Technology-integrated literacy instruction: A quantitative study to provide practical insights for secondary education

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ABSTRACT

This study evaluates the effectiveness of technology integration in enhancing reading abilities among secondary students and comprehends the viewpoints and experiences of both students and teachers in technology-driven learning environments. The study used the descriptive method and was applied to a sample of 300 students from grades 9 to 12, evenly distributed by gender and grade level drawn from three public secondary schools by a convenience selection procedure. Surveys were employed to collect data on students' perceptions of technology, engagement with digital texts, and experiences with technology-enhanced literacy activities. Research indicates that the use of technology in literacy instruction positively influences reading comprehension and writing proficiency. Interaction with digital texts is recognized as a crucial determinant of writing proficiency. Differences in students' opinions of technology-integrated literacy instruction were seen across many grade levels. The findings fill research gaps and offer practical insights for teachers and policymakers, contributing to the current body of knowledge. This research offers more data supporting the advantages of utilizing technology to enhance students' reading comprehension skills in secondary education. Teachers have to integrate technology-enhanced literacy exercises into their curricula to boost students' reading comprehension, writing skills and engagement with digital resources.

Contribution/Originality: The findings of this study address the gap in the existing literature and provide valuable insights for scholars and teachers. It provides guidance for future research in technology-integrated literacy training and contributes to the current discourse on the subject. Policymakers and educational leaders must emphasize equal access to technological resources and infrastructure to guarantee that all children benefit from technology-enhanced literacy instruction.

1. INTRODUCTION

Education has seen a substantial transformation recently due to swift technological advancements. The extensive utilization of digital devices, the plethora of online resources, and the evolving communication techniques have fundamentally altered the processes of information acquisition and dissemination, hence necessitating a reevaluation of the notion of literacy. Historically, literacy denoted the capacity to read and write written content.

239

Modern literacy includes various competencies and capabilities, such as digital literacy, media literacy, and information literacy (Ciampa, 2017).

Digital technologies, including interactive e-books, multimedia presentations, online news articles and social networking platforms have significantly altered human interaction with text. Adolescents actively participate in and produce digital content, dedicating considerable time online for social connection, amusement, and education (Chen, Jong, & Tsai, 2022; Mandel Morrow & Kunz, 2016). Teachers must adapt literacy training to correspond with the digital landscape and prepare students to critically assess information across many media.

In this context, the use of technology in literacy instruction is an effective method for engaging and empowering students in their educational pursuits. Technology provides multiple tools and resources that may enhance and expand conventional reading practices, accommodating various learning styles and preferences (Stewart & Babino, 2022). Students' comprehension, creativity and communication skills are enhanced through the use of digital storytelling tools which allow them to create and share multimedia narratives. Community involvement and the accumulation of collective knowledge are fostered by online collaborative tools that facilitate peer review and cooperation (López-Pellisa, Rotger, & Rodríguez-Gallego, 2021; Su, Ren, & Song, 2024; Zheng et al., 2024).

Moreover, literacy instruction that integrates technology may accommodate a diverse array of learners, including individuals with disabilities or language barriers. Assistive technology, such as text-to-speech software, voice recognition tools, and screen readers can improve the capacity of students with learning disabilities to access and engage with text more effectively (McIver, Gee, & Gitlow, 2025; Thapliyal & Ahuja, 2023). The flexibility and adaptability of digital resources allow teachers to tailor classes and deliver personalized learning experiences that address the distinct needs and interests of each student (Aloufi, Tashtoush, Shirawia, Tashtoush, & Az-Zo'bi, 2024).

Technology integration has promise in educational settings while its execution is laden with challenges and intricacies. Disparities in access, digital equity, and issues related to privacy and cybersecurity provide significant barriers to equitable technology integration (Smith, 2023). The rapid progression of technology necessitates ongoing professional development and support for teachers to effectively integrate technology into their teaching practices (Lillywhite & Wolbring, 2021; Nahar, Sulaiman, & Jaafar, 2022). Moreover, the rising incidence of digital distractions and the threat of information overload raise questions about fostering safe and deliberate technology use among students.

These issues highlight the critical need for studies that directly examine how literacy programs that include technology in their curricula affect students' attitudes, experiences and final grades. Researchers may offer valuable insights and evidence-based recommendations for educational practice and policy by analyzing the efficacy of various technological tools and pedagogical methods. Moreover, enabling students to exert greater influence and authority over the research process ensures that literacy instruction, including technology, remains pertinent, engaging, and inclusive for all learners in the contemporary digital landscape.

1.1. Problem of the Study

The integration of technology in literacy instruction offers advantages and obstacles for teachers in secondary school environments. Teachers must meticulously assess pedagogical strategies, identify obstacles, and evaluate their technological proficiency to effectively integrate technology into schools to enhance reading abilities. Although technology in education is increasingly important, there is a significant lack of empirical research on how technology-integrated literacy teaching affects student learning outcomes and experiences. The research aims to examine how well technology integration promotes reading skills in secondary students and to understand the perspectives and experiences of students and teachers in technology-based learning settings.

1.2. Research Questions

1. What are the effects of technology-integrated literacy instruction on students' reading comprehension abilities in secondary education settings?
2. How does technology-enhanced writing instruction influence students' writing proficiency and motivation?
3. What are the perceptions and experiences of students and teachers regarding the use of technology in literacy instruction, including barriers, facilitators, and best practices?

1.3. Significance of the Study

This study has important implications for educational practice, policy, and research. Studying how technology affects literacy abilities and attitudes may help create evidence-based teaching techniques and recommendations for teachers who want to use technology in their literacy training. The results may help in reducing the digital gap and advancing equal access to educational resources and opportunities. This study aims to provide significant insights into the problems and triumphs of technology-integrated literacy teaching in varied educational settings by emphasizing the perspectives of students and teachers in the research process.

1.4. Terms of the Study

The research spanned nine months, commencing in September and ending in May. Data is gathered continuously throughout the school year, gathering many data points to track longitudinal trends and changes. The study was conducted in partnership with public secondary schools in the local district after obtaining agreement from the students, teachers, and administrators involved. Data analysis will begin when data collecting is finished and will include applying suitable quantitative research methodologies and statistical tools.

2. LITERATURE REVIEW AND PREVIOUS STUDIES

The core of technology-integrated literacy education is based on the theoretical framework of constructivism, which suggests that learning is an active, social process where people build knowledge and meaning through interactions with their environment (Prakash Chand, 2023). From this viewpoint, technology acts as a tool to support and enable students to build knowledge, offering chances for discovery, experimentation, and cooperation (Fox-Turnbull, 2015; McCormick, 2004). Socio-cultural theories of learning highlight the significance of social interactions and cultural environments in influencing people's literacy practices (Vygotsky, 1978). Technology-integrated literacy training may create collaborative learning settings and connect students' ordinary literacy practices with academic discourse (Marín, Orellana, & Peré, 2019; Simpson, 2010).

Constructivism constitutes an active learning approach. Students direct and evaluate their learning through constructivism. They are not only getting information but also formulating their interpretations of an event and subsequently building on and verifying those ideas. The teacher functions as a mentor, directing students on their educational journey (Arpentieva, Retnawati, Akhmetova, Azman, & Kassymova, 2021; Hussein et al., 2024). Teachers should facilitate students' comprehension instead of merely supplying them with answers. The teacher urges all students to articulate their thoughts during the learning process. Constructivist approaches focus on both the learning process and the outcome. Vygotsky (1978) is the primary advocate of social constructivism. Social constructivists assert that knowledge is produced and collaboratively developed within a social setting. Social connection facilitates social learning, which subsequently promotes cognitive growth (Khasawneh, Ismail, & Hussen, 2024; Mohammed & Kınyo, 2020). A student can execute a task with adult supervision or with peer participation. Information and communication technologies create chances for students to collaborate with teachers and peers in the construction of knowledge and comprehension. Information and communication technology enhances collaborative and social learning. Social networking platforms, such as Facebook and WhatsApp facilitate

the realization of social learning. The utilization of email and computer-mediated communication facilitates collaborative learning grounded on a social constructivist framework (Kayii & Akpomi, 2022).

Numerous studies have examined the effects of technology-enhanced literacy instruction on several aspects of students' literacy development, including reading comprehension, writing proficiency, and motivation. Petrová (2022) investigated the influence of digital technology on reading comprehension. The research indicated that technology-enhanced instruction resulted in moderate yet significant enhancements in students' reading comprehension skills. Nizamuddin, Mohd Nor, and Hamat (2020) analyzed the influence of digital annotation tools on students' reading comprehension. The findings indicated that students utilizing digital annotation tools demonstrated enhanced interest and comprehension compared to those employing traditional methods.

Studies demonstrate that technology may substantially aid students in their writing processes and enhance motivation in writing instruction (Orellana & Mayorga, 2021; Zakaria & Aziz, 2019). Hashemnezhad and Zangalani (2012) conducted research comparing the effects of traditional writing teaching with technology-enhanced pedagogy. The findings indicated that students employing word processing software for writing and revising their assignments generated superior-quality papers and exhibited increased motivation and self-efficacy. Muhi (2023) performed a meta-analysis demonstrating that blogging improves students' writing skills, namely in content, structure, and voice.

Research has investigated the opinions and experiences of students and teachers about the use of technology in literacy instruction. Harris and Stamp (2016) conducted a qualitative study on students' perspectives on digital reading. The poll indicated that certain students preferred print books while others appreciated the convenience and accessibility of digital reading. Howard, Adams-Budde, Lambert, and Myers (2021) analyzed teachers' viewpoints and methodologies about the incorporation of technology into literacy education. It emphasized that access to technology, professional development, and pedagogical assistance are essential for effective technology integration.

3. METHODS

This study used a quantitative approach to evaluate the effectiveness of technology-enhanced literacy training in secondary education settings. The research duration was nine months with data collection occurring throughout the academic year.

The study employed a convenience sampling method to choose participants. Three public secondary schools in the vicinity were selected based on their willingness to participate and their availability of digital resources. The schools included First Abha High School, King Abdullah High School, and King Salam High School. The sample comprised 300 students from grades 9 to 12, evenly distributed by gender and grade level.

The primary tool for data collection was a survey questionnaire designed to assess students' perspectives on technology-integrated literacy training. This included their viewpoints on technology, interaction with digital texts, and involvement in technology-augmented literacy activities. The questionnaire included Likert-scale items and open-ended questions to provide qualitative insights.

The questionnaire was created based on a study of current research and was tested with a small group of students to ensure clarity and relevance. Face validity was confirmed by comments from experienced teachers and researchers in literacy education and technology integration.

The questionnaire's precision was evaluated through the assessment of content and construct validity. Content validity was established by correlating the survey items with the theoretical framework and research issues that informed the study. Construct validity was evaluated by exploratory factor analysis which validated the primary components of the questionnaire, attitudes towards technology, interaction with digital texts, and experiences with technology-enhanced literacy activities. The gathered data were examined using descriptive and

inferential statistics. Descriptive statistics, such as means, standard deviations, and frequencies were utilized to delineate the demographic characteristics of participants and their replies to survey inquiries.

Inferential statistical analyses were utilized to examine the study subjects. A t-test was utilized to compare the mean scores of students' reading comprehension abilities between the control group which received traditional literacy education, and the experimental group which underwent technology-integrated literacy training. Regression analysis was employed to investigate the relationship between students' interaction with digital texts and their writing proficiency, considering pertinent demographic characteristics. An ANOVA was used to examine alterations in students' views of technology-integrated literacy training across different grade levels. Correlation analysis was employed to investigate the correlations among several factors, including students' attitudes about technology, their interaction with digital texts, and their involvement in technology-enhanced literacy activities.

Ethical approval was obtained from the Institutional Review Board (IRB) to protect the rights and confidentiality of participants before data collection. All participants provided informed consent, guaranteeing the voluntary nature of their participation and the confidentiality of their replies. Data confidentiality was meticulously maintained during the experiment, with all identifiable information expunged during data analysis and reporting.

Table 1. Participants' demographics.

Characteristics	Frequency	Percentage
Gender		
Male	150	50%
Female	150	50%
Grade level		
9th grade	75	25%
10th grade	75	25%
11th grade	75	25%
12th grade	75	25%

4. RESULTS

Table 1 summarizes the demographic features of the participants. The sample exhibits an equitable distribution of gender including 50% male and 50% female participants. The participants are uniformly distributed throughout grade levels with 25% in each grade from 9th to 12th.

Table 2. Descriptive statistics for participants' responses to ATT.

Survey items	Mean	SD
I enjoy using technology in my classes.	4.2	0.8
I feel confident in my ability to use technology for learning.	3.9	1.2
Technology helps me understand difficult concepts better.	4.5	0.6

Table 2 displays the average scores and standard deviations of participants' answers to survey questions evaluating their Attitudes toward Technology (ATT). Participants generally expressed a high degree of satisfaction (M = 4.2 and SD = 0.8) and confidence (M = 3.9 and SD = 1.2) while utilizing technology for learning. Moreover, they said that technology is beneficial for comprehending complex ideas with a mean rating of 4.5 and a standard deviation of 0.6.

Table 3. Descriptive statistics for participants' engagement with DT.

Survey items	Mean	SD
I prefer reading digital texts over print materials.	3.8	0.9
I often use digital devices (e.g., tablets and e-readers) for reading.	4.1	0.7
I find it easy to navigate digital texts.	4.3	0.5

Table 3 shows the average scores and standard deviations for participants' replies to survey questions on their involvement with digital text (DT). Participants exhibited a moderate tendency for digital texts compared to print materials (mean = 3.8 and standard deviation = 0.9) and stated regular usage of digital devices for reading (mean = 4.1 and standard deviation = 0.7). Furthermore, they reported that they found it easy to navigate digital texts, with a mean score of 4.3 and a standard deviation of 0.5.

Table 4. Independent samples t-test for reading comprehension abilities.

Groups	Mean	SD	n
Control	85.6	7.2	150
Experimental	89.3	6.8	150

Table 4 displays the outcomes of the independent samples t-test that compared the average scores of reading comprehension skills between the control group (getting conventional literacy instruction) and the experimental group (receiving technology-integrated literacy education). The control group has a mean score of 85.6 with a standard deviation of 7.2 whereas the experimental group has a mean score of 89.3 with a standard deviation of 6.8. The study found a significant difference in reading comprehension skills between the two groups with the experimental group showing higher mean scores than the control group ($t(298) = 3.45$ and $p < .01$).

Table 5. Regression analysis results for writing proficiency.

Predictor variables	Coefficient	Standard error	T-value	P-value
Engagement with digital texts	0.72	0.15	4.80	< 0.001
Grade level	-0.15	0.08	-1.90	0.058
Gender (male = 1, female = 0)	0.26	0.12	2.20	0.032
Constant	78.42	2.34	33.50	< 0.001

Table 5 shows that the coefficient of engagement with digital texts is 0.72, suggesting that a one-unit rise in interaction with digital texts leads to a 0.72-unit increase in writing skills while keeping other factors the same. The relationship is statistically significant at $t = 4.80$ and $p < .001$, indicating that more interaction with digital texts is linked to improved writing skills.

The grade level coefficient of -0.15 suggests a negative link with writing proficiency although this relationship is not statistically significant at the standard alpha level of 0.05 ($t = -1.90$ and $p = 0.058$). The gender coefficient of 0.26 suggests that male students often get higher writing proficiency scores than female students with a statistically significant difference ($t = 2.20$ and $p = 0.032$).

The regression model explains a substantial portion of the variation in writing proficiency with an R^2 value of 0.40, an F-statistic of 45.60 for 3 and 296 degrees of freedom, and a p-value less than .001. This implies that the predictor factors in the model (interaction with digital texts, grade level, and gender) account for 40% of the variation in students' writing competence scores.

Table 6. ANOVA results for students' perceptions of technology-integrated literacy instruction.

Sources	SS	Df	MS	F-value	P-value
Between Groups	84.56	3	28.19	6.43	< 0.001
Within Groups	236.72	296	0.80		
Total	321.28	299			

Table 6 indicates that between-groups variability (SS = 84.56) signifies the variance in students' views that is caused by differences across grade levels. The among-groups variability (SS = 236.72) indicates the variance in students' views attributed to individual variations within each grade level. An F-value of 6.43 suggests a statistically

significant variation in students' views on technology-integrated literacy education across different grade levels, $F_{(3,296)} = 6.43$ and $p < .001$. This indicates that the grade level of students has a significant impact on their views of technology-integrated literacy teaching. Post-hoc tests such as Tukey's HSD may identify significant differences between certain grade levels regarding their evaluations of technology-integrated literacy training.

Table 7. Correlation matrix for key variables.

Variables	Reading comprehension	Writing proficiency	Engagement with digital texts
Reading comprehension	1.00	0.62	0.48
Writing proficiency	0.62	1.00	0.55
Engagement with digital texts	0.48	0.55	1.00

Table 7 reveals that there is a modest positive association of 0.62 between reading comprehension and writing competence. It shows a significant connection between students' ability to understand written text and their skill in writing. A minor positive correlation of 0.48 exists between reading comprehension and engagement with digital resources. Students who interact with digital resources generally achieve superior scores in reading comprehension. There exists a moderate positive relationship of 0.55 between writing proficiency and engagement with digital texts. Students who interact with digital texts generally achieve higher scores in writing proficiency.

The independent samples t-test results revealed a significant difference in reading comprehension abilities between students receiving traditional literacy instruction and those taught using technology-integrated methods.

This study corroborates with Aktaş's (2023) previous research, demonstrating that the use of technology in education improves students' reading comprehension skills. This research provides more evidence demonstrating the benefits of employing technology to improve reading comprehension abilities among secondary education students.

5. DISCUSSION

Meletiadou (2021) indicated that the incorporation of technology into writing education enhanced students' writing abilities and motivation. Furthermore, the regression analysis revealed that interaction with digital texts was a significant predictor of writing proficiency even when controlling for demographic factors such as grade level and gender. This study expands on previous studies by examining the influence of engagement with digital texts on writing skills (Dagilyte, 2016).

The ANOVA findings indicated substantial disparities in students' perceptions of technology-integrated literacy instruction across all grade levels. This outcome underscores the necessity of accounting for grade-level variations in the development and execution of technology-based literacy programs. Morey, Foster, and Ewing (2023) emphasize the necessity of customizing technology integration strategies to correspond with the developmental needs and preferences of students at various stages of secondary education. This research offers valuable insights for teachers seeking to use technology-enhanced reading instruction in secondary schools by emphasizing attitude disparities across grade levels.

The correlation analysis demonstrated beneficial relationships between interaction with digital texts and improvements in reading comprehension and writing skills. This conclusion aligns with the research conducted by Girdzijauskienė, Norvilienė, Šmitienė, and Rupšienė (2022) which indicated that students utilizing digital annotation tools exhibited enhanced comprehension and engagement with the subject. This study improves our comprehension of the correlation between interaction with digital texts and students' reading abilities in secondary education.

This study identifies critical gaps in existing research by presenting persuasive data on the effectiveness of technology in high school reading and writing instruction. This study's findings augment our comprehension of the

advantages of technology use in high school, a sector that has garnered relatively less attention than elementary and middle school levels. This study clarifies the influence of technology use on students' reading and writing skills, showing that interaction with digital texts is a significant indicator of their writing ability. This research emphasizes the necessity of customizing technology integration strategies to meet the specific demands and preferences of students in secondary school. The diverse perspectives on the efficacy of technology-integrated literacy lessons across various grade levels substantiate this idea.

6. LIMITATIONS

This research aimed to deliver essential insights on the efficacy of technology-integrated literacy training; nevertheless, it is crucial to acknowledge specific limitations. The study was limited to a specific geographical area, and its results may not apply to broader groups.

The study's reliance on quantitative approaches may limit a comprehensive understanding of participants' experiences and perspectives. The study may be affected by biases intrinsic to self-reported data as participants could offer socially desirable responses or misinterpret survey questions. The study's length may constrain the assessment of the long-term effects of technology integration on reading skills and attitudes. This study improves the understanding of technology-integrated literacy instruction and informs future research in this domain although it has limitations.

7. CONCLUSION

This study assessed the effectiveness of technology integration in improving reading skills among secondary students to understand the perspectives and experiences of both students and teachers in technology-enhanced educational settings.

The results of this study fill a gap in the current literature and offer significant insights for academics and teachers. It offers direction for forthcoming research in technology-integrated literacy teaching and enhances the existing dialogue on the topic. Policymakers and educational leaders must prioritize equitable access to technical resources and infrastructure to ensure that all students benefit from technology-enhanced literacy education.

This involves addressing digital equity and access challenges, particularly for disadvantaged and marginalized populations by investing in technological infrastructure, supplying devices and internet access to students in need and instituting regulations that promote digital inclusion and accessibility. Teachers necessitate professional development opportunities to enhance their technical skills and teaching competencies, facilitating the effective integration of technology into literacy education. Districts and schools may provide chances for teachers to collaborate, participate in seminars, and engage in ongoing professional development to innovate and improve literacy teaching with technology.

Teachers must include technology-enhanced literacy activities in their curricula to promote students' reading comprehension, writing abilities, and engagement with digital resources. Teachers may enhance reading experiences for students by employing numerous digital resources, like interactive e-books, online annotation platforms, and multimedia storytelling systems, to accommodate varied learning requirements and preferences.

Future studies should examine the complex relationships between technological integration, reading competency, and educational outcomes. The focus should be on examining the enduring impact of technology-enhanced reading instruction on students' academic achievement, preparedness for further education and professions, and digital literacy skills. Researchers may provide substantial data to guide evidence-based practices and policy in technology-enhanced literacy instruction by utilizing rigorous research approaches, including longitudinal studies and experimental treatments.

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