-Barbosa, 2019), there is an imperative to update educational curricula with tools that steer the educational process toward a digital environment.

In this context, the issue of teacher job satisfaction emerges as a critical factor in navigating the challenges posed by digital transformation. Barba-Sánchez *et al.* (2022) emphasize that teacher job satisfaction significantly enhances crucial aspects such as motivation, degree of involvement, commitment, and overall performance. The study's results reveal the impactful relationships between ICT skills, improvement in teaching, and job satisfaction. Specifically, the findings indicate that ICT skills not only contribute to enhanced teaching practices but also play a role in influencing job satisfaction, both directly and indirectly through ICT integration and improvement in teaching.

Consistent with existing literature (Chai *et al.*, 2019), the study acknowledges the limited ICT knowledge among primary school teachers, which may hinder the adaptation of the educational model to an ICT-based teaching environment. However, the empirical study suggests that despite these challenges, teachers are cognizant of the potential of ICT for their teaching activities, emphasizing the importance of awareness in adapting the educational model to environmental needs (Özgür, 2020). Importantly, the research concludes that ICT skills wield a pivotal influence on the integration of ICT, ultimately simplifying teaching tasks and contributing to increased job satisfaction. This highlights the interconnected relationship between technological proficiency, effective teaching practices, and the overall job satisfaction of educators.

On the other hand, enhancing student engagement through technology integration represented a multifaceted

journey with profound implications for the landscape of education. According to Ahmed *et al.* (2021), the meticulous design and delivery of online teacher resources were integral, serving as a cornerstone in ensuring that educators perceived learning materials and tools as not only meaningful but also educationally sound and user-friendly. This, in turn, equipped teachers with the ability to acquire knowledge more effectively, instill confidence in its application, and subsequently transfer these honed skills to their classrooms. In this iterative process, the ultimate outcome was a tangible enhancement in student engagement and subsequent improvements in overall learning outcomes.

According to Kwok (2020), several elements contributed to shaping student engagement. These encompassed teacher-related factors, spanning interaction style, the level of support, responsiveness, and behavioral and academic expectations. Additionally, school-related factors, including aspects like classroom layout, noise, lighting levels, and the institution's approach to supporting and disciplining students, played a crucial role. Furthermore, student-specific factors, such as emotional, physical, cognitive, and behavioral states, incorporating considerations like health, disability, and peer relationships, significantly influenced engagement. Family and community dynamics, encompassing a student's residential circumstances, the extent of family support or involvement in education, and family relationships, also contributed to this multifaceted picture. Lastly, curriculum and resource factors, such as the availability and nature of learning resources (including educational systems and technology), characteristics of learning tasks (e.g., difficulty, interest, meaningfulness), access to educational tools, alignment with learning goals and objectives, and approaches to assessment, collectively impacted the overall landscape of student engagement.

Within the realm of technology integration, student engagement unfolded across diverse dimensions, as elucidated by Korhonen *et al.* (2019). The cognitive and behavioral engagement of students while utilizing technology became the focal point of the investigation, reflecting a paradigm shift in teaching and learning, as suggested by Halili (2019). In addition, Wallace-Spurgin (2020) explored the effective use of technology in education to enhance student cognitive engagement. Teacher training and collaborative efforts are crucial to transform teaching methods and curriculum. Students, often called "digital natives," need to be seen as "digital learners" to cater to their unique needs. Further, the author accentuated the transformative potential of technology, offering abundant opportunities for both learners and educators to reshape the classroom environment. This restructuring facilitated higher-order cognitive engagement among students, emphasizing the evolution of educational paradigms (Wallace-Spurgin, 2019).

Moreover, Baporikar (2020) directed attention to the role of digital technological tools and models, specifically focusing on their capacity to promote

reflective engagement among students. Platforms such as video tutorials, vlogs, electronic portfolios, and online discussions emerged as facilitators of metacognitive awareness and reflective thinking (Katyara *et al.*, 2022). The inherent affinity students possessed for technology empowered them to analyze information, compare ideas, and actively engage in reflective practices using various devices like computers, laptops, and smartphones. The promotion of reflective engagement aligned seamlessly with metacognitive awareness, as emphasized by Korucukis and Demir (2019). An array of technological tools, including vlogs, blogs, online tutorials, and discussion platforms, acted as supportive frameworks for students, enabling them to employ metacognitive and self-explanation techniques. This, in turn, fostered deeper levels of reflective thinking throughout the learning process.

In essence, technology integration emerged as a catalytic force propelling student engagement beyond conventional boundaries. This transformative approach offered avenues for cognitive, behavioral, and reflective engagement, reshaping the educational landscape and contributing to a dynamic and enriched learning experience.

Challenges Encountered by the Teachers

The integration of technology in classrooms, as highlighted by Jakubek (2023), brought substantial benefits for teachers, enabling them to customize instructional materials and assessments to address the unique learning needs of students. This empowerment was further emphasized by the vast array of authentic resources technology provided, facilitating the creation and delivery of engaging lesson plans. Nevertheless, challenges arose when educators adopted technology without sufficient consideration for the quality of teaching and learning experiences it generated.

Relatively, the study of Dube and Wen (2021) provided a comprehensive analysis of technology trends in K-12 education from 2011 to 2021 which focused on the dynamic evolution of technology. While technology rapidly progressed, the study emphasized the imperative need for increased attention to the outcomes and impacts of these changes. Notably, there was a discernible trend over the past decade toward adopting mobile and analytical technologies, with mobile technology emerging as the most effective form of educational technology.

In contrast, Yilmaz (2020) investigated critical thinking and multidimensional 21st-century skills, exploring the associated shift in academic achievement resulting from technology integration. The study involved prospective teachers comparing instruction with and without technology integration, revealing positive changes with the gradual inclusion of technology in the educational process. Yilmaz's findings underscored the benefits of incorporating technology into instruction, particularly in fostering critical thinking skills and multidimensional competencies.

Moreover, Eppard (2022) emphasized the parents' and students' perceptions regarding iPad integration in the classroom uncovered positive outcomes. The results revealed that 80% of students reported a better understanding of new concepts through iPad usage, particularly in math instruction, where it enhanced student engagement levels and attention. Likewise, Christopoulos (2020) study on educational technology in elementary school mathematics compared the skills and competencies developed through intervention, highlighting the potential of curriculum-driven digital learning tools to support and enhance mathematics learning at the elementary school level.

In a study conducted by Ricci *et al.* (2023) on the effects of technology on early childhood, both positive and negative aspects were presented. In contrast to earlier sources predominantly highlighting detrimental impacts, Cordeiro's research shed light on potential benefits. Excessive internet usage was associated with intellectual deficits and mental health concerns, emphasizing the importance of parents enforcing limits on screen time and controlling the content their children were exposed to. Collectively, these varied studies accentuated the transformative potential of technology in education, provided its integration was thoughtful and aligned with pedagogical goals.

Similarly, the integration of artificial intelligence (AI) into educational practices aimed to enhance student learning experiences across various domains. These included personalizing tasks based on individual competence, facilitating human-machine conversations, analyzing student work for feedback, and increasing adaptability and interactivity in digital environments. While AI-powered systems successfully tailored learning tasks to individual student abilities, as demonstrated by Hirankerd and Kittisunthonphisarn (2020) and Yang and Shulruf (2019), challenges persisted due to the scarcity of supportive learning resources. Similarly, AI chatbots and interactive books fostered communication skills among students, yet further exploration was needed to optimize their impact in educational settings (Chew & Chua, 2020; Kim *et al.*, 2021).

Moreover, AI applications for analyzing student work showed promise in enhancing learning processes, but the pre-prepared nature of feedback often failed to address the diverse needs of students and educators (Fu *et al.*, 2020; Porter & Grippa, 2020). Additionally, AI technologies aimed to enhance adaptability and interactivity in digital learning environments by capturing student data and facilitating personalized interactions (Kickmeier-Rust & Holzinger, 2019; Westera *et al.*, 2020). However, the lack of appropriate evaluation methods hindered the assessment of their impact on student learning outcomes. Furthermore, Hero (2019) stressed the challenges teachers faced in fully integrating technology into their teaching practices, despite recognizing its potential benefits. This emphasized the importance of comprehensive professional development programs to

support technology integration, especially considering the varying levels of tech skills among faculty members. Addressing these challenges through targeted training initiatives could empower teachers to leverage technology effectively, thereby enhancing classroom engagement and learning outcomes.

MATERIALS AND METHODS

The present study employed a quantitative method of research, particularly the descriptive design, in assessing the level of the teacher’s technology integration. The descriptive design extracted and gauged the level of effects of technology integration in terms of teaching style, teaching performance, teaching preference, job satisfaction, teachers’ commitment, teachers’ acceptance, the engagement of students, and the challenges experienced by teachers in public secondary schools in the Division of Balanga City.

The research was conducted in selected public secondary schools of the Division of City of Balanga. A convenient sampling technique was used to select a sample size of 30 teachers from public secondary schools. The respondents belonged to the regular teachers and were chosen based on particular inclusion criteria, as follows:

- (1) A regular teacher at least with one (1) year teaching

experience,

- (2) Must be LET passer, and

- (3) Using technology-focused learning method of instruction.

The research materials, used in the study, are adapted from the questionnaire in the study of Sarker *et al.*, 2019, Jakubek, 2023, and Hero *et al.*, 2019. The first section comprised informed consent, a statement of confidentiality, and the demographic profile of participants in terms of age, sex, years of teaching, educational background, and subject taught. The second section was made up of statements related to various indicators of technology integration in terms of teaching style, teaching performance, teacher preference, job satisfaction, teacher commitment, teacher acceptance, and student engagement. The third part, on the other hand carried questions in relation to the challenges that the respondents experienced through the fusion of technology.

Descriptive statistics, including arithmetic mean and standard deviation, were used to assess technology integration and challenges. T-tests and ANOVA evaluated significant differences in respondents’ views on various aspects of technology integration. The Likert Scale was employed to facilitate data interpretation, providing a common approach for scaling survey responses.

Table 1: Scale and Description

Scale and Description			
Score	Scale Range	Description	Interpretation
4	3.26 – 4.00	Strongly Agree	High level of effects
3	2.51 – 3.25	Agree	Moderate level of effects
2	1.76 – 2.50	Disagree	Low level of effects
1	1.00 – 1.75	Strongly Disagree	Very low level of effects

RESULTS AND DISCUSSION

Socio-Demographic Profile of the Respondents

Based on the gathered responses, the frequency distribution

of the respondents in terms of age, sex, years of teaching, educational background, and subject taught was shown in Table 2.

Table 2: Scale and Description

Profile	Frequency	Percentage
Age		
25 - 30 years old	14	47
31 - 35 years old	10	33
36 - 40 years old	6	20
Total	30	100
Sex		
Male	12	40
Female	18	60
Total	30	100
Years in Teaching		
1 - 5 years	13	44
6 - 10 years	10	33
More than 10 years	7	23
Total	30	100

Educational Background		
Bachelor's Degree	16	54
Master's Degree	10	33
Doctorate Degree	4	13
Total	30	100
Subject Taught		
General Education	18	60
Business Subject	5	17
All Subjects	7	23
Total	30	100

Number of Cases=30

The study revealed that most respondents were aged 25-30 years (47%), indicating a concentration in the mid-to-late twenties. In contrast, the 36-40 age group had the lowest frequency (20%), suggesting a younger demographic. Regarding sex, 60% of respondents were female, highlighting a potential gender disparity in technology-related fields. Most respondents had 1-5 years of teaching experience (44%), reflecting early-career educators' perspectives and adaptability to technology integration. Respondents with over 10 years of experience comprised 23%, indicating a seasoned group. Educationally, 54% had Bachelor's degrees, 33% had Master's degrees, and 13%

had Doctorates, suggesting varying levels of familiarity with technology integration. Teachers with Bachelor's degrees might have encountered educational technologies during their studies, while those with Doctorates likely had advanced expertise in educational technology. The study also found that 60% of respondents taught General Education, 23% taught all subject areas, and 17% taught business subjects. This broad representation implied that technology integration initiatives impacted various academic domains.

Level of Effects of Technology Integration

Table 3: Level of effects of technology integration in terms of teaching style

Statements	Mean	Std. Deviation	Interpretation	Rank
1. Technology integration has made my lessons more engaging for students.	3.89	.31	High level	1
2. Technology integration has positively influenced my teaching style, making it more interactive and dynamic.	3.83	.38	High level	2
3. Technology integration has allowed me to adapt and diversify my teaching style to cater to individual student needs.	3.69	.52	High level	5
4. Technology integration has improved my ability to deliver content in a way that resonates with my students.	3.75	.44	High level	4
5. Technology integration has led to increased student participation and interaction in the classroom.	3.81	.40	High level	3
Overall Mean	3.79	.34	High level	

Based on the results in Table 3, it was clear that technology integration highly affected the teaching style of the teacher with an overall mean of 3.79 (SD = .34) which suggested a high level of influence on teaching methodologies. Among the statements, statement 1 stated that "Technology integration has made my lessons more engaging for students," received the highest mean score of 3.89 (SD = .31). This indicated that the majority of participants perceived a high level of effectiveness in enhancing student engagement through technology integration. This result underscored the positive influence of technology on instructional methods, aligning with the notion that well-implemented technology could contribute to increased student engagement. The literature and studies cited significantly bolstered

the study's findings regarding the effects of technology integration on teaching styles. The Kwok (2020) exploration highlighted the transformative role of information technology, emphasizing the positive impact of online resources, software programs, and apps in facilitating student engagement. This aligned seamlessly with the study's conclusion that technology integration had a high level of effect on teaching styles, particularly in enhancing student engagement. Moreover, the study of Auld (2019) emphasized the significance of effective teaching styles in engaging students and fostering enjoyment in learning resonating with the study's assertion that well-implemented technology positively influenced instructional methods and teaching approaches. The ACER review in 2021 further reinforced the study's

findings by highlighting the importance of blending technology with pedagogical strategies, affirming the need to integrate cutting-edge tools harmoniously with traditional teaching methods (Kwok, 2020). Finally, Agbo *et al.* (2023) study of immersive virtual reality (IVR) was aligned with the study's conclusions, emphasizing the positive potential of IVR mini-games in enhancing

computational thinking and supporting the idea that technology integration shaped teaching styles by offering innovative approaches to student experiences and outcomes. Collectively, these studies provided robust support for the study's findings, validating the notion that technology integration played a crucial role in shaping diverse aspects of teaching styles.

Table 4: Level of effects of technology integration in terms of teaching performance

Statements	Mean	Std. Deviation	Interpretation	Rank
1. Technology integration has significantly improved my teaching performance.	3.77	.42	High level	3
2. Technology integration has positively impacted my ability to deliver lessons effectively.	3.85	.35	High level	1
3. Technology integration into my teaching has enhanced my overall performance as an educator.	3.73	.45	High level	5
4. Technology integration has made me more adaptable and effective in responding to students' learning needs.	3.75	.43	High level	4
5. Technology integration has improved my teaching performance in terms of student comprehension and engagement.	3.80	.40	High level	2
Overall Mean	3.78	.33	High level	

The analysis of the results presented in Table 4 highlighted that technology integration significantly influenced teaching performance, as evidenced by the high overall mean score of 3.78 (SD = .33). This indicated a widespread perception among participants regarding the positive impact of technology integration on their teaching effectiveness. Among the individual statements, statement 2 emerged as particularly noteworthy, with the highest mean score of 3.85 (SD = .35). This statement, "Technology integration has positively impacted my ability to deliver lessons effectively," indicated that the majority of participants recognized technology as a valuable tool for enhancing their instructional delivery. The high mean score suggested a strong consensus among participants regarding the effectiveness of technology in facilitating effective lesson delivery, highlighting its potential to improve teaching performance.

The study of Jung and Lee (2020) corroborated the findings as it highlighted the crucial role of performance expectancy (PE) in shaping teachers' expectations

regarding technology's positive impact on job performance. Their research solidified the link between teachers' performance expectancy, ease of use perceptions, and attitudes towards Open Educational Resource (OER) adoption, offering a valuable framework for understanding how teachers perceived technology's effects on their professional performance, aligning with existing literature in the context of technology integration. Additionally, Solé-Beteta's (2022) study complemented the research by exploring methodologies to quantify student engagement in synchronous virtual learning environments, emphasizing the interconnected nature of technology integration in both teaching and student engagement. Solé-Beteta's emphasis on a tailored approach to measure student engagement resonated with the study's overarching theme, enriching the understanding of how technology impacted teaching effectiveness. The findings from Solé-Beteta's research provided valuable insights into the intricate relationship between technology, teaching, and student engagement, contributing to the depth and scope of the study.

Table 5: Level of effects of technology integration in terms of teaching preference

Statements	Mean	Std. Deviation	Interpretation	Rank
1. I prefer using technology-assisted teaching methods over traditional approaches in my classroom.	3.37	.58	High level	5
2. Technology has become my preferred teaching tool to enhance student learning.	3.57	.50	High level	4
3. Technology integration aligns with my teaching preferences and enhances my instructional methods.	3.69	.46	High level	1
4. I have developed a strong preference for technology as a means to enrich my teaching practices.	3.64	.48	High level	2

5. Considering my teaching experience, technology has become my preferred way to engage and educate students effectively.	3.61	.49	High level	3
Overall Mean	3.57	.40	High level	

The analysis of the results presented in Table 5 provided insights into the impact of technology integration on the teaching preferences of the teachers. The data indicated that all statements related to technology integration had a significant effect on teaching preferences, reflected in the high overall mean score of 3.57 (SD = .40). This suggested a notable influence of technology on educators' preferences in instructional methods. Among the individual statements, statement 3 stood out with the highest mean score of 3.69 (SD = .46). This statement, "Technology integration aligned with my teaching preferences and enhanced my instructional methods," indicated that teachers perceived technology as not only aligning with their existing teaching preferences but also improving their instructional methods. The elevated mean score highlighted a strong agreement among participants concerning the favorable influence of incorporating technology on their teaching preferences.

The exploration of Solé-Beteta's (2022) into the methodologies for quantifying student engagement aligned with the study's focus on teaching preferences, emphasizing the interconnected nature of technology integration in teaching and student engagement. Wallace-Spurgin (2020) further contributed by highlighting the challenges school districts faced in optimizing technological devices to enhance student cognitive engagement and academic achievement. The call for comprehensive tools to assess technology's impact on education by Lai (2022) reinforced the study's emphasis on evaluating the outcomes of technology integration in teaching practices. Additionally, Muller & Wulf's (2020) acknowledgment of the multifaceted and contentious nature of the evaluation process aligned with the challenges highlighted in the study, emphasizing the need for a nuanced understanding of technology's impact on teaching preferences.

Table 6: Level of effects of technology integration in terms of job satisfaction

Statements	Mean	Std. Deviation	Interpretation	Rank
1. Technology integrated into my teaching practices has significantly increased my job satisfaction.	3.58	.50	High level	5
2. The use of technology in education has positively impacted my job satisfaction as an educator.	3.63	.48	High level	2
3. The successful integration of technology has made me more satisfied with my teaching profession.	3.62	.59	High level	3
4. Technology integration has enhanced my job satisfaction by improving the effectiveness of my teaching methods.	3.61	.54	High level	4
5. Technology integration in education has contributed to higher job satisfaction by better meeting my teaching goals and the needs of my students	3.64	.53	High level	1
Overall Mean	3.62	.46	High level	

The findings presented in Table 6 indicated that all statements related to the effect of technology integration on job satisfaction were interpreted at a high level, with an overall mean of 3.62 (SD = .46). This suggested a substantial impact of technology integration on educators' satisfaction with their jobs. Among the statements, statement 5 stood out with the highest mean of 3.64 (SD = .53). This statement, "Technology integration in education contributed to higher job satisfaction by better meeting my teaching goals and the needs of my students," highlighted the perception among participants that technology integration positively influenced job satisfaction by aligning with teaching objectives and student needs. Similarly, statement 1, which indicated, "Technology integrated into my teaching practices significantly increased my job satisfaction," had the lowest mean

of 3.58 (SD = .50), yet it was still interpreted at a high level. This suggested that while this statement received a slightly lower mean score compared to others, it still reflected a strong perception among participants regarding the positive impact of technology integration on job satisfaction. In support of these findings, Barba-Sánchez *et al.* (2022) accentuated teachers' effectiveness in integrating ICT into classrooms, particularly in STEM subjects, emphasizing the need to update curricula for the digital era. The study underscored the crucial role of teacher job satisfaction in addressing digital transformation challenges, with increased satisfaction positively impacting motivation, involvement, commitment, and overall performance. Significant relationships were found between ICT skills, teaching improvement, and job satisfaction, indicating direct and indirect contributions of ICT skills, through

ICT integration and teaching enhancement, to heightened job satisfaction among educators. Despite acknowledging primary school teachers' limited ICT knowledge, in line with prior research (Kovarik *et al.*, 2013; Chai, 2019), the study highlighted teachers' awareness of ICT's potential and the importance of adapting the educational model to

environmental needs (Özgür, 2020). Notably, the study concluded that ICT skills were pivotal in ICT integration, simplifying teaching tasks and enhancing job satisfaction, emphasizing the interconnected relationship between technological proficiency, effective teaching practices, and overall job satisfaction in educators.

Table 7: Level of effects of technology integration in terms of job satisfaction

Statements	Mean	Std. Deviation	Interpretation	Rank
1. My commitment to integrating technology into teaching has significantly increased over time.	3.59	.49	High level	3
2. Technology integration has positively influenced my commitment to improving educational outcomes.	3.55	.56	High level	4
3. I am highly committed to utilizing technology to enhance my teaching methods and student engagement.	3.59	.55	High level	3
4. My commitment to technology integration is reflected in my ongoing efforts to adapt and innovate in the classroom.	3.61	.49	High level	2
5. Technology integration in education aligns with my commitment to providing high-quality learning experiences for my students.	3.63	.54	High level	1
Overall Mean	3.59	.45	High level	

The results presented in Table 7 demonstrated that all statements related to the effects of technology integration indicated a high level, with an overall mean score of 3.59 (SD = .45). These findings suggested a substantial impact of technology integration on teacher commitment. Among the statements, statement 5 stood out with the highest mean of 3.63 (SD = .54). This statement, "Technology integration in education aligned with my commitment to providing high-quality learning experiences for my students," highlighted the participants' perception that technology integration positively influenced their commitment to delivering high-quality educational experiences. The high mean score reinforced the idea that teachers saw technology integration as aligned with their dedication to providing excellent learning opportunities for students. Supporting these findings, Jung and Lee's (2020) research emphasized the importance of individuals anticipating

positive outcomes from technology utilization, aligning with the positive perceptions of teachers in the study. The review of technology use in education, identifying eight primary themes, including learning outcomes, was further enriched by studies such as those by ElMaghraby (2021) and Komalawardhana *et al.* (2021), which emphasized the impact of well-designed online teacher resources on learning outcomes. Ahmed *et al.*'s (2021) perspective on the meticulous design and delivery of online teacher resources as integral echoed the study's emphasis on the positive influence of technology integration on teacher commitment. Additionally, Dube and Wen (2021) comprehensive analysis of technology trends highlighted the dynamic evolution of technology, reinforcing the need for attention to outcomes and impacts, and supported the study's focus on understanding the effects of technology integration on teacher commitment.

Table 8: Level of effects of technology integration in terms of teacher's acceptance

Statements	Mean	Std. Deviation	Interpretation	Rank
1. I am enthusiastic about and accepting of technology integration into my teaching practices.	3.71	.45	High level	4
2. I have a positive attitude toward technology integration in education.	3.81	.39	High level	2
3. I readily embrace technology as a valuable tool for enhancing teaching and student engagement.	3.71	.45	High level	4
4. I am open to new technological advancements and their integration into my educational methods.	3.83	.38	High level	1
5. Technology integration aligns with my teaching philosophy and enhances my effectiveness as an educator.	3.72	.45	High level	3
Overall Mean	3.76	.36	High level	

The results presented in Table 8 demonstrated that all statements related to the effects of technology integration indicated a high level, with an overall mean score of 3.76 (SD = .36). These findings suggested a substantial impact of technology integration on teacher acceptance. Among the statements, statement 4 stood out with the highest mean of 3.83 (SD = .38), interpreted as a high level. This statement, “I was open to new technological advancements and their integration into my educational methods,” highlighted a strong willingness among participants to embrace new technological developments and integrate them into their teaching practices. The research findings on the effects of technology integration on teachers’ acceptance were substantiated and reinforced by several pertinent studies in the literature. Tang *et al.*’s (2020) investigation into technology

acceptance, focusing on perceived usefulness and ease of use, aligned directly with the present research’s emphasis on assessing teachers’ readiness to adopt new technological advancements in teaching. Additionally, insights from Jung and Lee (2020) underscored the pivotal role of performance expectancy (PE) in shaping teachers’ expectations of technology’s positive impact on job performance. The Unified Theory of Acceptance and Use of Technology (UTAUT) model enhanced understanding by providing essential variables like hedonic motivation and habit. Furthermore, meta-analytical reviews by Granić & Marangunic (2019) and Scherer *et al.* (2019) emphasized the significant roles of performance expectancy (PE) and effort expectancy (PU) in shaping teachers’ intentions to adopt technology.

Table 9: Level of effects of technology integration in terms of student engagement

Statements	Mean	Std. Deviation	Interpretation	Rank
1. Technology integration has significantly enhanced student engagement in my classroom.	3.69	.52	High level	1
2. Students are more actively engaged in their learning when technology is integrated into my teaching methods.	3.67	.47	High level	2
3. Technology has a positive impact on student engagement and participation during lessons.	3.67	.47	High level	2
4. Students exhibit increased interest and involvement in their education due to technology integration.	3.67	.47	High level	2
5. Technology integration has led to higher levels of student engagement and interactive learning experiences.	3.67	.47	High level	2
Overall Mean	3.67	.42	High level	

The findings from Table 9 provided a valuable understanding of the perceived high level of effects of technology integration on student engagement. The overall high mean score of 3.67 (SD = .42) across all statements indicated a strong agreement among participants that technology integration had a substantial positive impact on student engagement in the classroom. Among the statements, statement 1, which emphasized that “Technology integration significantly enhanced student engagement in my classroom,” stood out with the highest mean of 3.69 (SD = .52). This result accentuated a strong consensus among participants that integrating technology into teaching practices led to a notable improvement in student engagement. The higher mean score for this statement suggested that teachers particularly emphasized the transformative effect of technology on enhancing the level of interaction and involvement among students. Notably, all remaining statements from 2 to 4 yielded mean scores equivalent to 3.67 (SD = .47), interpreted at a high level. This consistency across statements indicated a consistent perception among participants that various aspects of technology integration positively contributed to student engagement. While the mean

scores were slightly lower than statement 1, the fact that they were still interpreted at a high level emphasized the broad agreement among teachers regarding the positive influence of technology on student engagement. These findings were strongly corroborated by several studies by Ahmed *et al.* (2021) and Kwok (2020) which emphasized the transformative impact of technology on teaching practices and student engagement. Ahmed *et al.* highlighted the importance of online teacher resources in making learning materials meaningful and user-friendly, which resonated with the study’s findings on technology integration. Kwok’s exploration of factors influencing student engagement supported the idea that various aspects of technology integration contributed positively to student engagement. Additionally, Korhonen *et al.* (2019) underscored the cognitive and behavioral dimensions of student engagement with technology, while Halili (2019) and Wallace-Spurgin (2019) highlighted technology’s potential to reshape teaching paradigms and foster higher-order cognitive engagement. Finally, Baporikar’s (2020) study on digital technological tools aligned with the study’s assertion that technology promoted metacognitive awareness and reflective thinking in students.

Table 10: Summary of the level of effects of technology integration

Statements	Mean	Std. Deviation	Interpretation	Rank
Teaching style	3.79	.34	High level	1
Teaching performance	3.78	.33	High level	2
Teaching preference	3.57	.40	High level	7
Job satisfaction	3.62	.46	High level	5
Teacher's commitment	3.59	.45	High level	6
Teacher's acceptance	3.76	.36	High level	3
Student engagement	3.67	.42	High level	4

The results highlighted participants' perceptions of the effects of technology integration across seven indicators. Overall, the findings suggested that participants perceived a high level of impact from technology integration with these indicators. The study indicated that technology integration had a substantial effect on teaching style, as evidenced by the overall mean of 3.79 (SD = .34). This high mean score suggested a widespread agreement among participants that incorporating technology significantly influenced and enhanced their teaching approaches.

Despite a high level of effect on teaching preference, it is noteworthy that it received the lowest mean among the seven indicators, with a mean of 3.57 (SD = .40). This suggested that while participants acknowledged the positive impact of technology on their teaching

preferences, there may have been variations in the extent to which educators preferred technology-assisted methods over traditional approaches.

Significant Difference between the Effects of Technology Integration and Demographic Profile

The succeeding tables reveal the comparison of the effects of technology integration when the teachers are grouped according to their demographic profile. The Independent Sample T-test was applied to compare the Effects of Technology Integration when the teachers were grouped according to their sex. On the other hand, to compare the Effects of Technology Integration the participants were grouped according to their age, years in teaching, educational attainment, and subject teaches, One-way Analysis of Variance was carried out.

Table 11: Test of Difference Between the Effects of Technology Integration when the teachers are grouped according to Age

Indicators	Age	N	Mean	Sd	F-value (29)	p-value	Remarks
Teaching Style	25 - 30 y/o	14	3.69 _a	0.38	2.16 ^{ns}	.134	Do not Reject the Null Hypothesis
	31 - 35 y/o	10	3.92 _a	0.10			
	36 - 40 y/o	6	3.87 _a	0.21			
Teaching Performance	25 - 30 y/o	14	3.61 _a	0.41	5.93 ^{**}	.007	Reject the Null Hypothesis
	31 - 35 y/o	10	4.00 _b	0.00			
	36 - 40 y/o	6	3.93 _a	0.10			
Teacher Preference	25 - 30 y/o	14	3.39 _a	0.38	5.34 [*]	.011	Reject the Null Hypothesis
	31 - 35 y/o	10	3.68 _b	0.41			
	36 - 40 y/o	6	3.93 _b	0.10			
Job Satisfaction	25 - 30 y/o	14	3.46 _a	0.44	8.05 ^{**}	.002	Reject the Null Hypothesis
	31 - 35 y/o	10	4.00 _b	0.00			
	36 - 40 y/o	6	3.80 _b	0.31			
Teachers' Commitment	25 - 30 y/o	14	3.40 _a	0.43	5.95 ^{**}	.007	Reject the Null Hypothesis
	31 - 35 y/o	10	3.76 _b	0.31			
	36 - 40 y/o	6	3.93 _b	0.10			
Teachers' Acceptance	25 - 30 y/o	14	3.84 _a	0.19	5.04 [*]	.014	Reject the Null Hypothesis
	31 - 35 y/o	10	4.00 _b	0.00			
	36 - 40 y/o	6	4.00 _b	0.00			
Student Engagement	25 - 30 y/o	14	3.59 _a	0.46	2.15 ^{ns}	.135	Do not Reject the Null Hypothesis
	31 - 35 y/o	10	3.92 _a	0.10			
	36 - 40 y/o	6	3.67 _a	0.52			

Overall	25 - 30 y/o	14	3.57_a	0.34	6.06**	.007	Reject the Null Hypothesis
	31 - 35 y/o	10	3.90_b	0.05			
	36 - 40 y/o	6	3.88_b	0.19			

** significant at 0.01 alpha level; ns – not significant at 0.05 alpha level; Mean ratings in a row not sharing subscripts are significantly different at .05 level

As demonstrated in Table 11, the test statistics value [F(29)=6.06; p-value=.007] signifies that there is enough evidence that a significant difference exists in the effects of technology integration when they are grouped according to their age. Furthermore, the post hoc test (Tukey HSD) infers that the effects of technology integration on teachers who are 31 to 35 years old (Mean=3.90; SD=0.05) and 36 to 40 years old (Mean=3.88; SD=0.19) are significantly higher than 25 to 30 years old (Mean=3.57; SD=0.34).

Based on the results provided, several implications and analyses could be drawn regarding the effects of technology integration on teachers across different age groups. Notably, the findings indicated a significant difference in various sub-variables related to teaching performance, teacher preference, job satisfaction, teachers' commitment, and teachers' acceptance when teachers were grouped according to their age. This suggested that the impact of technology integration varied among different age cohorts of teachers. Specifically, teachers in the age groups of 31 to 35 and 36 to 40 years old

demonstrated significantly higher effects of technology integration across multiple domains compared to their younger counterparts aged 25 to 30. This highlighted the importance of considering age-related differences in the implementation and utilization of technology in educational settings. Younger teachers might have required additional support or training to fully leverage the benefits of technology integration, while older teachers might have benefited from targeted strategies to enhance their engagement and effectiveness with technology.

These findings implied the need for tailored approaches to technology integration in education that addressed the diverse needs and preferences of teachers across different age groups. Additionally, the significant difference in the effects of technology integration based on age emphasized the importance of ongoing professional development initiatives that catered to the evolving technological landscape in education, ensuring that teachers of all ages were equipped with the necessary skills and resources to effectively integrate technology into their teaching practices.

Table 12: Test of Difference Between the Effects of Technology Integration when the teachers are grouped according to Sex

Indicators	Gender	N	Mean	Sd	T-value (28)	p-value	Remarks
Teaching Style	Male	12	3.93	0.16	2.13 *	.043	Reject the Null Hypothesis
	Female	18	3.71	0.34			
Teaching Performance	Male	12	3.88	0.29	1.03 ns	.313	Do not Reject the Null Hypothesis
	Female	18	3.76	0.36			
Teacher Preference	Male	12	3.50	0.31	-1.02 ns	.315	Do not Reject the Null Hypothesis
	Female	18	3.66	0.46			
Job Satisfaction	Male	12	3.82	0.35	1.22 ns	.232	Do not Reject the Null Hypothesis
	Female	18	3.63	0.44			
Teachers' Commitment	Male	12	3.82	0.28	2.23 *	.034	Reject the Null Hypothesis
	Female	18	3.50	0.44			
Teachers' Acceptance	Male	12	3.98	0.06	1.71 ns	.098	Do not Reject the Null Hypothesis
	Female	18	3.89	0.18			
Student Engagement	Male	12	3.83	0.39	1.33 ns	.195	Do not Reject the Null Hypothesis
	Female	18	3.63	0.41			
Overall	Male	12	3.83	0.14	1.33 ns	.195	Do not Reject the Null Hypothesis
	Female	18	3.68	0.36			

* Significant at 0.05 alpha level; ns – not significant at 0.05 alpha level

Based on Table 12, the corresponding significant values for each sub-variable of the Effects of Technology Integration are higher than the value of 0.05 significant level. As a result, there is no significant difference posted

on the effects of technology integration when they are grouped according to their gender, as indicated by the test statistics value [T(28)=1.33; p-value=.195].

Based on the results presented, it was evident that the

effects of technology integration did not significantly differ based on the gender of teachers. The corresponding significant values for each sub-variable, including teaching performance, teacher preference, job satisfaction, teachers' acceptance, and student engagement, were all higher than the predetermined significance level of 0.05. This indicated that there was no substantial variation in these variables among male and female teachers. However, two sub-variables, teaching style, and teachers' commitment, demonstrated a significant difference based on gender, with corresponding significant values below the 0.05 level. Specifically, male teachers exhibited significantly higher effects of technology integration in teaching style

and teachers' commitment compared to their female counterparts. Nevertheless, when considering the effects of technology integration overall, regardless of gender, the test statistics value indicated no significant difference. These findings suggested that while gender may have influenced certain aspects such as teaching style and teachers' commitment, overall, technology integration had a similar impact on both male and female teachers. Hence, efforts to enhance technology integration in education should have focused on fostering equitable opportunities and support for all teachers, irrespective of gender, to ensure that they could effectively leverage technology in their teaching practices.

Table 13: Test of Difference Between the Effects of Technology Integration when the teachers are grouped According to Years in Teaching

Indicators	Years in Teaching	N	Mean	Sd	F-value (29)	p-value	Remarks
Teaching Style	1 - 5 years	13	3.66 _a	0.39	4.64*	.019	Reject the Null Hypothesis
	6 - 10 years	10	4.00 _b	0.00			
	> 10 years	7	3.77 _a	0.14			
Teaching Performance	1 - 5 years	13	3.66 _a	0.39	2.41 ^{ns}	.109	Do not Reject the Null Hypothesis
	6 - 10 years	10	3.90 _a	0.32			
	> 10 years	7	3.94 _a	0.10			
Teacher Preference	1 - 5 years	13	3.28 _a	0.35	13.67**	.000	Reject the Null Hypothesis
	6 - 10 years	10	3.76 _b	0.31			
	> 10 years	7	3.94 _b	0.10			
Job Satisfaction	1 - 5 years	13	3.49 _a	0.44	3.92*	.032	Reject the Null Hypothesis
	6 - 10 years	10	3.90 _b	0.32			
	> 10 years	7	3.83 _b	0.29			
Teachers' Commitment	1 - 5 years	13	3.49 _a	0.49	1.99 ^{ns}	.156	Do not Reject the Null Hypothesis
	6 - 10 years	10	3.82 _a	0.30			
	> 10 years	7	3.60 _a	0.26			
Teachers' Acceptance	1 - 5 years	13	3.85 _a	0.20	3.84*	.034	Reject the Null Hypothesis
	6 - 10 years	10	3.98 _b	0.06			
	> 10 years	7	4.00 _b	0.00			
Student Engagement	1 - 5 years	13	3.55 _a	0.46	4.64*	.018	Reject the Null Hypothesis
	6 - 10 years	10	4.00 _b	0.00			
	> 10 years	7	3.60 _a	0.42			
Overall	1 - 5 years	13	3.57_a	0.36	5.21*	.012	Reject the Null Hypothesis
	6 - 10 years	10	3.91_b	0.14			
	> 10 years	7	3.81_b	0.14			

** Significant at 0.01 alpha level; ns – not significant at 0.05 alpha level; Mean ratings in a row not sharing subscripts are significantly different at .05 level

To summarize Table 13, the test statistics value [F(29)=5.21; p-value=.012] implies that there is sufficient evidence that a significant difference exists in the effects of technology integration when they are grouped according to their years in teaching. To be more specific, the post hoc test (Tukey HSD) conveys that the effects of technology integration on teachers who have been teaching for 6 to 10 years (Mean=3.91; SD=0.14)

and more than 10 years (Mean=3.81; SD=0.14) are significantly higher than on those who have been teaching for 1 to 5 years (Mean=3.57; SD=0.36).

The results provided significant insights into the effects of technology integration on teachers based on their years of experience in teaching. While there was no significant difference observed in teaching performance and teachers' commitment across different tenure

groups, a notable variation was evident in other sub-variables. Specifically, teaching style, teacher preference, job satisfaction, teachers' acceptance, and student engagement demonstrated significant differences based on years in teaching. The post hoc test further elucidated these distinctions, revealing that teachers with 6 to 10 years and more than 10 years of experience consistently experienced significantly higher effects of technology integration compared to those with 1 to 5 years of experience across various aspects. Notably, in teaching style, teacher preference, job satisfaction, teachers' acceptance, and student engagement, technology integration had a more pronounced impact on teachers

with intermediate levels of experience.

These findings highlighted the importance of considering teachers' tenure when implementing technology integration initiatives in education. Efforts to support and train teachers, particularly those with fewer years of experience, were crucial in maximizing the benefits of technology integration and enhancing overall teaching effectiveness. Additionally, tailored professional development programs aimed at addressing the specific needs and preferences of teachers at different stages of their careers could contribute to more effective technology integration practices in educational settings.

Table 14: Test of Difference between the Effects of Technology Integration when the teachers are grouped According to Educational Attainment

Indicators	Educational Attainment	N	Mean	Sd	F-value (29)	p-value	Remarks
Teaching Style	Bachelor's	16	3.73 _a	0.37	1.36 ^{ns}	.274	Do not Reject the Null Hypothesis
	Master's	10	3.92 _a	0.17			
	Doctorate	4	3.80 _a	0.00			
Teaching Performance	Bachelor's	16	3.73 _a	0.37	1.30 ^{ns}	.289	Do not Reject the Null Hypothesis
	Master's	10	3.86 _a	0.31			
	Doctorate	4	4.00 _a	0.00			
Teacher Preference	Bachelor's	16	3.41 _a	0.43	5.20 [*]	.012	Reject the Null Hypothesis
	Master's	10	3.72 _b	0.29			
	Doctorate	4	4.00 _b	0.00			
Job Satisfaction	Bachelor's	16	3.59 _a	0.44	2.03 ^{ns}	.151	Do not Reject the Null Hypothesis
	Master's	10	3.78 _a	0.37			
	Doctorate	4	4.00 _a	0.00			
Teachers' Commitment	Bachelor's	16	3.59 _a	0.49	1.46 ^{ns}	.251	Do not Reject the Null Hypothesis
	Master's	10	3.78 _a	0.29			
	Doctorate	4	3.40 _a	0.00			
Teachers' Acceptance	Bachelor's	16	3.88 _a	0.19	2.13 ^{ns}	.138	Do not Reject the Null Hypothesis
	Master's	10	3.98 _a	0.06			
	Doctorate	4	4.00 _a	0.00			
Student Engagement	Bachelor's	16	3.64 _a	0.45	0.57 ^{ns}	.571	Do not Reject the Null Hypothesis
	Master's	10	3.80 _a	0.42			
	Doctorate	4	3.80 _a	0.00			
Overall	Bachelor's	16	3.65_a	0.36	1.67^{ns}	.207	Do not Reject the Null Hypothesis
	Master's	10	3.84_a	0.17			
	Doctorate	4	3.86_a	0.00			

** Significant at 0.01 alpha level; ns – not significant at 0.05 alpha level; Mean ratings in a row not sharing subscripts are significantly different at .05 level

Essentially, there is no significant difference observed in the effects of technology integration when they are grouped according to educational attainment, as marked by the test statistics value [F(29)=1.67; p-value=.207]. The results offered an understanding of how technology integration affected teachers based on their educational background. While no notable differences were detected in variables such as teaching style, teaching performance,

job satisfaction, teachers' commitment, teachers' acceptance, and student engagement across various educational levels, an exception was evident in teacher preference. The significant contrast in teacher preference suggested that educators with advanced academic credentials, particularly those with Doctorate and Master's degrees, tended to show a stronger inclination toward technology integration compared to their counterparts

with Bachelor's degrees. This observation emphasized the potential impact of educational qualifications on teachers' attitudes toward integrating technology in the classroom. However, overall, the findings indicated that educational attainment did not notably influence the effects of technology integration on teachers. This suggested that teachers may have derived similar benefits from technology integration initiatives regardless of their educational background. Hence, efforts to promote technology

integration in education should have prioritized providing support and resources to all educators, regardless of their academic credentials, to ensure fair access to the advantages of technology in teaching and learning. Furthermore, future research could delve into the underlying factors shaping teacher preferences for technology integration across different educational attainment levels, aiding in the development of more targeted interventions to address the diverse needs of educators.

Table 15: Test of Difference Between the Effects of Technology Integration when the teachers are grouped According to Subject Taught

Indicators	Subject Teachers	N	Mean	Sd	F-value (29)	p-value	Remarks
Teaching Style	General Education	18	3.93 _b	0.14	75.44**	.000	Reject the Null Hypothesis
	Business Subject	5	3.20 _a	0.00			
	All Subjects	7	3.89 _b	0.11			
Teaching Performance	General Education	18	3.90 _b	0.24	31.11**	.000	Reject the Null Hypothesis
	Business Subject	5	3.20 _a	0.00			
	All Subjects	7	4.00 _b	0.00			
Teacher Preference	General Education	18	3.60 _b	0.34	20.52**	.000	Reject the Null Hypothesis
	Business Subject	5	3.00 _a	0.00			
	All Subjects	7	4.00 _b	0.00			
Job Satisfaction	General Education	18	3.79 _b	0.30	27.91**	.000	Reject the Null Hypothesis
	Business Subject	5	3.00 _a	0.00			
	All Subjects	7	4.00 _b	0.00			
Teachers' Commitment	General Education	18	3.79 _b	0.32	14.13**	.000	Reject the Null Hypothesis
	Business Subject	5	3.00 _a	0.00			
	All Subjects	7	3.66 _b	0.32			
Teachers' Acceptance	General Education	18	3.99 _b	0.05	229.02**	.000	Reject the Null Hypothesis
	Business Subject	5	3.60 _a	0.00			
	All Subjects	7	4.00 _b	0.00			
Student Engagement	General Education	18	3.84 _b	0.32	23.05**	.000	Reject the Null Hypothesis
	Business Subject	5	3.00 _a	0.00			
	All Subjects	7	3.89 _b	0.11			
Overall	General Education	18	3.84_b	0.13	86.39**	.000	Reject the Null Hypothesis
	Business Subject	5	3.14_a	0.00			
	All Subjects	7	3.92_b	0.07			

** Significant at 0.01 alpha level; ns – not significant at 0.05 alpha level; Mean ratings in a row not sharing subscripts are significantly different at .05 level

Overall, the test statistics value [F(29)=86.39; p-value=.000] denotes sufficient evidence that a significant difference exists in the effects of technology integration when grouped according to the subjects they teach. To be more precise, the post hoc test (Tukey HSD) reflects that the effects of technology integration on teachers teaching All Subjects (Mean=3.92; SD=0.07) and General Education (Mean=3.84; SD=0.13) significantly surpass those of teachers handling Business Subjects (Mean=3.14; SD=0.00).

The results above showed there were significant differences in the effects of technology integration among different teaching subjects. All sub-variables of

Effects of Technology Integration had a value below the 0.05 level, indicating that there were variations among teachers grouped according to the subjects they were teaching. Conversely, A post hoc test using Tukey HSD was used in determining specific areas of disparity between variables. Significantly, the integration of technology had a far greater effect on teaching style, teaching performance, teacher preference, job satisfaction, teachers' commitment, teachers' acceptance, and student engagement among General Education and All Subjects teachers than among Business Subjects teachers. This difference showed how subject specialization affects the efficacy of technology integration in teaching practices.

In other words, the test statistics revealed sufficiently strong evidence that there were significant differences in the effect sizes of technology integration among different teaching subjects. More specifically, the post hoc test revealed that teacher instructing All Subjects and General Education showed significantly stronger effects of technology integration compared to their peers who only taught Business Subjects.

These findings were supported by a considerable amount of literature in use regarding technology in education and teacher effectiveness. Granić and Marangunić, in their study, focused on performance expectancy and effort expectancy as major factors influencing teachers' intentions to implement technologies, with effort expectancy having the strongest influence in implementation intentions. Similarly, Scherer *et al.* (2019) identified attitude toward technology as a critical mediator between intention and PE/PU within educational settings. The findings sounded very consistent with the present study in that all variables involved with teaching performance, teacher preference, job satisfaction, teachers' commitment, and teachers' acceptance were significantly affected by technology integration, regardless of age, gender, or teaching experience.

On the other hand, Kwok (2020) highlighted how strong

information technology is in transforming teaching styles and relating to students, whereas Barba-Sánchez *et al.* (2022) stressed that ICT skills fostered effective teaching practices, mainly in STEM subjects.

Moreover, Ahmed *et al.* (2021) stressed that well-designed online teacher resources might have a positive effect on learning outcomes and student engagement, which resonates with the focus of the current study in finding the key differences regarding the effects of technology integration on student engagement across different subjects of teaching. These studies, taken together, thus reiterated what was stated previously: technology integration in pedagogical practice shaped teaching practices, enhanced student engagement, and improved learning outcomes within education.

Challenges Encountered by the Teachers in Technology Integration

Based on the findings, the respondents faced several challenges in integrating technology as specified in Table 10. Eight indicators have been assessed whether the respondents agreed with some of the challenges that they might experience.

Table 16 exhibits the challenges encountered by the participants in the technology integration in the school.

Table 16: Challenges Encountered in the Technology Integration in the School

Statements	Mean	Std. Deviation	Interpretation	Rank
Indicators	Mean	SD	DE	Level
1. Inequal access of infrastructure and disparities to high-speed internet, modern devices, and software	3.47	0.78	Strongly Agree	High Level
2. Inadequate teacher training and professional development to leverage technology effectively.	3.30	0.75	Strongly Agree	High Level
3. Both teachers and students may resist adopting digital changes and new technological tools.	3.30	0.70	Strongly Agree	High Level
4. Concerns about data privacy and security become evident.	3.37	0.49	Strongly Agree	High Level
5. Socioeconomic disparities can result in some students being left behind in technology-integrated education.	3.43	0.50	Strongly Agree	High Level
6. Limited access to maintenance and technical support.	3.43	0.50	Strongly Agree	High Level
7. The lack of more comprehensive research and established best practices to know the most effective ways for technology integration becomes challenging.	3.10	0.80	Agree	Moderate Level
8. Students are experiencing digital distractions.	3.53	0.51	Strongly Agree	High Level
Overall Mean	3.37	0.53	Strongly Agree	High Level

Scale of Means: 4.00–3.26 Strongly Agree/High Level; 3.25–2.51 Agree/Moderate Level; 2.50–1.76 Disagree/Low Level; 1.75–1.00 Strongly Disagree/Very Low Level; SD-Standard Deviation; DE-Descriptive Equivalent

Based on the results of Table 15, the indicator with the highest rating is “Students are experiencing digital distractions.” (Mean=3.53; SD=0.51; Strongly Agree; High Level). On the other hand, the indicator with the lowest rating is “The lack of more comprehensive research and established best practices to know the most effective ways for technology integration becomes

challenging.” (Mean=3.10; SD=0.80; Agree; Moderate Level). Collectively, the rating (Mean=3.37; SD=0.53) denotes that the teachers responded “Strongly Agree” on the challenges encountered in the technology integration in the school. Additionally, the teachers face significant challenges when integrating technology into the school, often reaching a “High Level” of difficulty.

These findings stressed the importance of addressing disparities in infrastructure access while simultaneously navigating resistance to technological change. Efforts aimed at providing equitable access to technological resources and fostering a culture of openness and adaptability towards technological innovations were essential for overcoming the challenges encountered in technology integration. Systematically tackling these issues could enable educational institutions to establish an atmosphere favorable to the successful integration of technology, ultimately enriching the teaching and learning encounters for educators and students alike.

These findings aligned with the study of Chiu *et al.* (2023) that explored the integration of artificial intelligence (AI) into educational practices. While AI-powered systems successfully personalized learning tasks and fostered communication skills among students, challenges persisted due to the scarcity of supportive learning resources, as evidenced by various studies. Additionally, AI applications aimed at analyzing student work and enhancing adaptability in digital learning environments faced obstacles, including the pre-prepared nature of feedback and the lack of appropriate evaluation methods. Moreover, concerns highlighted by Hero's (2019) study emphasized the challenges teachers encountered in fully integrating technology into their teaching practices, despite recognizing its potential benefits. The importance of comprehensive professional development programs to support technology integration, particularly considering varying levels of tech skills among faculty members, was underscored. Addressing these challenges through targeted training initiatives could empower teachers to leverage technology effectively, ultimately enhancing classroom engagement and learning outcomes.

Proposed Intervention Framework



Figure 1: Intervention Framework (Dizon, 2024)

The proposed intervention framework consists of seven categories: teacher professional development programs, curriculum integration and resource allocation, support

mechanisms, teacher reflection and feedback, digital equity and accessibility, and research and evaluation. This framework emphasizes the need for comprehensive professional development programs to enhance teachers' ICT skills and knowledge. It also calls for a curriculum revision to align education with the demands of the digital age and highlights the necessity of budgeting for access to appropriate technology tools.

Additionally, the framework emphasizes the importance of establishing support structures, such as technology integration support teams, to align technology use with curricular objectives and teaching goals. Promoting a culture of self-assessment and peer observation is also essential for effective technology integration. To bridge the digital divide, the framework advocates partnering with local organizations and government agencies to ensure accessibility and inclusivity.

Finally, continuous research and evaluation are crucial to understanding the impact of technology integration on student learning outcomes and teacher job satisfaction.

CONCLUSION

The demographic profile analysis revealed diverse teacher participants in age, gender, teaching experience, educational background, and subjects taught, enhancing the generalizability of the studies' results. It can be noted that assessments on the effects of technology revealed significant positive effects of technology integration, specifically determinations of effects across lenses of teaching style, performance, preference, job satisfaction, commitment, acceptance, and student engagement, with notable differences among demographics. Delving into differences of effects vis-à-vis demography, age and experience significantly showed differences in teaching performance and job satisfaction, with those aged 31-40 and more experienced teachers showing greater effects. Gender and educational attainment, on the other hand, showed less pronounced differences except in teacher preference, where higher degrees indicated stronger integration effects. Subject matter also played a significant role, with General Education teachers experiencing greater integration instances than those teaching Business Subjects. Recommendations include tailored professional development, ongoing support, and collaborative environments to sustain technology integration, considering demographic distinctions, and further research into the observed differences to maximize benefits across diverse teacher demographics. And implementing multifaceted intervention frameworks involving professional development, curriculum revisions, support structures, reflection mechanisms, and digital equity initiatives is essential to be considered by educational institutions and policymakers.

Acknowledgment

The researcher would like to thank the Bataan Peninsula State University and Research Development Office for the support extended to finish this paper.

REFERENCES

- Agbo, F. J., Olaleye, S. A., Bower, M., *et al.* (2023). Examining the relationships between students' perceptions of technology, pedagogy, and cognition: The case of immersive virtual reality mini games to foster computational thinking in higher education. *Smart Learning Environments*, 10(16). <https://doi.org/10.1186/s40561-023-00233-1>
- Ahmed, Z. A. T., Jadhav, M. E., Al-madani, A. M., Tawfik, M., Alsubari, S. N., & Shareef, A. A. A. (2022). Real-time detection of student engagement: Deep learning-based system. In A. Khanna, D. Gupta, S. Bhattacharyya, A. E. Hassanien, S. Anand, & A. Jaiswal (Eds.), *International Conference on Innovative Computing and Communications: Advances in Intelligent Systems and Computing* (Vol. 1387, pp. 297–308). Springer. https://doi.org/10.1007/978-981-16-2594-7_26
- Auld, S. (2019, July 18). *Different teaching styles suit different students*. Australian Christian College. <https://www.acc.edu.au/blog/students-suit-different-styles/>
- Baporikar, N. (2020). Reflective teaching and technology integration in management education. In *Handbook of research on diverse teaching strategies for the technology-rich classroom* (pp. 153–169). IGI Global.
- Barba-Sánchez, V., Gouveia-Rodrigues, R., & Meseguer-Martínez, Á. (2022). Information and communication technology (ICT) skills and job satisfaction of primary education teachers in the context of COVID-19: Theoretical model. *Profesional De La Información*, 31(6), e310617. <https://doi.org/10.3145/epi.2022.nov.17>
- Barba-Sánchez, V., Arias-Antúnez, E., & Orozco-Barbosa, L. (2019). Smart cities as a source for entrepreneurial opportunities: Evidence for Spain. *Technological Forecasting and Social Change*, 148, 119713. <https://doi.org/10.1016/j.techfore.2019.119713>
- Bergdahl, N., Nouri, J., & Fors, U. (2020). Disengagement, engagement, and digital skills in technology-enhanced learning. *Education and Information Technologies*, 25(2), 957–983. <https://doi.org/10.1007/s10639-019-09998-w>
- Chai, C. S., Jong, M., Yin, H., Chen, M., & Zhou, W. (2019). Validating and modeling teachers' technological pedagogical content knowledge for integrative science, technology, engineering, and mathematics education. *Educational Technology & Society*, 22(3), 61–73. <https://www.jstor.org/stable/26896710>
- Chew, E., & Chua, X. N. (2020). Robotic Chinese language tutor: Personalizing progress assessment and feedback or taking over your job? *On the Horizon*, 28(3), 113–124. <https://doi.org/10.1108/OTH-04-2020-0015>
- Chiu, K. F., Thomas, X., Qi, X. Z., Chai, C. S., & Cheng, M. (2023). Systematic literature review on opportunities, challenges, and future research recommendations of artificial intelligence in education. *Computers and Education: Artificial Intelligence*, 4, 100118. <https://doi.org/10.1016/j.caeai.2022.100118>
- Christopoulos, A., Kajasilta, H., Salakoski, T., & Laako, M. (2020). Limits and virtues of educational technology in elementary school mathematics. *Journal of Educational Technology Systems*, 49(1). <https://doi.org/10.1177/0047239520908838>
- D'Angelo, C. (2018). *The impact of technology integration, technology, and curriculum* (Summer 2018). Pressbooks. <https://pressbooks.pub/techandcurriculum/chapter/engagement-and-success/>
- Dubé, A. K., & Wen, R. (2021). Identification and evaluation of technology trends in K-12 education from 2011 to 2021. *Education and Information Technologies*. <https://doi.org/10.007/s10639-021-10689-8>
- El-Maghraby, A. S. A. (2021). Investigating the effectiveness of Moodle-based blended learning in developing writing skills for university students. *Journal of Research in Curriculum Instruction and Educational Technology*, 7(1), 115–140. <https://doi.org/10.21608/jrciet.2021.134636>
- Eppard, J., Williams, C., Hojeij, Z., & Johnson, J. D. (2022). iPad integration: How parents and students perceive its effectiveness. *International Journal of Education in Mathematics, Science, and Technology*. <https://doi.org/10.46328/ijemst.2079>
- Fu, S., Gu, H., & Yang, B. (2020). The affordances of AI-enabled automatic scoring applications on learners' continuous learning intention: An empirical study in China. *British Journal of Educational Technology*, 51(5), 1674–1692. <https://doi.org/10.1111/bjet.12995>
- Granić, A., & Marangunić, N. (2019). Technology acceptance model in educational context: A systematic literature review. *British Journal of Educational Technology*, 50(5), 2572–2593.
- Halili, S. H. (2019). Technological advancements in education 4.0. *The Online Journal of Distance Education and E-Learning*, 7(1), 63–69.
- Hero, J. L. (2019). The impact of technology integration in teaching performance. *International Journal of Sciences: Basic and Applied Research (IJSBAR)*, 48(1), 101–114. <https://core.ac.uk/download/pdf/249336742.pdf>
- Hew, K. F., Hu, X., Qiao, C., & Tang, Y. (2020). What predicts student satisfaction with MOOCs: A gradient boosting trees supervised machine learning and sentiment analysis approach. *Computers & Education*, 145, 103724. <https://doi.org/10.1016/j.compedu.2019.103724>
- Hiranker, K., & Kittisunthonphisarn, N. (2020). E-learning management system based on reality technology with AI. *International Journal of Information and Education Technology*, 10(4), 259–264. <https://doi.org/10.18178/ijiet.2020.10.4.1373>
- Huang, F., Teo, T., & Zhou, M. (2020). Chinese students' intentions to use Internet-based technology for learning. *Educational Technology Research and Development*, 68(1), 575–591. <https://doi.org/10.1007/s11423-019-09695-y>
- Hwang, G. J., & Wu, P. H. (2020). Applications, impacts, and trends of mobile technology-enhanced learning: A review of 2008–2018 publications in selected SSCI

- journals. *Computers & Education*, 143, 103678.
- Jahnke, I., & Liebscher, J. (2020). Three types of integrated course designs for using mobile technologies to support creativity in higher education. *Computers & Education*, 146, 103782. <https://doi.org/10.1016/j.compedu.2019.103782>
- Jakubek, J. (2023). *Exploring the impact of technology implementation at the elementary level* (M.Ed. Literature Reviews, 4). https://digitalcommons.tacoma.uw.edu/med_theses/4
- Johnson, L., Adams Becker, S., Estrada, V., & Freeman, A. (2019). *NMC Horizon Report: 2019 Higher Education Edition*. The New Media Consortium.
- Jones, M. (2019). The fusion of technology and education: A melodious symphony. *Educational Innovations*, 5(1), 102–115.
- Jung, I., & Lee, J. (2020). A cross-cultural approach to the adoption of open educational resources in higher education. *British Journal of Educational Technology*, 51(1), 263–280.
- Katyara, P., Katyara, K. H., Muhiuddin, G., & Shaboz, S. (2022). Impact of technology on student's engagement in different dimensions: Cognitive, behavioral, reflective, and social engagement. *Webology*, 19(3). <https://www.researchgate.net/publication/373102909>
- Kickmeier-Rust, M. D., & Holzinger, A. (2019). Interactive ant colony optimization to support adaptation in serious games. *International Journal of Serious Games*, 6(3), 37–50. <https://doi.org/10.17083/ijsg.v6i3.308>
- Kim, H. S., Kim, N. Y., & Cha, Y. (2021). Is it beneficial to use virtual reality for the purpose of understanding in engineering education? *Journal of Educational Technology Systems*, 50(1). <https://doi.org/10.1177/00472395211013830>
- Kirkwood, A., & Price, L. (2019). Technology-enhanced learning and teaching in higher education: What is “enhanced” and how do we know? *Computers & Education*, 138, 13–23. <https://doi.org/10.1016/j.compedu.2019.04.015>
- Korhonen, V., Mattsson, M., Inkinen, M., & Toom, A. (2019). Understanding the multidimensional nature of student engagement during the first year of higher education. *Frontiers in Psychology*, 10, 1056. <https://doi.org/10.3389/fpsyg.2019.01056>
- Kwok, J. (2020, February 7). How technology in education improves student engagement. Australian Christianaan College. <https://www.acc.edu.au/blog/technology-improves-student-engagement/>
- Lai, J. W. M., & Bower, M. (2019). How is the use of technology in education evaluated? A systematic review. *Computers & Education*, 133, 27–42. <https://doi.org/10.1016/j.compedu.2019.01.010>
- Lai, J. W. M., Bower, M., Breyer, Y., & De Nobile, J. (2022). Comprehensive evaluation of the use of technology in education: Validation with a cohort of global online learners. *Education and Information Technologies*. <https://doi.org/10.1007/s10639-022-10986-w>
- Liu, Q., & Lin, P. (2021). How technology-enhanced learning systems can support teacher development: A case study of integrating OERs into flipped classroom. *Educational Technology Research and Development*, 69(1), 19–40. <https://doi.org/10.1007/s11423-020-09839-7>
- Makhataeva, Z., & Varol, H. A. (2020). Augmented reality for robotics: A review. *Robots*, 9(4), 11. <https://doi.org/10.3390/robots9040111>
- McDiarmid, G. W., & Zhao, Y. (2022). Time to rethink educating for a technology-transformed world. *ECNU Review of Education*. <https://doi.org/10.1177/20965311221107649>
- Meyer, A. P. (2020). Mobile learning: A learner-centered approach. In *Mobile learning for the digital classroom* (pp. 12–27). IGI Global.
- Muller, F. A., & Wulf, T. (2020). Technology-supported management education: A systematic review of antecedents of learning effectiveness. *International Journal of Educational Technology in Higher Education*, 17(1). <https://doi.org/10.1186/s41239-020-00226-1>
- Mumtaz, S., & Riaz, S. (2019). The impact of ICT integration on student learning outcomes. *Journal of Educational Technology & Society*, 22(3), 1–10.
- Nikolopoulou, K., & Gialamas, V. (2019). The impact of mobile technology on learning. *Computers & Education*, 128, 106–116. <https://doi.org/10.1016/j.compedu.2018.09.004>
- Padilla, A., Concha, A., & Hernández-Leal, P. (2022). Opportunities and challenges in artificial intelligence-supported learning analytics. *Journal of Educational Data Mining*, 14(1), 1–24.
- Park, S. Y., & Song, K. S. (2020). Examining social presence and collective efficacy on international online collaborative learning. *Journal of Interactive Learning Research*, 31(2), 101–114.
- Phillips, L. (2018). Integrating technology and pedagogy: Systematic review of peer-reviewed articles. *Journal of Educational Technology Development and Exchange (JETDE)*, 11(1). <https://doi.org/10.18785/jetde.1101.03>
- Rangel, J. (2021). Student perceptions of digital game-based learning in science and social studies. *Journal of Educational Technology Systems*, 50(1). <https://doi.org/10.1177/00472395211010894>
- Ricci, R. C., Souza Costa, A., & Pereira Borges de Freitas, K. A. (2023). Impacts of technology on children's health: A systematic review. *Revista Paulista de Pediatria*, 41, e2020504. <https://doi.org/10.1590/1984-0462/2023/41/2020504>
- Sarker, M. N. I., Wu, M., Qian, C., & Alam, G. M. M. (2019). Leveraging digital technology for better learning and education: A systematic literature review. *International Journal of Information and Education Technology*, 9(7). <http://dx.doi.org/10.18178/ijiet.2019.9.7.1246>
- Schäfer, A., & Brahler, M. (2022). Evaluating the impact of technology-enhanced learning on student engagement and motivation. *Educational Technology Research and Development*, 70(1), 23–40.

- Scherer, R., Siddiq, F., & Tondeur, J. (2019). The technology acceptance model (TAM): A meta-analytic structural equation modeling approach to explaining teachers' adoption of digital technology in education. *Computers & Education*, 128, 13–35. <https://doi.org/10.1016/j.compedu.2018.09.009>
- Solé-Beteta, X., Navarro, J., & Gajšek, B. (2022). A data-driven approach to quantify and measure students' engagement in synchronous virtual learning environments. *Sensors (Basel, Switzerland)*, 22(9). <https://doi.org/10.3390/s22093294>
- Sung, H. Y., Chang, H., & Liu, Y. (2020). The effect of online learning on students' critical thinking skills: Evidence from a large-scale study. *Journal of Educational Technology Development and Exchange*, 13(1), 10. <https://doi.org/10.1080/17439884.2021.2004925>
- Tang, H., Lin, Y., & Qian, Y. (2020). Understanding K-12 teachers' intention to adopt open educational resources: A mixed methods inquiry. *British Journal of Educational Technology*, 51(6), 2558–2572. <https://doi.org/10.1111/bjet.12937>
- Thang, S. M., Mahmud, W. A., & Ahmad, F. (2020). ICT and mobile learning: Analysis of ICT skills, and perceptions among Malaysian students. *Journal of Educational Technology & Society*, 23(3), 33–47.
- Undheim, M., & Jernes, M. (2020). Teachers' pedagogical strategies when creating digital stories with young children. *European Early Childhood Education Research Journal*, 28(2), 256–271. <https://doi.org/10.1080/1350293X.2020.1735743>
- Wallace-Spurgin, M. (2019). Measuring student cognitive engagement when using technology. In I. Sahin & V. Akerson (Eds.), *Monument* (Vol. 1). CO, USA: ISTES Organization.
- Wallace-Spurgin, M. (2020). Implementing technology: Measuring student cognitive engagement. *The International Journal of Technology in Education*, 3(1). https://www.researchgate.net/publication/341613139_Implementing_Technology_Measuring_Student_Cognitive_Engagement/link/5ecb1c37a6fdcc90d696edd2/download
- Westera, W., Prada, R., et al. (2020). Artificial intelligence moving serious gaming: Presenting reusable game AI components. *Education and Information Technologies*, 25(1), 351-380. <https://doi.org/10.1007/s10639-019-09968-2>
- Yang, Y. Y., & Shulruf, B. (2019). Expert-led and artificial intelligence (AI) system-assisted tutoring course increase confidence of Chinese medical interns on suturing and ligature skills: Prospective pilot study. *Journal of Educational Evaluation for Health Professions*, 16. <https://doi.org/10.3352/jeehp.2019.16.7>
- Yilmaz, A. (2021). The effects of technology integration in education on prospective teachers' critical and creative thinking, multidimensional 21st century skills, and academic achievements. *Education Faculty, Department of Educational Sciences, Division of Measurement and Evaluation in Education*. <https://doi.org/10.17275/per.21.35.8.2>
- Yuen, A. H., & Ma, W. W. (2018). Information and communications technology (ICT) in education: A critical literature review and its implications. *International Journal of Education and Development Using Information and Communication Technology*, 14(3), 57-67.