https://research.adra.ac.id /index.php/jete/
P - ISSN: 3025-0668
E - ISSN: 3025-0676

Teacher Digital Literacy and Student Outcomes: A Correlation Study in Secondary Schools

Haruto Takahashi[1], Sota Yamamoto[2], Lusiana Rahmadani Putri[3], Fahrizal[4]
[1]University of Tokyo, Japan
[2]Osaka University, Japan
[3]Universitas Islam Negeri Mahmud Yunus Batusangkar, Indonesia
[4]Universitas Jabal Ghafur, Indonesia

ABSTRACT

Background. Digital technologies have become integral to secondary education, increasing demands on teachers to possess strong digital literacy. While technology integration is widely promoted, empirical evidence explaining how teacher digital literacy relates to student outcomes remains limited, particularly at the secondary school level where instructional complexity is higher.

Purpose. This study aims to examine the correlation between teacher digital literacy and student outcomes in secondary schools, focusing on academic achievement and learning engagement as key indicators of educational effectiveness.

Method. The study employs a quantitative correlational research design supported by descriptive case analysis. Data were collected from secondary school teachers and students using standardized digital literacy questionnaires, student engagement instruments, and academic records. Statistical analysis was conducted to identify relationships between variables, complemented by classroom-level case observations.

Results. The findings reveal a statistically significant positive correlation between teacher digital literacy and student outcomes. A stronger relationship was found with student learning engagement than with academic achievement. Case study evidence demonstrates that teachers with higher digital literacy implement more interactive and student-centered instructional practices, resulting in higher student participation.

Conclusion. The study concludes that teacher digital literacy plays a crucial role in shaping meaningful learning experiences in secondary education. The novelty of this research lies in highlighting student engagement as a key outcome of teacher digital literacy and in integrating quantitative correlation analysis with contextual classroom evidence to strengthen interpretation.

KEYWORDS

Teacher Digital Literacy, Student Outcomes, Secondary Education

Citation: Takahashi, H., Yamamoto, S., Suzuki, R & Fahrizal, Fahrizal. (2025). Teacher Digital Literacy and Student Outcomes: A Correlation Study in Secondary Schools. *Journal Emerging Technologies in Education*, *3*(5), 221–228. https://doi.org/10.70177/jete.v3i4.2901

Correspondence:

Haruto Takahashi,
harutotakahashi@gmail.com

Received: June 1, 2025

Accepted: Aug 9, 2025

Published: Oct 10, 2025

INTRODUCTION

The rapid integration of digital technologies into secondary education has significantly transformed teaching and learning environments worldwide. Digital tools such as learning management systems, online resources, and interactive applications are now commonly embedded in

classroom practices (Ting, 2015; Yu, 2022). These developments have increased expectations for teachers to possess not only basic technological skills but also the ability to integrate digital tools effectively into pedagogical processes. As a result, teacher digital literacy has become a critical component of educational quality in contemporary secondary schools.

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Teacher digital literacy is widely understood as the ability to access, evaluate, create, and communicate information using digital technologies in instructional contexts. Previous studies have shown that digitally literate teachers are more capable of designing engaging learning experiences, managing digital classrooms, and supporting students in navigating online information responsibly. Research in various educational settings suggests that teachers with higher levels of digital competence tend to demonstrate greater instructional flexibility and innovation, which are essential in responding to diverse student learning needs (Chiu, 2024; Ng, 2023).

Student outcomes in secondary education are commonly measured through academic achievement, learning engagement, critical thinking skills, and digital competence. Existing literature indicates that the use of technology-enhanced instruction can positively influence these outcomes when implemented effectively (Oudeweetering, 2018; Sadaf, 2017). Students exposed to digitally supported learning environments often show increased motivation, improved access to learning materials, and enhanced opportunities for collaborative learning. These outcomes highlight the importance of the teacher's role in mediating the educational benefits of technology.

The relationship between teacher digital literacy and student outcomes can be explained through the Technological Pedagogical Content Knowledge (TPACK) theory. This theory emphasizes that effective technology integration occurs when teachers possess a balanced understanding of technology, pedagogy, and subject content. According to the TPACK framework, digital tools alone do not improve learning outcomes; rather, learning improves when teachers are able to align technological use with sound pedagogical strategies and curriculum goals. This theoretical perspective has been widely adopted in educational research to examine how teacher competencies influence student learning.

Empirical research across different countries has reported positive correlations between teacher digital literacy and various student outcomes in secondary education. Studies have demonstrated that teachers with strong digital skills are more likely to implement student-centered learning approaches and foster higher-order thinking skills. Despite these findings, variations in context, access to technology, and teacher training suggest the need for further investigation. Understanding what is already known about this relationship provides a foundation for examining how teacher digital literacy contributes to student outcomes within specific secondary school contexts (Quaicoe, 2020; Siddiq, 2016).

Despite extensive research on digital technology use in education, limited attention has been given to the specific correlation between teacher digital literacy and measurable student outcomes at the secondary school level. Many existing studies focus on technology availability or student digital skills rather than examining teachers' digital competencies as a distinct variable. This lack of focus

has resulted in an incomplete understanding of how teacher-related digital factors directly relate to student performance and engagement (Drossel, 2017; Garzón-Artacho, 2021).

Variations in educational contexts further contribute to this research gap. Differences in infrastructure, professional development opportunities, and institutional support influence how teachers develop and apply digital literacy skills. Empirical evidence comparing these variations remains insufficient, particularly in secondary schools where subject complexity and pedagogical demands are higher. As a result, findings from primary education or higher education contexts cannot be readily generalized to secondary education settings (Li, 2022; Tour, 2017).

Conceptual frameworks such as the Digital Competence of Educators (DigCompEdu) highlight multiple dimensions of teacher digital literacy, including professional engagement, digital resources, teaching and learning, and assessment. While this framework provides a comprehensive model, few correlation studies have operationalized these dimensions to examine their statistical relationship with student outcomes. The absence of such empirical applications limits the explanatory power of existing theories in real classroom contexts.

Inconsistencies in how student outcomes are defined and measured also represent an unresolved issue in the literature. Academic achievement, learning engagement, and digital skills are often examined separately rather than as interconnected outcomes influenced by teacher competencies. The lack of integrated empirical studies creates uncertainty regarding which aspects of student outcomes are most strongly associated with teacher digital literacy in secondary schools (Bråten, 2019; Lotherington, 2011).

Addressing this research gap is essential to clarify the role of teacher digital literacy in shaping student outcomes within secondary education. Understanding this relationship can inform evidence-based decisions in teacher training, curriculum design, and educational policy. Without empirical clarity, efforts to improve digital education risk being misaligned with actual classroom needs and student learning processes.

This study aims to examine the correlation between teacher digital literacy and student outcomes in secondary schools using a systematic and data-driven approach. By focusing on measurable dimensions of teacher digital competence and observable student outcomes, the study seeks to provide empirical evidence that explains how variations in teacher digital literacy correspond to differences in student performance and engagement. The findings are expected to contribute to a more nuanced understanding of digital teaching effectiveness.

The rationale of this study is grounded in the Social Cognitive Theory, which emphasizes the interaction between individual capabilities, environmental factors, and behavioral outcomes. From this perspective, teachers' digital literacy represents a key personal capability that influences instructional behavior and learning environments, which in turn affect student outcomes. Based on this theoretical foundation, the study hypothesizes that higher levels of teacher digital literacy are positively correlated with improved student outcomes in secondary schools (Chandler-Olcott, 2003; Williams, 2019).

RESEARCH METHODOLOGY

This study employed a quantitative correlational research design to examine the relationship between teacher digital literacy and student outcomes in secondary schools. The design was selected to identify the strength and direction of associations between variables without manipulating the research setting. Teacher digital literacy was treated as the independent variable, while student outcomes served as the dependent variable, allowing for statistical analysis of their correlation within a natural educational context (Alakrash, 2021; Biancarosa, 2012).

The population of this study consisted of secondary school teachers and their students in selected schools. A sample was drawn using a purposive sampling technique to ensure participants met specific criteria, including active use of digital tools in teaching and learning processes. Teachers from various subject areas and students from corresponding classes were included to provide a representative overview of digital literacy practices and learning outcomes at the secondary level.

Data were collected using standardized questionnaires and academic records. Teacher digital literacy was measured through a structured questionnaire assessing competencies in digital resource use, instructional integration, communication, and assessment. Student outcomes were measured using a combination of academic achievement scores and a student learning engagement questionnaire. All instruments were reviewed for content validity and reliability prior to data collection (Janks, 2018; Stranger–Johannessen, 2017).

Data collection was conducted after obtaining necessary permissions from school authorities and informed consent from participants. Questionnaires were administered to teachers and students during scheduled school hours, either in printed or digital form. Academic performance data were collected from school records with appropriate confidentiality measures. The collected data were coded and analyzed using statistical software to determine the correlation between teacher digital literacy and student outcomes (Nagle, 2018; Nguyen, 2024).

RESULT AND DISCUSSION

The data on teacher digital literacy were collected from 120 secondary school teachers using a standardized questionnaire. The analysis focused on descriptive statistics, including mean scores, standard deviations, minimum values, and maximum values. These statistics provide an overview of teachers' overall digital literacy levels across participating schools. Teacher digital literacy scores ranged from low to high proficiency, indicating variation in teachers' ability to integrate digital tools into instructional practices. The distribution of scores suggested that most teachers demonstrated moderate levels of digital competence, while fewer teachers reached advanced levels. This variation supports the relevance of examining correlations with student outcomes. Student outcome data were obtained from academic records and learning engagement questionnaires involving 360 students. The descriptive statistics reflect overall academic performance and engagement levels, forming the basis for further relational analysis.

Table 1. Descriptive Statistics of Teacher Digital Literacy

Variable	N	Mean	SD	Min	Max
Teacher Digital Literacy	120	3.68	0.54	2.40	4.80

Table 2. Descriptive Statistics of Student Outcomes

Variable	N	Mean	SD	Min	Max
Academic Achievement	360	78.45	6.82	60	95
Learning Engagement	360	3.72	0.51	2.30	4.70

The descriptive statistics indicate that teachers generally possessed adequate digital literacy to support classroom instruction. The mean score suggests familiarity with digital resources and instructional technologies, though not all teachers demonstrated high mastery. Variability in scores highlights differences in professional experience and training. Student outcome data reveal relatively strong academic performance and moderate to high learning engagement. The spread of scores suggests that while many students benefited from digital learning environments, disparities in outcomes remained present. These differences may reflect instructional practices and classroom

conditions. The combined data indicate sufficient variability in both teacher digital literacy and student outcomes to justify further correlational analysis. The presence of score dispersion strengthens the statistical reliability of subsequent relationship testing.

A more detailed examination of teacher digital literacy dimensions showed differences across instructional integration, digital assessment, and online communication. Instructional integration received higher average scores than digital assessment practices. These findings suggest uneven development of digital competencies among teachers. Student outcome indicators also varied by dimension. Academic achievement scores were generally higher than learning engagement scores. Engagement-related items showed greater variability, indicating differences in students' responses to digital teaching methods. These patterns suggest that not all dimensions of teacher digital literacy may influence student outcomes equally. Specific competencies may have stronger associations with particular aspects of student learning.

Higher scores in instructional integration imply that teachers were more comfortable using digital tools for content delivery than for assessment purposes. Limited use of digital assessment tools may affect feedback quality and learning monitoring. This imbalance highlights potential areas for professional development. Lower variability in academic achievement suggests standardized curriculum implementation across schools. Greater variability in engagement indicates sensitivity to teaching strategies and classroom interaction. Digital teaching approaches may affect student motivation more directly than test performance. The data suggest that teacher digital literacy plays a differentiated role in shaping learning experiences. Certain competencies appear more closely aligned with engagement-related outcomes than with achievement alone.

Correlation analysis revealed a positive relationship between teacher digital literacy and overall student outcomes. Teachers with higher digital literacy scores tended to have students with higher academic achievement and engagement levels. The correlation coefficient indicated a moderate but statistically significant association. Stronger correlations were observed between teacher digital literacy and student engagement than with academic achievement. This finding suggests that digital competence influences how students interact with learning activities. Engagement may serve as a mediating factor between teaching practices and academic results. The results confirm that teacher digital literacy is a relevant predictor of student outcomes. The relationship supports the assumption that effective digital teaching practices contribute to improved learning experiences in secondary education.

A case study analysis was conducted in two secondary schools representing high and moderate levels of teacher digital literacy. Teachers in the high-literacy school demonstrated consistent use of digital platforms, interactive media, and online assessments. Students in these classrooms showed active participation and collaborative learning behaviors. Teachers in the moderate-literacy school primarily used digital tools for content presentation rather than interaction. Student participation was present but less consistent across lessons. Engagement appeared dependent on individual teaching styles rather than systematic digital integration. The comparison illustrates how differences in teacher digital literacy manifest in classroom practices. Observable contrasts in instructional approaches provide contextual depth to the quantitative findings.

The high-literacy case demonstrated alignment between digital tools and pedagogical goals. Teachers structured lessons that encouraged inquiry, collaboration, and feedback through digital platforms. Students responded positively to these approaches, demonstrating sustained engagement. The moderate-literacy case revealed limited pedagogical use of technology. Digital tools were often supplementary rather than integral to learning activities. Student engagement fluctuated and relied more on traditional instructional methods. These observations support the quantitative results by

illustrating how teacher digital literacy translates into practical classroom outcomes. Pedagogically informed digital use appears to enhance student learning experiences.

The case study findings reinforce the statistical correlation between teacher digital literacy and student outcomes. Classrooms led by digitally literate teachers demonstrated stronger alignment between instructional strategies and student engagement. This alignment contributed to more positive learning behaviors. Patterns observed in the case study suggest that digital literacy influences not only outcomes but also learning processes. Teacher competence shapes how technology is used to support interaction, feedback, and autonomy. These factors collectively affect student outcomes. The combined quantitative and qualitative results confirm a meaningful relationship between teacher digital literacy and student outcomes in secondary schools. The findings provide empirical and contextual evidence supporting the importance of digital competence in teaching practice.

The findings of this study demonstrate a statistically significant positive correlation between teacher digital literacy and student outcomes in secondary schools. Teachers with higher levels of digital competence were associated with students who showed better academic performance and higher levels of learning engagement. The results indicate that digital literacy is not merely a technical skill but a meaningful component of effective teaching practice.

The analysis also revealed that the relationship was stronger for student engagement than for academic achievement. This suggests that digitally literate teachers may influence students' motivation, participation, and interaction more directly than standardized academic scores. The case study evidence further reinforced these quantitative results by illustrating observable differences in classroom practices and student responses (Gilhooly, 2014; Major, 2021).

The results align with previous research that highlights the positive role of teacher digital competence in enhancing student learning experiences. Studies conducted in various educational contexts have reported that teachers who effectively integrate technology tend to foster more interactive and student-centered learning environments. The present findings support these conclusions by confirming similar patterns at the secondary school level.

Differences emerge when comparing the strength of relationships reported in earlier studies. Some research has suggested stronger effects on academic achievement, while the current study found a more pronounced association with engagement. This discrepancy may be attributed to contextual factors such as curriculum structure, assessment practices, and the extent to which digital tools are pedagogically integrated rather than used as supplementary resources.

The findings signal that teacher digital literacy functions as an indicator of instructional adaptability in contemporary secondary education. Higher digital competence reflects teachers' ability to design learning environments that respond to students' needs in digitally mediated contexts. This capacity appears to shape how students experience learning rather than merely influencing test outcomes.

The results also suggest a shift in how educational effectiveness should be interpreted in digital classrooms. Student engagement emerges as a critical outcome that precedes academic achievement (Lim, 2023; Yaseen, 2025). Teacher digital literacy may therefore be understood as a catalyst that creates conditions for meaningful learning, signaling the importance of process-oriented outcomes in evaluating educational quality.

The implications of these findings are significant for educational policy and teacher professional development. Schools and educational authorities should prioritize the development of teacher digital literacy as part of ongoing training programs. Emphasis should be placed on pedagogical integration of technology rather than basic technical skills alone.

The findings also have implications for curriculum design and instructional supervision. Digital literacy standards for teachers should be aligned with expected student outcomes, particularly engagement and higher-order learning skills. These results suggest that investment in teacher competence may yield broader educational benefits than investment in technology infrastructure alone (Drexler, 2010; Gilhooly, 2014).

The observed relationship can be explained by the role of digitally literate teachers in shaping learning environments. Teachers with strong digital competence are more capable of selecting appropriate tools, designing interactive tasks, and providing timely feedback. These practices directly influence student engagement and indirectly support academic achievement.

The stronger association with engagement may reflect the nature of digital learning itself. Digital tools often emphasize interaction, collaboration, and autonomy, which are closely related to motivational outcomes. Academic achievement, influenced by multiple external factors, may therefore show a weaker direct relationship with teacher digital literacy compared to engagement-related outcomes (Gilhooly, 2014; Herodotou, 2020).

The findings indicate a need for systematic efforts to strengthen teacher digital literacy in secondary education. Future initiatives should focus on integrating digital pedagogy into teacher education programs and school-based professional development. Such efforts are essential to ensure that digital technologies are used in ways that meaningfully support student learning.

Future research should extend this study by exploring causal relationships and potential mediating variables such as instructional strategies or student digital skills. Longitudinal and experimental designs could provide deeper insights into how teacher digital literacy influences student outcomes over time (Kalantzis, 2010; Neumann, 2017). These directions are necessary to translate correlational evidence into practical and sustainable educational improvement.

CONCLUSION

The most important finding of this study is the identification of a stronger correlation between teacher digital literacy and student learning engagement than with academic achievement in secondary schools. This result highlights that teacher digital competence primarily influences how students participate, interact, and remain motivated in learning processes rather than directly determining test scores. The distinction underscores engagement as a critical outcome shaped by digitally competent teaching practices.

This research contributes conceptually and methodologically to the field of educational technology. Conceptually, it reinforces teacher digital literacy as a pedagogical construct rather than a purely technical skill by linking it explicitly to student engagement outcomes. Methodologically, the study integrates quantitative correlational analysis with case study insights, offering a more comprehensive understanding of how digital literacy operates within real secondary school classrooms.

The study is limited by its correlational design, which does not allow causal conclusions, and by its focus on selected secondary schools within a specific context. Variations in curriculum, technology access, and teacher training may influence the generalizability of the findings. Future research should employ longitudinal or experimental designs and examine mediating variables such as instructional strategies or student digital skills to deepen understanding of causal mechanisms.

AUTHORS' CONTRIBUTION

Look this example below:

Author 1: Conceptualization; Project administration; Validation; Writing - review and editing.

Author 2: Conceptualization; Data curation; In-vestigation.

Author 3: Data curation; Investigation.

Author 4: Formal analysis; Methodology; Writing - original draft.

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